

ภาคผนวก จ
เอกสารสอบเทียบเครื่องมือ

รายการใบรับรองเทียบ/ตรวจสอบ 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	Mettler-Toledo	Seven Easy S30 / 12305212	National Food Institute, Ministry of Industry, Thailand	2302181-001-01	24 Mar 23	22 Mar 24	-
2	pH Meter		Mettler-Toledo	SevenCompact S220/ C113432421	National Food Institute, Ministry of Industry, Thailand	2303560-001-01	26 Jun 23	26 Jun 24	-
3	Conductivity Meter	ความนำไฟฟ้า (EC)	SI Analytics	Lab955 / 16300356	DKSH (Thailand) Ltd.	C2420059	16 Mar 23	14 Mar 24	-
4	Analytical Balance (Readability 0.01 mg)	ของแข็งละลายทั้งหมด (TDS) ของแข็งแขวนลอยทั้งหมด (TSS)	Mettler-Toledo	XSR205DU / C210685394	Technology Promotion Association (Thailand-Japan)	23MM113	26 Apr 23	24 Apr 24	-
5	Hot Air Oven	ของแข็งรวมอบ	Memmert	UF55 / R222-2772	Thermology Co., Ltd.	2572801	19 Jul 23	17 Jul 24	-
6	Analytical Balance (Readability 0.1 mg)	น้ำมันเชื้อเพลิง (Cold/Groove)	Mettler-Toledo	XS204 / C1171635043	National Food Institute, Ministry of Industry, Thailand	2302827-001-01	10 May 23	8 May 24	-
7	BOD Incubator	บีโอดี (BOD)	Arco	UC41320 / (LAE-WAO-015/2561)	Technology Promotion Association (Thailand-Japan)	23TM649	15 Feb 23	14 Feb 24	-
8	DO Meter		YSI	5100 / 118101863	Technology Promotion Association (Thailand-Japan)	24TW59	21 Feb 24	20 Feb 25	-
9	COD Reactor (Heating Block)	ซีโอดี (COD)	Hanna	HB3980-02 / H0189001	Hanna Instruments (Thailand) Ltd.	HF12312-0342	10 Mar 23	9 Mar 24	-
10	COD Reactor (Heating Block)		Hanna	HB3980-02 / 04500052101	Hanna Instruments (Thailand) Ltd.	HF12312-0775	26 Jun 23	24 Jun 24	-
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพดินและน้ำ									
11	Digestor Unit	ฟอสฟอรัส (TKN)	FOSS	2520auto / 9179469	National Food Institute, Ministry of Industry, Thailand	2302131-001-01	30 Mar 23	28 Mar 24	-
12	Distillation Unit (Kjeldahl Method)		FOSS	KJ8100 / 91880052	FOSS South East Asia	8411	29 May 23	27 May 24	-
13	UV-Vis Spectrophotometer	สี (AOM), ซัลเฟต, ไนเตรต	Agilent Technologies	Cary60 66060A / M119410009	DOE Services Co., Ltd.	9923-021	20 May 23	18 May 24	-
14	UV-Vis Spectrophotometer		Hach	U1900 / 2021-1664	DOE Services Co., Ltd.	9923-007	6 Jan 23	5 Jan 24	-
15	Atomic Absorption Spectrophotometer (AAS)	ตะกั่ว (Pb), แคดเมียม (Cd), ปรอท (As) ปรอท (Hg)	Agilent Technologies	System DGA8432A AA240FS / M113160001	Thailand Institute of Scientific and Technological Research(TISTR)	MITC-ACC No. 387/66	2 Feb 23	1 Feb 24	-
16	Inductively Coupled Plasma (ICP)		Agilent Technologies	System DGA8432A AA240FS / M113160001	Thailand Institute of Scientific and Technological Research(TISTR)	Preventive Maintenance Checklist	24 Jan 24	23 Jan 25	-

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

Calibration Certificate

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

Page 1 of 5

Equipment: pH Meter
Manufacturer: METTLER TOLEDO
Model: 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: N. Niyomchart
(Mr.Nuttaporn Niyomchart)
Specialist, Division of Calibration Laboratory
Responsible for the Technical Management Team

Date of issue: 24 March 2023

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

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

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

2302181-001-01-01 ฐานข้อมูลระบบมาตรฐานอาหาร
ศูนย์บริการข้อมูลอาหาร
20000 Soi 36, Anurama Road, Bang Na Khan, Suburban, Bang Na District, Bangkok 10700, Thailand
Tel: +66(0) 2422 8688 Fax: +66(0) 2422 8545

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

Page 2 of 5

Date of Calibration: 24 March 2023
Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: Ambient Temperature: (23.4 ± 1.5) °C
Condition of Equipment: Good Condition
Condition of this Results of Calibration:

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

2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fuka	22E1959	17 June 2023
2.2 Digital Thermometer	2709007	Fuka	CC-650567-01	30 October 2023
2.3 Thermo-Hygro Meter	NF1.BTH003/17	PONPE	TE 650550-01	21 September 2023
Certified Reference Material				
	Lot No.	Manufacturer	Ref No.	Expiry Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	873608	CPAchem	PHQ16.L5	16 February 2025
2.5 pH buffer 6.865 (Primary pH buffer Solution)	873609	CPAchem	PHQ17.L5	16 February 2025
2.6 pH buffer 10.01 (Primary pH buffer Solution)	873611	CPAchem	PHQ20.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-TS1-TIS 17025 Laboratory Accreditation of Calibration No.0008
3.2 Instruments No.2.2 through NSC-TS1-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.3 Instruments No.2.3 through NSC-TS1-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.4 Certified Reference Material No. 2.4 to 2.8 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 RefH Hi-13 Lot# 25.05.2022; BIM RefH Hi-16 Lot# 02.06.2022; BIM RefH Hi-13 Lot# 25.05.2022; BIM RefH Hi-16 Lot# 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

2302181-001-01-01 ฐานข้อมูลระบบมาตรฐานอาหาร
ศูนย์บริการข้อมูลอาหาร
20000 Soi 36, Anurama Road, Bang Na Khan, Suburban, Bang Na District, Bangkok 10700, Thailand
Tel: +66(0) 2422 8688 Fax: +66(0) 2422 8545

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	177.484	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	-59.166	-59	8.00	0.58	2.00
10	-177.480	-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
6.865	6.86	14	-	0.0083	2.00

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

2302181-001-01-01 ฐานข้อมูลระบบมาตรฐานอาหาร
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20000 Soi 36, Anurama Road, Bang Na Khan, Suburban, Bang Na District, Bangkok 10700, Thailand
Tel: +66(0) 2422 8688 Fax: +66(0) 2422 8545

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

Page 4 of 5

Date of Calibration: 24 March 2023
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:

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

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

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

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

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

2302181-001-01-01 ฐานข้อมูลระบบมาตรฐานอาหาร
ศูนย์บริการข้อมูลอาหาร
20000 Soi 36, Anurama Road, Bang Na Khan, Suburban, Bang Na District, Bangkok 10700, Thailand
Tel: +66(0) 2422 8688 Fax: +66(0) 2422 8545

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 -----

FCS-012 Revision: 01 Date: 20-04-65

เอกสารไม่ควบคุม



Calibration Certificate

Certificate No.: 2303560-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Sol Udomsuk 41, Sukhumvit Road, Bangchack, Prakanong, Bangkok 10260

Page 1 of 5

Equipment: pH Meter
Manufacturer: Mettler Toledo
Model: Seven Compact S220
Serial No.: C113432421
ID No.: UAE.WAT.009/2564
Order No.: 2303560
Operation No.: 2303560-001
Date of Receipt: 23 June 2023
Date of Calibration: 26 June 2023

Calibrated by: Mr. Worapob Sooktong Scientist
Approved by: P. Jenghantit (Mr. Pheraphat Tuenjit) (for)
Manager, Division of Calibration Laboratory
Date of Issue: 27 June 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.

FCS-009 Revision: 01 Date: 20-04-65

เอกสารไม่ควบคุม



Calibration Report

Certificate No.: 2303560-001-01
Equipment: pH Meter
Resolution: 0.01 pH ; 1 mV
Manufacturer: Mettler Toledo
Model: Seven Compact S220
Serial No.: C113432421
Type: Bench top
ID No.: UAE.WAT.009/2564

Date of Calibration: 26 June 2023 Page 2 of 5

Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: Ambient Temperature: (24.3 ± 1.5) °C Relative Humidity: (48 ± 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

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	23E0603	14 June 2024
2.2 Digital Thermometer	2709007	Fluke	CG-650557-01	30 October 2023
2.3 Thermo-Hygro Meter	NF18TH0317	PONPE	TE 650555-01	21 September 2023

Certified Reference Material	Lot No.	Manufacturer	Ref. N	Expiry Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)	873608	CPAchem	PH219.L5	16 February 2025
2.5 pH buffer 7.00 (Standard pH buffer Solution)	873612	CPAchem	PH107.L5	16 February 2024
2.6 pH buffer 10.01 (Primary pH buffer Solution)	873611	CPAchem	PH020.L5	16 February 2024
2.7 pH buffer 6.865 (Primary pH buffer Solution)	873609	CPAchem	PH017.L5	16 February 2025
- 3 This certification is traceable to The International System of Unit (SI Unit)

3.1 Instruments No.2.1	through	NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0008
3.2 Instruments No.2.2	through	NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.3 Instruments No.2.3	through	NSC-TIS-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.4 Certified Reference Material No. 2.4 to 2.6	traceable to	Primary measurement method - Homed cell using calibrated thermometer, barometer, and reagentwater. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.5 Certified Reference Material No.2.7	traceable to	BM RefN HI-13 LotN 25.05.2022; BM RefN HI-16 LotN 02.06.2022; BM RefN HI-13 LotN 25.05.2022; BM 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 was calibrated.
- 5 This result of calibration was found accurate as shown on date and place of calibration only.

FCS-012 Revision: 01 Date: 20-04-65

เอกสารไม่ควบคุม



Calibration Report

Certificate No.: 2303560-001-01
Equipment: pH Meter
Resolution: 0.01 pH ; 1 mV
Manufacturer: Mettler Toledo
Model: Seven Compact S220
Serial No.: C113432421
Type: Bench top
ID No.: UAE.WAT.009/2564

Date of Calibration: 26 June 2023 Page 3 of 5

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

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (± mV)	Coverage Factor (k)
		mV	pH		
0	414.121	414	6.00	0.58	3.00
2	295.914	295	2.00	0.58	3.00
4	177.404	177	4.00	0.58	3.00
6	59.160	59	6.00	0.58	3.00
7	0.001	0	7.00	0.58	3.00
8	-59.159	-59	8.00	0.58	3.00
10	-177.461	-177	10.00	0.58	3.00
12	-295.811	-296	12.00	0.58	3.00
14	-414.118	-414	14.00	0.58	3.00

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

Equipment: pH Electrode
Manufacturer: Mettler Toledo
Model: InLab Expert Pro-ISM
Serial No.: 3114136
ID No.: N/A

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

Certified Value (±25 °C (pH))	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	177	-	0.0071	3.00
6.905	6.90	9	99.26	0.0074	3.00
10.01	10.01	-168	98.20	0.0069	3.00
6.968	7.02	3	-	0.0092	3.00

FCS-012 Revision: 01 Date: 20-04-65

เอกสารไม่ควบคุม



CAI-EM-C24-09: 12 Sep 2021

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2304472

ชนิดเครื่องมือ: CONDUCTIVITY METER

รุ่น: Lab 955

หมายเลขเครื่อง: 16300356

ตรวจสอบ (รับ)	รายการตรวจเช็ค	ตรวจสอบ (ส่ง)	หมายเหตุ
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ
General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
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<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Spectrophotometer			
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
pH Meter and Conductivity Meter			
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Turbidimeter			
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<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Automatic Titrator			
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

อุณหภูมิ: Electrode วัดอุณหภูมิได้ 25.1°C ควบคุม Control Waterbath ที่ 25.0 ± 0.1°C

Mr. Atachai Ngamchanat

Service Engineer

เอกสารไม่ควบคุม

CAL-FM-R31-03; 20 Jul 2022

DKSH Technology Limited
2533 Sukhumvit Road, Bangkok, Thailand 10260
Phone: +66 2638 7000 Email: info.calibration@dksh.com Website: www.dksh.com/calibration-thailand
Delivering Growth - In Asia and Beyond.



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
3344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2713-3000-29 FAX: 0-2719-0484



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 10280
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 :
Approved Signatory

() Pongthippa Tameyakul
() Mahee Burkrua
(✓) Suwit Imjai

Issue Date : 2 May 2023

The Uncertainties are for a confidence probability of approximately 95 %

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

Uncontrolled Document



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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:

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

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

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

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

Before Adjustment :

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
(g)	(g)	(g)	(± mg)	(k)
80	79.99992	+0.00008	0.15	2.00
200	199.9995	+0.0005	0.29	2.00

After Adjustment :

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

Applied Weight	Standard Deviation of Reading (g)
(g)	(g)
80	0.000007
200	0.00004



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

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

Result of calibration

2. Effect of off center loading

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

Position 1	Position 2	Position 3	Position 4	Position 5	Maximum difference between off-center and central loading
(g)	(g)	(g)	(g)	(g)	(g)
-0.0001	-0.0001	0.0000	-0.0001	-0.0001	0.0001

3. Departure from nominal value

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
53/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG DISTRICT, BANGKOK 10250
TEL: 0-2715-9005-17 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 Hlshib
Approved by:
() Ponthippa Tarneyakul
() Malee Butkruea
(✓) Suwit Imjai
Issue Date: 31 October 2022

The Uncertainties are for a confidence probability of approximately 95%

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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:-

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

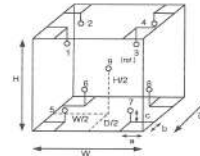
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration: (*) Without Adjustment

Function of UUC: Temperature Source

Fresh air setting: Close



Probe Installation Details:
a = 5.0 cm
b = 5.0 cm
c = 5.0 cm
Dimension of Chamber:
D = 0.33 m
W = 0.40 m
H = 0.40 m
Capacity = 0.053 m³

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

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

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a 1133252



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

Cert. No.: 22TM1490
Page: 3 of 3

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

Calibration Point (°C)	Measured Temperature (°C)								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.076	103.876	103.777	104.124	104.667	104.426	104.012	103.928	104.370
140.0	138.199	139.189	138.808	139.550	140.266	139.622	139.293	139.385	140.369
180.0	177.930	179.267	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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a 1133251



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



Calibration Certificate

Certificate No.: 2302827-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
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
Responsible for the Technical Management Team

Date of Issue: 18 May 2023

The uncertainties are for a confidence probability of approximately 95%

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

FCS-009 Revision: 01 Date: 20-04-65

2008 53/4 ถนนพหลโยธิน แขวงสามยุค เขตเมืองใหม่ กรุงเทพมหานคร 10260
2008 53/4 ถนนพหลโยธิน แขวงสามยุค เขตเมืองใหม่ กรุงเทพมหานคร 10260
Tel: +66(0) 2432 3550 Fax: +66(0) 2432 3555

Uncontrolled Document

Calibration Report

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

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 Imp to 200g 890567572 TCS M33040535 8 April 2024
Instrument Model Serial No. Calibrated By Certificate No. Due Date
Thermo-Hygro Meter 608-H1 NFI.BTH 036/23 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.

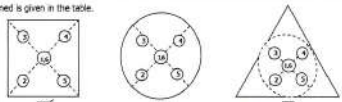
Calibration Results:

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

FCS-012 Revision: 01 Date: 20-04-65

Calibration Report

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

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
Unitad	0.0000	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

FCS-012 Revision: 01 Date: 20-04-65

Calibration Report

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

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 %.

FCS-012 Revision: 01 Date: 20-04-65



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/4 PATTANAKARN ROAD SOI 18, SUKHUMVIT, SUKHUMVIT BANGKOK, 10250
TEL: 0-2711-3009-29 FAX: 0-2719-9484



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

Certificate of Calibration

Equipment : BOD Incubator
Manufacturer : Arco
Model : UC4-1320
Serial No. : 13URCA5013201
ID No. : UAE.WAO.015/2561
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Lab Floor 2
Received Order : 15 February 2023
Calibration Date : 15 February 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Preecha Hiahib
Approved by :
() Pornthippa Tameyakul
() Malee Butkrues
() Suwit Imjai
Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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



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

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

Procedure Used :-

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

Condition of this result of calibration

1. Reference standard instrument:-

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

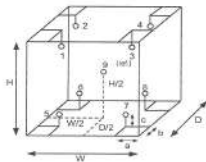
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available



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

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

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

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a 1149512



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

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

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

Measured Temperature (°C)									
Calibration Point (°C)	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.086	19.916	20.386	19.976	19.973	19.838	19.837	19.821	19.949

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

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

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

UUC* : Unit Under Calibration

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

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

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a 1149512



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3 : EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 11, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000 FAX. 0-2719-9486

Cert.No.: 22TW240
Page: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : YSI
Model : 4010-2W
Serial No. : 20280326
ID No. : UAE.WAO.063/2563
Received Date : 21 October 2022
Test Date : 26 October 2022
Reference : 2210-0734DSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangkok, 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 Sirirthean

Approved by :
Approved Signatory

() Malee Butkrues
(✓) Sathip Meangmal
() Warakom Lerngagrakul

Issue Date : 27 October 2022

เอกสารไม่ควบคุม

a 0299352



Cert.No.: 22TW240
Page: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

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

2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 20E103527

Titration Method (Azide Modification Method)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.14	8.12	0.0084

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 1132301

CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater
Meter Model : HI839800-02 Serial No.: H0185001
Tube Heater : 25 Vial Capacity Accuracy : $\pm 2^{\circ}\text{C}$
Temperature Range : -10°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 : RE230392
Customer name : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Rd., Bangchak,
Phrakhanong, Bangkok 10260
Received date : 8 March 2023
Calibrate date : 10 March 2023
Issue date : 20 March 2023
Calibrated Location : Hanna Instruments (Thailand) Ltd.
Calibration Procedure : This calibrator was conducted by using in-house: calibration procedure
CP-04 by using certified reference material.

Calibrated by : ☒ Mr. Pichit Pethong
☐ Mr. Jakkapob Pentisan Approved by : Mr. Anan Suwanchaisakul
☐ Mr. Channarong Soinak
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).

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Condition of this calibration result

Reference Standard Instruments:

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

Calibration Result:

Measurement Temperature Source Accuracy for COD Reactor

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

Figure: Shows the location of the temperature source.

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

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

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

** End of certificate **

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CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater
Meter Model : HI839800-02 Serial No.: 04500052101
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 : RE231008
Customer name : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Rd., Bangchak,
Phrakhanong, Bangkok 10260
Received date : 20 June 2023
Calibrate date : 27 June 2023
Issue date : 28 June 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 Pethong
☐ 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 ($^{\circ}\text{C}$)	Average Value ($^{\circ}\text{C}$)	\pm Uncertainty ($^{\circ}\text{C}$)	\pm Tolerance of UUC ($^{\circ}\text{C}$)	Acceptance Criteria
25 Vial	150.0	150.4	0.58	2	Pass

Figure: Shows the location of the temperature source.

(1A)	(2A)	(3A)	(4A)	(5A)
150.04 $^{\circ}\text{C}$	150.07 $^{\circ}\text{C}$	150.42 $^{\circ}\text{C}$	150.27 $^{\circ}\text{C}$	149.65 $^{\circ}\text{C}$
(1B)	(2B)	(3B)	(4B)	(5B)
150.32 $^{\circ}\text{C}$	150.59 $^{\circ}\text{C}$	150.90 $^{\circ}\text{C}$	150.27 $^{\circ}\text{C}$	150.70 $^{\circ}\text{C}$
(1C)	(2C)	(3C)	(4C)	(5C)
150.49 $^{\circ}\text{C}$	150.22 $^{\circ}\text{C}$	151.10 $^{\circ}\text{C}$	151.09 $^{\circ}\text{C}$	150.46 $^{\circ}\text{C}$
(1D)	(2D)	(3D)	(4D)	(5D)
150.15 $^{\circ}\text{C}$	150.40 $^{\circ}\text{C}$	150.16 $^{\circ}\text{C}$	150.55 $^{\circ}\text{C}$	150.17 $^{\circ}\text{C}$
(1E)	(2E)	(3E)	(4E)	(5E)
150.34 $^{\circ}\text{C}$	150.54 $^{\circ}\text{C}$	150.38 $^{\circ}\text{C}$	150.48 $^{\circ}\text{C}$	150.18 $^{\circ}\text{C}$

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

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

** End of certificate **

เอกสารไม่ควบคุม

Verification Certificate

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

Page 1 of 4

Equipment: HEATING BLOCK DIGESTION

Manufacturer: FOSS

Model: 2520

Serial No.: 91794469

ID No.: UAE.WAS.011/2560


Order No.: 2302413

Operation No.: 2302413-001

Date of Receipt: 28 March 2023

Date of Calibration: 30-31 March 2023

Calibrated by Mr.Nuttapol Niyomchat
 Specialist

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

Date of Issue: 10 April 2023

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

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

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

2008 โซ 36 ถนนสุขุมวิท แขวงคลองตัน เขตคลองเตย กรุงเทพมหานคร 10700 **เอกสารไม่ควบคุม**
 2008 Soi 36, Anur Adorn Road, Bang Yi Khan, Suburban, Bangkok 10700, Thailand
 Tel :+662) 6462 8568 Fax :+662) 6462 8545 nfi.th

Verification Report

Certificate No.: 2302413-001-01
Equipment: HEATING BLOCK DIGESTION
 Model: 2520 Serial No.: 91794469
 Resolution: 1 °C ID No.: UAE.WAS.011/2560
 Manufacturer: FOSS
Date of Calibration: 30-31 March 2023

Page 2 of 4

Location: Laboratory Room, NATIONAL FOOD INSTITUTE
Environment Condition: Ambient Temperature (25 ± 3) °C
 Relative Humidity (55 ± 15) %
 Line Voltage (220 ± 10) Volt

Condition of this results of Calibration:

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

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
Digital Thermometer with Thermocouple	34970A	MY44865576 / MY41394453	TC22/0044	5-May-2023	N.F.I. Technical Center Laboratory
Type R	TC4180-102 / CH201-102				

3. This certificate is traceable to international system of units (SI Units).

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

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

6. Condition of Calibrated item : Good

UUC* Description

Time of Record : Hour 30 Minute At 380 °C

7. Result of Calibration : ☒ Without adjustment ☐ After adjustment

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

2008 โซ 36 ถนนสุขุมวิท แขวงคลองตัน เขตคลองเตย กรุงเทพมหานคร 10700 **เอกสารไม่ควบคุม**
 2008 Soi 36, Anur Adorn Road, Bang Yi Khan, Suburban, Bangkok 10700, Thailand
 Tel :+662) 6462 8568 Fax :+662) 6462 8545 nfi.th

Verification Report

Certificate No.: 2302413-001-01
Equipment: HEATING BLOCK DIGESTION
 Model: 2520 Serial No.: 91794469
 Resolution: 1 °C ID No.: UAE.WAS.011/2560
 Manufacturer: FOSS

Date of Calibration: 30-31 March 2023

Page 3 of 4

Calibration point: 380 °C

Calibration result:

Reporting of Temperature

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

Note:

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

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

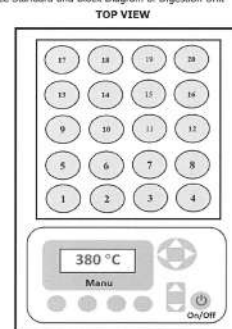
2008 โซ 36 ถนนสุขุมวิท แขวงคลองตัน เขตคลองเตย กรุงเทพมหานคร 10700 **เอกสารไม่ควบคุม**
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Verification Report

Certificate No.: 2302413-001-01
Equipment: HEATING BLOCK DIGESTION
 Model: 2520 Serial No.: 91794469
 Resolution: 1 °C ID No.: UAE.WAS.011/2560
 Manufacturer: FOSS
Date of Calibration: 30-31 March 2023
Calibration point: 380 °C
Calibration result: Continued

Page 4 of 4

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



Sensor Installation Location

Note:

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

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

----- End -----

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

2008 โซ 36 ถนนสุขุมวิท แขวงคลองตัน เขตคลองเตย กรุงเทพมหานคร 10700 **เอกสารไม่ควบคุม**
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DQE Services Co.,Ltd.
32 Soi Ladprao-Wanghin 55, Ladprao-Wanghin Rd., Ladprao, Bangkok 10230
Phone : +66 (0)2 538 2054, Email : dqeservicesinfo@gmail.com

REPORT OF CALIBRATION

Certificate No. : SP23-007 Page 4 of 5

Photometric Accuracy :

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

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

REPORT OF CALIBRATION

Certificate No. : SP23-007 Page 5 of 5

Wavelength Accuracy :

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

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

- End of Certificate -
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CERTIFICATE OF CALIBRATION

Certificate No. : SP23-021 Page 1 of 5

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

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

Location of calibration : Laboratory 315

Equipment : UV-Vis Spectrophotometer

Manufacturer : Agilent Technologies

Model : Cary 60

Serial No. : MY15410009



ID No. : N/A

Received Date : 20 May 2023

Calibration Date : 20 May 2023

Issue Date : 23 May 2023

Condition Instrument : Good

Calibrated by :  Approved by : 
(Mr. Tanawat Ritidach) (Ms. Chonthicha Saingam)
Technical Manager Quality Manager

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

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

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REPORT OF CALIBRATION

Certificate No. : SP23-021 Page 2 of 5

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

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

Certified Reference Materials :

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

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

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REPORT OF CALIBRATION

Certificate No. : SP23-021 Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.0000	0.0000	0.0028	2.00
	0.5787	0.5742	0.0045	0.0031	2.00
	1.0490	1.0423	0.0067	0.0029	2.00
	2.1900	2.1847	0.0053	0.0075	2.00
440	0.0000	0.0000	0.0000	0.0028	2.00
	0.5607	0.5577	0.0030	0.0034	2.00
	1.0247	1.0234	0.0013	0.0035	2.00
	2.1229	2.1171	0.0058	0.0088	2.00
465	0.0000	0.0000	0.0000	0.0028	2.00
	0.5236	0.5184	0.0052	0.0029	2.00
	0.9634	0.9607	0.0027	0.0029	2.00
	1.9763	1.9715	0.0048	0.0081	2.00
546.1	0.0000	-0.0001	0.0001	0.0028	2.00
	0.5191	0.5159	0.0032	0.0031	2.00
	1.0003	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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REPORT OF CALIBRATION

Certificate No. : SP23-021 Page 4 of 5

Photometric Accuracy :

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

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REPORT OF CALIBRATION

Certificate No. : SP23-021 Page 5 of 5

Wavelength Accuracy :

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

Remark : - UUC = Unit Under Calibration

- 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 TSI accredited

- End of Certificate -

FM-708-02 R01 1/11/2021

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

CALIBRATION CERTIFICATE

NOMENCLATURE : 1. Atomic Absorption Spectrophotometer "Agilent Technologies"
Model AA240FS, Serial No. MY13160001

2. Working standard solution "Inorganic Ventures"
Multi Analyte Custom Grade Solution, Lot No. S2-MEB708640

SUBMITTED BY : United Analyst and Engineering Consultant Co., Ltd.
3. Soi Udonsuk41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

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

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

CALIBRATION DATE : 2 February 2023

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

AMBIENT CONDITIONS : Temperature 22 °C Relative humidity 58 %

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

Calibrated by 1. *Dani Sathirongkum*
(Mr. Danai Srithongkum)

2. *Atipat*
(Mr. Atipat Ratana)

Approved by *Miss Sutadida Deawong*
(Miss Sutadida Deawong)
Senior Technical Officer
Acting Director of Analytical Chemistry Laboratory
Ref. 2015266012600366001
Issued Date : 15 February 2023

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TSTR.

Head Office
35 Mu 3 Tambon Khlong Ma, Amphoe Khlong Luang
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
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Email : rumpat@tstr.or.th Website:www.tstr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang Chiangwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-30 ext. 115, 116
Fax. (66) 0 2323 9165
Email : mtg@tstr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10960,
Thailand
Tel. (66) 0 2579 1121-88 ext. 5215, 5225, 5217
Fax. (66) 0 2579 1121-88
Email : tstr@tstr.or.th

FM.BLMTC.002 Rev.4

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Request No. 25-66 / 0323

1 / 5

MTC. ACL. No. 387 / 66

CALIBRATION DATA

1. Noise Level

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

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MTC. ACL. No. 387 / 66

2. Precision

Element	Conc (mg/l)	Absorbance										Ave. Abs.	SD	%RSD
Cd	0.02	0.0085	0.0084	0.0090	0.0089	0.0089	0.0090	0.0086	0.0092	0.0090	0.0089	0.009	0.0003	2.88
	0.30	0.0993	0.1001	0.1007	0.1004	0.1004	0.0995	0.0997	0.0998	0.0999	0.0996	0.100	0.0005	0.45
	0.70	0.2238	0.2229	0.2244	0.2249	0.2243	0.2233	0.2235	0.2231	0.2251	0.2240	0.224	0.0007	0.33
Cr	0.10	0.0088	0.0087	0.0094	0.0086	0.0086	0.0091	0.0099	0.0095	0.0076	0.0085	0.009	0.0006	7.25
	0.30	0.0257	0.0265	0.0255	0.0270	0.0266	0.0258	0.0261	0.0262	0.0274	0.0262	0.026	0.0006	2.25
	0.70	0.0573	0.0590	0.0580	0.0576	0.0578	0.0579	0.0593	0.0599	0.0586	0.0594	0.058	0.0009	1.51
Cu	0.05	0.0083	0.0084	0.0084	0.0075	0.0086	0.0086	0.0081	0.0080	0.0087	0.0092	0.008	0.0005	5.45
	0.30	0.0430	0.0444	0.0426	0.0429	0.0435	0.0432	0.0428	0.0441	0.0427	0.0436	0.043	0.0006	1.41
	0.70	0.0961	0.0992	0.0990	0.0997	0.0977	0.0986	0.0990	0.0982	0.0988	0.0980	0.099	0.0006	0.63
Fe	0.10	0.0109	0.0104	0.0087	0.0100	0.0087	0.0094	0.0102	0.0092	0.0094	0.0100	0.010	0.0007	7.53
	0.50	0.0456	0.0442	0.0450	0.0444	0.0450	0.0455	0.0455	0.0441	0.0446	0.0444	0.045	0.0006	1.27
	1.00	0.0904	0.0901	0.0891	0.0876	0.0873	0.0901	0.0876	0.0886	0.0879	0.0901	0.089	0.0012	1.38
Pb	0.20	0.0093	0.0099	0.0104	0.0102	0.0104	0.0109	0.0102	0.0103	0.0115	0.0117	0.010	0.0007	6.85
	0.70	0.0344	0.0336	0.0336	0.0328	0.0338	0.0346	0.0336	0.0331	0.0343	0.0350	0.034	0.0007	2.02
	1.50	0.0709	0.0718	0.0706	0.0713	0.0698	0.0718	0.0712	0.0713	0.0715	0.0719	0.071	0.0006	0.90
Mn	0.05	0.0115	0.0130	0.0131	0.0127	0.0135	0.0136	0.0124	0.0133	0.0124	0.0130	0.013	0.0006	4.88
	0.30	0.0709	0.0700	0.0714	0.0704	0.0700	0.0705	0.0714	0.0698	0.0694	0.0700	0.070	0.0007	0.96
	0.70	0.1619	0.1633	0.1666	0.1638	0.1646	0.1614	0.1632	0.1614	0.1636	0.1652	0.163	0.0014	0.83
Ni	0.10	0.0113	0.0105	0.0113	0.0114	0.0110	0.0113	0.0117	0.0112	0.0107	0.0117	0.011	0.0004	3.45
	0.50	0.0509	0.0517	0.0508	0.0502	0.0517	0.0516	0.0516	0.0523	0.0518	0.0503	0.051	0.0007	1.36
	1.00	0.0997	0.1006	0.1006	0.1006	0.0996	0.0998	0.1007	0.1000	0.1013	0.0999	0.100	0.0006	0.55
Zn	0.05	0.0315	0.0309	0.0322	0.0304	0.0329	0.0312	0.0313	0.0319	0.0308	0.0311	0.031	0.0007	2.35
	0.30	0.1705	0.1728	0.1688	0.1693	0.1711	0.1704	0.1704	0.1707	0.1708	0.1688	0.170	0.0012	0.70
	0.70	0.3559	0.3572	0.3548	0.3560	0.3559	0.3550	0.3579	0.3552	0.3574	0.3573	0.356	0.0011	0.31

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MTC. ACL. No. 387 / 66

3. Trueness

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Calibrated by 1. Danai Srithongkum
(Mr. Danai Srithongkum)
2. Atipat
(Mr. Atipat Ratana)

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

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Agilent 5110 and 5100 ICP-OES Preventive Maintenance Checklist

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

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

Customer Information

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

Service Engineer's Responsibilities

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

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System Information

Instrument system name and ID	ICP 5110 VDV
Instrument system site and location	URE / 3rd Floor Laboratory
List system component product numbers	List the serial numbers of each component
1. G8015A	1. MY18030001
2. G8015A	2. 1801-019878
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

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

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General Preparation

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

Inspect and clean the system

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

G8481A Cooling water system

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

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SPS 3 Auto Sampler

Section NOT Applicable

- ❑ Power cycle the autosampler and verify successful initialization.
- ❑ Inspect X and Z axis belts for wear. Replace if necessary.
- ❑ Clean X and Z axis slide shafts.
- ❑ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

SPS 4 Auto Sampler

Section NOT Applicable

- ❑ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ❑ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
- ❑ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ❑ Check the X-axis, Theta-axis and Z-axis PTC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ❑ Pump Tubing Replacement: Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles.

AVS 4, 6, 7

Section NOT Applicable

- ❑ Replace valve rotor seal
- ❑ Check fittings for signs of leaks
- ❑ Check tubing including autosampler tubing for kinks or excessive wear
- ❑ Check high flow pump for signs of leaks

Instrument Adjustment

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

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

Instrument Performance Test Results Table

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

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial*	Radial	Axial*
Zn 213.857 nm SRBR	4100.6	8364.8	4375.0	8400.8
Mn 257.610 nm SRBR	11064.7	31842.1	12801.7	30846.8
Al 396.162 nm SBR	7.5	14.9	9.9	16.8
K 766.491 nm SBR	5.1	36.8	6.4	39.7

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

Instrument Test Results Table

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

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

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ICP-OES Status Results Table

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

Measurement	Standby Mode		Plasma On	
Mains Voltage	224.540	VAC	221.913	VAC
Mains Current	0.204	A	0.104	A
Instrument Temperature	22.6	°C	22.7	°C
RF Air Flow (sensor speed)	15.0	Hz	13.0	Hz
Plasma Exhaust Temperature	No measurement		26.7	°C
Water Flow Oscillator	No measurement		1.64	L/min
Water Flow Detector	1.06	L/min	1.06	L/min
Water Inlet Temperature	18.0	°C	18.0	°C
Polychromator Temperature	35.0	°C	35.0	°C
CCD Temperature	-33.8	°C	-33.8	°C
Thermal Stabilizer	35.0	°C	35.0	°C
Argon Supply Pressure	671.94	kPa	687.33	kPa
Purge Gas Supply Pressure*1	674.30	kPa	645.40	kPa
Option Gas Supply Pressure*1	N/A	kPa	N/A	kPa
Nebulizer Flow	No measurement		0.70	L/min
Nebulizer Back Pressure	No measurement		164.63	kPa
Plasma Gas Flow	No measurement		11.92	L/min
Auxiliary Gas Flow	No measurement		1.00	L/min
RF Power	No measurement		1200	W
RF Supply Current	No measurement		8.663	A
RF Supply Voltage	No measurement		164.660	V

*1 If option installed

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ICP-OES Parts List Table

Part description	Part Number	Product / Model # where used	Quantity Consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Polyclear Cooling Fluid	G3202-80010	G8481A	
Purge Gas Filter	G8010-60136	All	1
Air Inlet Filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	
PVC waste tubing, 8mm od x 5mm id, 2m	G8410-80122	SPS 4	
Additional Parts may be required from engineers stock:			
X axis drive belt	5410047500	SPS 3	
Z axis drive belt	5410047400	SPS 3	
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	

Restore system

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

Leave system in an idle state: on and purging.

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

Service Review

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

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Agilent Technologies

เอกสารไม่ควบคุม

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

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

Service Engineer Comments (optional)

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

Other Important Customer Web Links

How to get information on your product:

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

Service Completion

Service request number 600565787 Date service completed 30 Nov 2022

Agilent signature Horngui T. Customer signature [Signature]

Document part number: G8014-90075

Issued: 3 February 2017, Revision: 1.1 Copyright © 2017
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Agilent Technologies

เอกสารไม่ควบคุม

Report Summary

Instrument Model Agilent 5100/5110 VDV ICP-OES
Instrument ID G8014-G8015A
Instrument Serial Number N718030001
Software Version 7.3.1.5507
Firmware Version 3447
Tested By Test Engineer
Test Completed On 11/30/2022 9:35:32 AM

Result Summary

Subsystem Communications Test Skipped
Air Flow Test Skipped
Water Flow Test Skipped
Gas Flow Test Skipped
RF Generator Test Skipped
Camera Test Skipped
Optics Test Skipped
Advanced Valve System Test Skipped
Resolution Test Pass
Sensitivity Test Pass
Precision Test Pass

Page 1 of 4

เอกสารไม่ควบคุม

Resolution Test Pass

Element Wavelength	Specification	Width
N (174.213 nm)	± 5.40	6.57
As (188.980 nm)	± 5.70	6.20
C (193.227 nm)	± 11.50	8.35
Mo (202.032 nm)	± 6.25	6.41
C (206.158 nm)	± 13.40	9.34
Zr (215.857 nm)	± 8.70	6.02
Pb (220.353 nm)	± 9.50	7.13
Co (228.615 nm)	± 17.70	11.71
Ba (230.424 nm)	± 9.40	7.21
K (257.810 nm)	± 13.30	9.50
Mn (259.583 nm)	± 20.30	14.35
Cr (267.716 nm)	± 11.00	6.14
Ca (285.204 nm)	± 23.00	18.38
Cu (327.396 nm)	± 14.20	11.24
Sr (328.071 nm)	± 33.50	24.67
Ba (455.403 nm)	± 44.00	33.88
Fe (486.732 nm)	± 36.00	17.22
Ba (486.408 nm)	± 36.00	23.48
Eu (486.171 nm)	± 42.00	25.47
Ar (675.283 nm)	± 74.00	59.82
K (766.481 nm)	± 80.00	54.54

Page 2 of 4

เอกสารไม่ควบคุม

Sensitivity Test Pass

Radial	Element Wavelength	Specification	Method	Ratio	Standard	Blank
Radial	As (188.980 nm)	± 40.0	SRBR	1:47.7	1160.5	55.5
	Se (196.026 nm)	± 41.0	SRBR	1:11.1	1160.3	07.7
	Zn (213.857 nm)	± 1421.0	SRBR	4:100.6	51259.5	159.5
	Pb (220.353 nm)	± 46.0	SRBR	192.5	2808.6	185.7
	Mn (257.810 nm)	± 3618.0	SRBR	1:1054.1	264165.0	567.5
	Al (396.152 nm)	± 3.4	SRBR	7.5	49047.9	5110.5
	Ba (486.408 nm)	± 34.0	SRBR	107.4	1887710.3	17407.5
	K (766.481 nm)	± 1.8	SRBR	5.1	101805.9	16626.4
Axial	Element Wavelength <th>Specification</th> <th>Method</th> <th>Ratio</th> <th>Standard</th> <th>Blank</th>	Specification	Method	Ratio	Standard	Blank
Axial	As (188.980 nm)	± 208.0	SRBR	234.9	3056.4	152.2
	Se (196.026 nm)	± 154.0	SRBR	216.1	3665.1	271.5
	Zr (215.857 nm)	± 224.0	SRBR	1306.5	15850.4	144.5
	Zn (213.857 nm)	± 1743.0	SRBR	8364.0	153327.8	476.4
	Co (228.615 nm)	± 4227.0	SRBR	7116.5	143240.2	342.8
	Pb (220.353 nm)	± 373.0	SRBR	576.3	14465.2	580.4
	Mn (257.810 nm)	± 12025.0	SRBR	31047.1	1411257.3	1958.0
	Cu (327.396 nm)	± 1048.0	SRBR	4492.1	23110.8	1632.2
	Ca (285.204 nm)	± 19.0	SRBR	46.2	371467.5	7362.8
	Al (396.152 nm)	± 5.0	SRBR	14.9	278447.4	17552.8
	Ba (486.408 nm)	± 80.0	SRBR	180.8	10051527.3	52519.6
	K (766.481 nm)	± 74.0	SRBR	36.5	1522163.4	50858.1

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เอกสารไม่ควบคุม

Precision Test

Pass

Radial

Element Wavelength	Specification	Measured Value % RSD
As (195.060 nm)	± 2.00	0.62
Sg (196.026 nm)	± 2.00	0.71
Zn (213.857 nm)	± 1.50	0.45
Pb (220.353 nm)	± 2.00	0.76
Mn (257.613 nm)	± 1.50	0.50
Al (308.452 nm)	± 1.50	0.48
Ba (493.408 nm)	± 1.50	0.59
K (766.491 nm)	± 1.50	0.42

Axial

Element Wavelength	Specification	Measured Value % RSD
Ag (188.953 nm)	± 1.50	0.57
Se (196.026 nm)	± 1.50	0.76
Zn (206.200 nm)	± 1.00	0.51
Zn (213.857 nm)	± 1.50	0.51
Cd (214.439 nm)	± 1.50	0.45
Pb (220.353 nm)	± 1.50	0.52
Mn (257.610 nm)	± 1.50	0.54
Cr (267.710 nm)	± 1.50	0.54
Co (244.754 nm)	± 1.50	0.69
Al (308.452 nm)	± 1.50	0.50
Ba (493.405 nm)	± 1.50	0.59
K (766.491 nm)	± 1.50	0.72

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เอกสารไม่ควบคุม

Report Summary

Instrument Model	Agilent 5100B/110 VDV ICP-OES
Instrument ID	GC011A/35015A
Instrument Serial Number	MY18030001
Software Version	7.0.1.550.7
Firmware Version	3442
Tested By	PM Functional test
Test Completed On	11/30/2022 11:42:58 AM

Result Summary

Subsystem Communications Test	Pass
Air Flow Test	Pass
Water Flow Test	Pass
Gas Flows Test	Pass
RF Generator Test	Pass
Camera Test	Pass
Optics Test	Skipped
Advanced Valve System Test	Skipped
Resolution Test	Skipped
Sensitivity Test	Skipped
Precision Test	Skipped

Subsystem Communications Test

Pass

Air Flow Test

Pass

30% Air Flow (relative speed)	75% Air Flow (relative speed)
14.00	15.00

Water Flow Test

Pass

RF Water Flow (L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.44	1.05	18.51

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เอกสารไม่ควบคุม

Gas Flows Test

Pass

Neonizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.70	161.37	2.00	1.99	102.40
Makup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	2.00	112.85	12.00	12.01	23.46

RF Generator Test

Pass

RF Power Supply Test	Passed
RF Power Supply (W)	147.437
RF Oscillator Test	Passed
RF Oscillator Frequency (MHz)	0.000
Work Coil Current (A)	45.060
RF Power Supply Current (A)	1.557

Camera Test

Pass

	Integration Time (ms)	Standard Deviation	Status
Electronic Offset Test	1000	5.305	Passed
Dark Current Test	5000	0.516	Passed
Array Test	5	0.024	Passed
Linearity Test		0.118	Passed

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เอกสารไม่ควบคุม

Report Summary

Instrument Model	Agilent 5100B/110 VDV ICP-OES
Instrument ID	GBU11A/35015A
Instrument Serial Number	MY18030001
Software Version	7.0.1.550.7
Firmware Version	3442
Tested By	PM Performance test
Test Completed On	11/30/2022 12:10:42 PM

Result Summary

Subsystem Communications Test	Skipped
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Pass
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass

Optics Test

Pass

	Radial	Axial
Intensity	5674808	5623476
Wavelength	737.212	737.212

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เอกสารไม่ควบคุม

Resolution Test			Pass
Element Wavelength	Specification	Width	
Ni (174.213 nm)	± 9.40	6.79	
As (188.580 nm)	± 8.20	6.09	
Se (196.026 nm)	± 11.50	6.29	
Mo (202.332 nm)	± 8.20	6.30	
Cr (204.168 nm)	± 13.40	9.35	
Zn (213.857 nm)	± 9.70	6.77	
Pb (220.353 nm)	± 9.50	7.02	
Cd (226.615 nm)	± 7.20	11.67	
Ba (228.424 nm)	± 9.40	7.39	
Mn (257.610 nm)	± 13.30	9.49	
W (265.566 nm)	± 20.30	14.25	
Cr (267.716 nm)	± 11.00	7.84	
Cu (324.754 nm)	± 25.00	18.99	
Cu (327.395 nm)	± 14.20	11.33	
Sr (336.371 nm)	± 33.50	24.44	
Ba (403.403 nm)	± 41.00	33.86	
Sr (406.733 nm)	± 30.00	17.51	
Ba (493.408 nm)	± 36.30	26.96	
Ba (514.171 nm)	± 42.00	24.96	
Ar (578.282 nm)	± 74.00	59.35	
K (766.491 nm)	± 20.00	65.63	

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เอกสารไม่ควบคุม

Sensitivity Test						Pass
Radial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.580 nm)	± 46.0	SRBR	147.8	1149.3	54.8	
Se (196.026 nm)	± 41.0	SRBR	111.5	1277.8	101.3	
Zn (213.857 nm)	± 1421.0	SRBR	4375.0	52592.3	143.7	
Pb (220.353 nm)	± 46.0	SRBR	109.8	2744.4	105.5	
Mn (257.610 nm)	± 3518.0	SRBR	12801.7	255591.3	406.0	
Ar (396.152 nm)	± 3.4	SBR	9.0	52668.5	4873.5	
Ba (493.408 nm)	± 34.0	SBR	154.6	2287201.5	14685.1	
K (766.491 nm)	± 1.8	SBR	6.4	106701.6	14350.9	
Axial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.580 nm)	± 206.0	SRBR	242.4	3110.1	154.6	
Se (196.026 nm)	± 152.0	SRBR	226.1	4134.5	259.3	
Zn (213.857 nm)	± 234.0	SRBR	1126.6	12782.0	140.5	
Pb (220.353 nm)	± 1743.0	SRBR	8400.6	177196.3	442.5	
Cd (226.615 nm)	± 4227.0	SRBR	7001.9	125884.2	321.6	
Mn (257.610 nm)	± 10926.0	SRBR	33846.2	1767969.0	1738.5	
Cr (267.716 nm)	± 1045.0	SRBR	4386.0	167335.6	1424.4	
Cu (324.754 nm)	± 19.0	SBR	52.1	373690.7	7033.1	
Ar (396.152 nm)	± 6.0	SBR	15.8	296357.7	15112.4	
Ba (493.408 nm)	± 60.0	SBR	225.2	1017344.1	44377.7	
K (766.491 nm)	± 74.0	SBR	39.7	574136.2	40065.7	

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เอกสารไม่ควบคุม

Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Var. ± % RSD	
As (188.580 nm)	± 2.60	0.60	
Se (196.026 nm)	± 2.60	0.84	
Zn (213.857 nm)	± 1.50	0.29	
Pb (220.353 nm)	± 2.80	0.69	
Mn (257.610 nm)	± 1.50	0.28	
Ar (396.152 nm)	± 1.50	0.28	
Ba (493.408 nm)	± 1.50	0.59	
K (766.491 nm)	± 1.50	0.23	
Axial			
Element Wavelength	Specification	Measured Var. ± % RSD	
As (188.580 nm)	± 1.50	0.71	
Se (196.026 nm)	± 1.50	0.42	
Zn (213.857 nm)	± 1.50	0.46	
Pb (220.353 nm)	± 1.50	0.48	
Mn (257.610 nm)	± 1.50	0.74	
Cr (267.716 nm)	± 1.50	0.28	
Cu (324.754 nm)	± 1.50	0.51	
Ar (396.152 nm)	± 1.50	0.45	
Ba (493.408 nm)	± 1.50	0.81	
K (766.491 nm)	± 1.50	0.84	

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เอกสารไม่ควบคุม

TECHNOLOGY PROMOTION ASSOCIATION (THAI AND JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
311-4 PATTAKARN ROAD SOI 11, SUKUMVIT 11, BANGKOK 10250
TEL: 02-211-8892-3 FAX: 0 219-9242

Cert.No.: 23CH418
Page.: 1 of 3

Certificate of Calibration

Equipment :	pH Meter
Manufacturer :	EcoSensa
Model :	pH103A
Serial No.:	JC03335
ID No.:	UAE.EFM.062/2662(ENV.pH.02/62)
Condition As-Received:	Used Item
Received Date :	28 March 2023
Calibration Date :	29 March 2023
Reference :	2303-1001WSC-1
Submitted by :	United Analyst and Engineering Consultant Co., Ltd 3 So. 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-CHB by comparison with standard thermometer
Calibrated by :	Warakorn Lemgagrakul
Approved by :	 Approved Signatory
Issue Date :	31 March 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate cannot be reproduced without prior written approval of the Issuing Service. Any misuse, alteration and forgery are strictly prohibited.

เอกสารไม่ควบคุม



Cert.No.: 23CI1418
Page.: 2 of 3

Condition of this calibration result

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	22E2769	24 Aug 2023
2) Ref. Standard Thermometer	4982054	110RC044	22I*306	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-ASC National Accreditation Board, Accredited No. AN-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	863832	28 Dec 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863835	28 Dec 2023

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

Calibration Results

Function : mV Measurement

Performing standard curve by Fluke at pH (4.7)(7.10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter S/N: JC03335	4.00	177.48	177	4.01	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.01	0.58	2.00

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เอกสารไม่ควบคุม



Cert.No.: 23CH418
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: 2203235IA605377	4.008	4.01	173	0.0071	2.00
	6.987	6.98	-1	0.011	2.00
	6.987	6.98	1	0.011	2.00
	10.010	10.01	-177	0.0092	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model :

- Serial No. : 2203235IA605377

- Dimension of probe:

- Length : 120 mm

- Diameter : 12 mm

- Immersion Depth : 100 mm

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

Remark : - UUC* = Unit Under Calibration

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

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

Cert.No.: 23TW49
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE9M0003
ID No. : UAE.EFM.015/2563 (EFM.DO.04/63)
Received Date : 27 February 2023
Test Date : 28 February 2023
Reference : 2302-0944WSC-5
Submitted by : United Adumst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak,
Phrakhanong, Bangkok 10260
Laboratory Condition : Temperature (25 \pm 5) °C
Humidity (50 \pm 20) %
Test Procedure : In - house method : CP-CH9
by Comparison Technique with Azide Modification Method
Tested by : Walalak Sirithean
Approved by :
Approved Signatory
(/) Malee Butkrua
(/) Sathip Meangmai
(/) Warakorn Lemgagtrakul
Issue Date : 3 March 2023

เอกสารไม่ควบคุม

0308930



Cert.No.: 23TW49
Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

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

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

2. Standard Material :-

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

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 9K2B0020

Titration Method (Azide Modification Method)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.12	8.13	0.0055

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SUI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2317-3000-29 FAX. 0-2319-9684



Cert. No.: 23LM32
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE9M0003
ID No. : UAE.EFM.015/2563 (EFM.DO.04/63)
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : TPA On Site Calibration Laboratory
Received Order : 27 February 2023
Calibrated Date : 3 March 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Kunchit Promprat
Approved by :
() Pomthippa Tameyakul
(/) Malee Butkrues
() Suwit Injai
Issue Date : 7 March 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม
A 0051655



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2302-0944WSC-6

Cert. No.: 23LM32
Page.: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT01 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1502A	A7B843	23I24	04 Jan 2024

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

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

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 9K2B0020

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	60	25.006	25.0	-0.006	0.16	2.00
30.0	60	30.002	30.0	-0.002	0.16	2.00
35.0	60	35.001	35.0	-0.001	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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เอกสารไม่ควบคุม
a 1151550



Request No. 25-66 / 0323

MTC. ACL.No. 387 / 66

CALIBRATION CERTIFICATE

NOMENCLATURE : 1. Atomic Absorption Spectrophotometer "Agilent Technologies"
Model AA240FS, Serial No. MY13160001
2. Working standard solution "Inorganic Ventures"
Multi Analyte Custom Grade Solution, Lot No. S2-MEB708640
SUBMITTED BY : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260

CALIBRATION PROCEDURE : 1. Performance Verification of Atomic Absorption Spectrophotometer
(WI-500-02-30)

2. Estimation Uncertainty of Measurement in Analytical Chemistry (QP-513)

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

CALIBRATION DATE : 2 February 2023

REFERENCE MATERIAL : Traceable to NIST "Carlo Erba", "PanReac AppliChem"

Cadmium Lot No. 1152457, Chromium Lot No. 1793249, Copper Batch No. T117098A, Iron Batch No. T126087A,
Lead Lot No. 1227873, Manganese Batch No. T109228A, Nickel Batch No. T270178A, Zinc Batch No. T820140A

AMBIENT CONDITIONS : Temperature 22 °C Relative humidity 58 %

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

Calibrated by :
(Mr. Danai Srithongkum)

Approved by :
(Miss Sutadida Deangtong)
Senior Technical Officer
Acting Director of Analytical Chemistry Laboratory
Ref. 2015266012600366001
Issued Date : 15 February 2023

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MTC. ACL. No. 387 / 66

CALIBRATION DATA

1. Noise Level

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

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MTC. ACL. No. 387 / 66

2. Precision

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

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MTC. ACL. No. 387 / 66

3. Trueness

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

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

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

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

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

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

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MTC. ACL. No. 387 / 66

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

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

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

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

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

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

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MTC. ACL. No. 387 / 66

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

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

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

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

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

Calibrated by 1. *Mr. Danai Srithongkum*

(Mr. Danai Srithongkum)

2. *Mr. Atipat*

(Mr. Atipat Ratana)

Approved by *Miss Sutadde Deawong*

(Miss Sutadde Deawong)

Senior Technical Officer

Acting Director of

Analytical Chemistry Laboratory

Issued Date : 15 February 2023

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End of Certificate

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Cert.No.: 24TW39
Page.: 1 of 2

Certificate of Testing

Equipment :	DO Meter
Manufacturer :	YSI
Model :	5100
Serial No. :	11B 101863
ID No. :	UAE.WAO.004/2554
Received Date :	20 February 2024
Test Date :	21 February 2024
Reference :	2402-0629DSC-1
Submitted by :	United Analyst and Engineering Consultant Co.,Ltd. 3 Sol Udomsuk 41, Sukhumvit Road, Bangchak, Phrahanong, Bangkok 10280
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 Sirthean

Approved by :

() Pornthippa Tameyakul
() Unnopphol Harachai
(✓) Saithip Meangmai

Issue Date : 22 February 2024

เอกสารไม่ควบคุม



Cert.No.: 24TW39
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	23CG1172	22 Mar 2025
2. Balance	14233821	110RC001	23MM405	16 July 2024

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.: 22B100125

Titration Method (Azide Modification Method) (mg/L)	DO Meter Reading (mg/L)	Standard Deviation (mg/L)
8.20	8.19	0.0055

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List of Instruments Certification for Air & Noise Quality Analysis

Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remarks
Perimeters								
1. 1000 Series Standard calibrator	Full Temperature and Humidity (20-30 °C) (RH) (10-90% RH)	TECO Instruments	TS-1000A	Ardenon Associates Inc., USA	15-0353-03	11 May 2024	11 May 2025	
2. 100 Series Standard	Full Temperature and Humidity (20-30 °C) (RH) (10-90% RH)	Deigo	1221-10-1004	Technology Resources Association (Thailand)sg	23F006	1 May 2024	1 May 2025	
3. The Flow Meter	Mass flow (m³/min) (0-1000 L/min)	Mettler-Toledo	1088022	Technology Resources Association (Thailand)sg	23-0496-007	10 Aug 2024	10 Aug 2025	
4. Industrial Recorder	Full Temperature and Humidity (20-30 °C) (RH) (10-90% RH)	Amey, Germany	1000000000	Technology Resources Association (Thailand)sg	23F006	1 Jun 2024	1 Jun 2025	
5. Gas Thermal Regulator	Full Temperature and Humidity (20-30 °C) (RH) (10-90% RH)	Amey, Germany	1000000000	Technology Resources Association (Thailand)sg	230021	1 Jun 2024	1 Jun 2025	
6. Nitrogen Gasflow Analyzer	Flow rate (m³/min) (0-1000 L/min)	Thermo Scientific	42-100237574	UKM Consultant Co., Ltd	22102033	22 Mar 24	21 Mar 25	
7. Nitrogen Gasflow Analyzer	Nitrogen Gasflow	Thermo Scientific	0099970737	UKM Consultant Co., Ltd	06032024	28 Mar 24	27 Mar 25	
8. Nitrogen Gasflow Analyzer	Nitrogen Gasflow	Thermo Scientific Instrument	GC-70001-NA7	UKM Consultant Co., Ltd	06032024	15 Mar 24	14 Mar 25	
9. Nitrogen Gasflow Analyzer	Nitrogen Gasflow	Thermo Scientific	1000000000	UKM Consultant Co., Ltd	23002023	29 Mar 23	29 Mar 24	
10. Gas flow Controller	Nitrogen Gasflow	Apex	1001000000	Apex on-site, Capital company	00000000000003	21 Mar 24	21 Mar 25	
11. Oxygen Gasflow Analyzer	Oxygen Gasflow	Thermo Scientific	20070556	UKM Consultant Co., Ltd	03102024	1 Mar 24	1 Mar 25	
12. Oxygen Gasflow Analyzer	Oxygen Gasflow	Thermo Scientific	GC-40002-1400	UKM Consultant Co., Ltd	03102024	7 Mar 24	4 Mar 25	

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	Remarks
Amusement									
1st	Ultrasonic Distance Analyzer	Ultrasonic Distance	Thomas Scientific	801	UWE Calibration Co Ltd	07020261	1 May 21	1 May 21	
2nd	Ultrasonic Distance Analyzer	Ultrasonic Distance	Thomas Scientific	805	UWE Calibration Co Ltd	06062021	6 Apr 20	1 Apr 20	
3rd	Ultrasonic Distance Analyzer	Ultrasonic Distance	Alphas	910010000			21 Jan 21	21 Jan 21	
4th	Standard Gas Standard	Ultrasonic Distance	Alphas	101010002	Alphas on Air liquider company	60000101001203	21 Jan 21	21 Jan 21	
5th	Speed/Meter Detector	Speed	Scantech Tech Ltd	ME 41			10 Feb 21	1 Feb 21	
6th	Speed/Meter Detector	Speed	Scantech Tech Ltd	ME 41	The Metrological department	070201	10 Feb 21	1 Feb 21	
7th	Speed/Meter Detector	Calibrator Speed and time	Sonitek	5016	Imacon Instrument	06475101	1 Aug 20	1 Aug 20	
8th	Speed/Meter Calibrator	Calibrator Speed and time	Sonitek	885001	Imacon Instrument	06475101	1 Aug 20	1 Aug 20	
9th	Speed/Meter Calibrator	Calibrator Speed and time	Calson Tech	0475	Calson Tech AG (Singapore, Inc)	0000000007	20 Feb 20	20 Feb 20	
10th	Speed/Meter Calibrator	Calibrator Speed and time	Calson Tech	000701	Calson Tech AG (Singapore, Inc)	0000000007	20 Feb 20	20 Feb 20	
11th	Speed/Meter Calibrator	Calibrator Speed and time	Calson Tech	00701	Calson Tech AG (Singapore, Inc)	0000000007	20 Feb 20	20 Feb 20	

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	Remarks
1	Tester	PH	Scotman	PH50A C0762	Technique Precision Association (Pakistan) (aqar)	205650	28 Apr 23	27 Apr 24	
2	D.O meter	DO	Hanna	HAQ40-0210 H040004	Technique Precision Association (Pakistan) (aqar)	237861	28 Apr 23	28 Apr 24	
3	Conductivity Meter	Conductivity	Hanna	HAQ40-0210 H040004	Technique Precision Association (Pakistan) (aqar)	205493	28 Apr 23	30 Apr 24	

List of Instruments Certification for Air & Noise Quality Analysis

[illegible]

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	Remarks
Workplace									
18	Thermal Environment Monitor	Heat Index	Quest Technologies, Inc	Questing 34 (75111803)	Invasive Instrument Co. JSE	23-794-021	15 Nov 23	14 Nov 24	
19	Thermal Environment Monitor	Heat Index	Quest	Questing 34 (200101916)	Invasive Instrument Co. JSE	23-794-001	1 Apr 23	7 Apr 24	

CERTIFICATE OF CALIBRATION

Certificate No. : CL-011-65

Page 1 of 2 Pages

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

Top Load Orifice
: TSC
: TE-5025A
: 8540
: UAE EFM 176/2561
Used item
: United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong,
Bangkok 10260

Calibration procedure:
The Orifice gas flow device was calibrated against
Standard Rotary Displacement Meter (Rods Meter)
Model G55 (Mettler-Toledo, The Weigh 504
was used as a calibration guideline).

Traceability:
This certificate provides a traceability of the
measurement to recognized the national
standards of the International System of Units (SI) through the VSL (National
Metrology Institute of Netherlands) via Certificate
number: 0722393

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

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

: 25 Oct 2022
: 31 Oct 2022
: 02 Nov 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:

Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

CALIBRATION CONDITION:

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

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibrated by:
Mr. Sitawat Thachulal
Mr. Jiraporn Lertsoonthul



Approved signatory: Mr. Parinya Booncharoen
Calibration Department Manager

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

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Continuation of Certificate of Calibration Number CL-011-65

Page 2 of 2 Pages

MEASUREMENT RESULTS:

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

Table 1: The results of Q Standard calibration data

Plate	Flow rate m ³ /min	Pressure (Pa) mmHg	Temperature (T _g) °C	Temperature (T _m) °C	Δp _{meter} mmHg	Δp _{Orifice} mmHg	γ	Standard Flow (Q _s) m ³ /min
1	0.702	758.204	24.560	23.300	57.130	1.568	1.252	0.650
2	0.999	758.182	24.620	24.010	60.852	3.088	1.756	0.919
3	1.119	758.204	24.550	23.960	40.965	4.167	2.041	1.080
4	1.169	758.226	24.540	24.060	39.007	4.728	2.214	1.124
5	1.419	758.202	24.720	24.250	28.776	7.044	2.852	1.366

Slope (k): 1.96180

Intercept (b): -0.03332

Correlation coefficient (r): 0.99914

Uncertainty (k=2): 0.017 m³/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m ³ /min	Pressure (Pa) mmHg	Temperature (T _g) °C	Temperature (T _m) °C	Δp _{meter} mmHg	Δp _{Orifice} mmHg	γ	Standard Flow (Q _s) m ³ /min
1	0.702	758.204	24.560	23.300	57.130	1.568	0.785	0.651
2	0.999	758.182	24.620	24.010	60.852	3.088	1.501	0.920
3	1.119	758.204	24.550	23.960	40.965	4.167	1.279	1.060
4	1.169	758.226	24.540	24.060	39.007	4.728	1.362	1.124
5	1.419	758.202	24.720	24.250	28.776	7.044	1.664	1.366

Slope (k): 1.22877

Intercept (b): -0.02091

Correlation coefficient (r): 0.99914

Uncertainty (k=2): 0.018 m³/min

End of Certificate of Calibration



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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTANAKARN ROAD SOI 11, SUANLIANG, SUANLIANG, BANGKOK 10250
TEL. 0-2717-3080-24 FAX. 0-2719-9444

Certificate of Calibration

Certificate No. : 23P1400
Page : 1 of 2

Equipment : U-Tube Manometer
Manufacturer : Dwyer
Model : 1221-36-WM
Serial No. : -
ID No. : UAE EFM 0202509

Condition As-Received: Used Item
Received Date: 26 April 2023
Calibration Date: 09 May 2023

Reference: 2304-0703W5G
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 5) %
Atmospheric Pressure: 1010 mbar

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

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments
Standard according to in-house calibration procedure CP-P04, using " DKD-R 8-1 ; Calibration of Pressure
Gauges, Edition 03/2014 " as a guidelines.

Condition of this result of calibration

1. Reference standards instruments :

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

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

3. Scale and conversion factor is 1 kPa = 4.0146293 inHgO

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

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

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

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

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

- National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussamee
Issue Date : 11 May 2023

Approved Signatory : Attapol P.
Phalinee Prapaisai
Sura Suwanasri
Attapol Panurach

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0314240



Cert.No.: 23P1400
Page: 2 of 2

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

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

Applied Pressure (inHgO)	High-port side (inHgO)	Low-port side (inHgO)	ΔP (inHgO)	Error (inHgO)
0.00	0.00	0.00	0.00	0.00
2.00	1.00	-1.00	2.00	0.00
4.00	2.00	-2.00	4.00	0.00
6.00	3.00	-3.00	6.00	0.00
8.00	4.00	-4.00	8.00	0.00
10.00	5.00	-5.00	10.00	0.00
12.00	6.00	-6.00	12.00	0.00
14.00	7.02	-7.02	14.04	0.04
16.00	8.02	-8.02	16.04	0.04
18.00	9.04	-9.04	18.08	0.08
20.00	10.04	-10.04	20.08	0.08
22.00	11.02	-11.02	22.04	0.04
24.00	12.02	-12.02	24.04	0.04
26.00	13.02	-13.00	26.02	0.02
28.00	14.00	-14.00	0.00	-26.00
30.00	15.00	-15.00	30.00	0.00
32.00	16.00	-16.00	32.00	-0.02
34.00	17.00	-17.00	34.00	-0.04
35.80	18.00	-17.84	35.84	0.14

The uncertainty of measurement was ± 0.11 inHgO

* UUC = Unit Under Calibration

* AP = High-port side - Low-port side

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

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Attapol P.

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1160341

Certificate of Calibration

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

Certificate No : 23-AFM-187
Request No : Req-2023-1655

Unit Under Calibration Details

Measurement Item : Air Flow Meter
Manufacturer : BGI
Model : Delta Cal DC1
Serial Number : 128850
ID : UAE-EFM-030/2561
Sensor Model : -
Sensor Serial Number : -

Location of Calibration : LAB-4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 7 August 2023
Calibration Date : 30 August 2023

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


Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	12 July 2024
Air Flow Meter	Gilibrator 3 High flow	18501012012	Sensidyne	12 July 2024
Temperature meter	GT 11	00000057	Orehorn	27 February 2024
Pressure meter	CPG2400	41000KDU1651382	TPA	7 November 2023


Traceability :

This Certificate is traceable to SI Unit through Sensidyne AZLA Accreditation No. 3943.01

Note :

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

Calibration By : 
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : 
Mr. Puch Mathavorn
Calibration Engineer Supervisor
Issue Date : 30 August 2023

เอกสารไม่ควบคุม

Certificate No : 23-AFM-187
Request No : Req-2023-1655

Result of Calibration :

Temperature (°C)	Pressure (hPa)	STD (l/min)	UUC (l/min)	Error (l/min)	Uncertainty (l/min)
25.10	100.70	14.50	14.50	0.00	0.20
25.10	100.70	35.00	34.99	-0.01	0.21
25.00	100.70	35.80	35.79	-0.01	0.22
24.90	100.70	36.67	36.65	-0.02	0.23
24.80	100.70	38.30	38.26	-0.04	0.26

Note : STD = Standard UUC = Unit Under Calibration
- UUC Reference Condition : At 25.0 °C, 101.3 kPa, Air
- Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{\text{meas}} = Q_{\text{ref}} \times \frac{P_{\text{ref}}}{P_{\text{meas}}} \times \frac{T_{\text{meas}}}{T_{\text{ref}}}$$

where : Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

End of Certificate

เอกสารไม่ควบคุม

Certificate of Calibration

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

Certificate No : 23-TPM-424
Request No : Req-2023-1655

Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Air Flow meter
Manufacturer : BGI
Model : Delta Cal DC1
Serial Number : 158850
Resolution : 0.1 °C
ID Number : UAE-EFM-038/2561
Range Calibration : 20 °C to 50 °C
Type of Sensor : RTD
Sensor Diameter (mm) : 3
Calibration Position (mm) : 45
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 15 %RH
Received Date : 7 August 2023
Calibration Date : 30 August 2023


Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO/INGO, Model: GT11/RTD100, SN: 98000057, ID: 02-TPM Which was calibrated on 27 February 2023, Calibration Certificate No : QR23-0494

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

Note

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

Approved By : 
Mr. Noppadon Luangart
Technical Manager
Issue Date : 30 August 2023


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Certificate No : 23-TPM-424
Request No : Req-2023-1655
Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (°C)
Ta	20.037	20.0	0.0	0.13
	25.034	25.0	0.0	0.13
	30.035	30.0	0.0	0.13
	35.036	35.0	0.0	0.13
	40.038	40.1	-0.1	0.13
	45.041	45.1	-0.1	0.13
	50.044	50.2	-0.2	0.13

End of Certificate

Calibrated By : 
Mr. Sittichok Jirapaddeesakul

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Certificate of Calibration

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

Certificate No : 23-TPM-458
Request No : Req-2023-1977

Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Air Flow meter
Manufacturer : BGI
Model : Delta Cal DC1
Serial Number : 158850
Resolution : 0.1 °C
ID Number : UAE.EPM.036/2561

Range Calibration : 20 °C to 50 °C
Type of Sensor : RTD
Sensor Diameter (mm) : 3
Calibration Position (mm) : 45
Instrument Status : Used

Calibration Environment and Details


Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 15 %RH
Received Date : 14 September 2023
Calibrated Date : 27 September 2023
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard
Digital Thermometer with Sensor, Manufacturer: GINGO/INGGO, Model: GT1U/RTD100, SN: 06000057, ID: 02-TPM Which was calibrated on 27 February 2023, Calibration Certificate No.: QR23-0494

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

Note

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

Approved By : 
Mr. Noppadon Luangrit
Technical Manager
Issue Date : 27 September 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Issuing Laboratory.
IM-700-TPM-01 Rev.01 Issue date: 13/02/20

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Calibration Note
UUC Adjustment : Not Adjust


Certificate No : 23-TPM-458
Request No : Req-2023-1977

Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (°C)
TF	20.033	20.0	0.0	0.13
	25.033	25.0	0.0	0.13
	30.033	30.0	0.0	0.13
	35.034	35.1	-0.1	0.13
	40.040	40.1	-0.1	0.13
	45.039	45.1	-0.1	0.13
	50.043	50.1	-0.1	0.13

End of Certificate

Calibrated By : 
Mr. Sittichok Jansakdeekul

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Issuing Laboratory.
IM-700-TPM-01 Rev.01 Issue date: 13/02/20

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG, BANGKOK 10260
TEL: 0-2717-3000-24 FAX: 0-2719-9484



Certificate of Calibration

Certificate No. : 23P1856
Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer: Barigo
Model : -
Serial No.: -
ID No.: UAE.EMA2.110/2555

Condition As-Received: Used Item
Received Date: 26 May 2023
Calibration Date: 02 June 2023

Reference : 2305-0919WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1009 mbar

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

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P10, using * DKD-R 8-1; Calibration of Pressure Gauges, Edition 03/2014 * as a guidelines.

Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DP142	142205048	MP-0094-23	03 May 2024

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

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

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


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

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suksan Khankasaw
Issue Date : 06 June 2023

Approved Signatory : 
| | Phalinee Pratsapaipal
| | Sura Suwanneest
| | Attapol Panunach

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a 0316956



Cert.No: 23P1856
Page: 2 of 2

Result of calibration:- Without adjustment
Function:- Absolute Pressure Measurement
Range : 720 mmHg to 800 mmHg
Scale Interval : 1 mmHg (The Fifth Estimate)

Increasing Pressure

Applied Pressure (mmHg)	720.43	730.67	740.34	751.52	756.56	761.83	773.53	796.76
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	755.0	760.0	770.0	790.0
Error (mmHg)	-0.43	-0.67	-0.34	-1.52	-1.56	-1.83	-3.53	-6.76

Decreasing Pressure

Applied Pressure (mmHg)	798.76	773.60	761.89	756.89	751.59	740.72	730.68	720.59
UUC* Indication (mmHg)	790.0	770.0	760.0	755.0	750.0	740.8	730.0	720.0
Error (mmHg)	-8.76	-3.60	-1.89	-1.85	-1.59	-6.72	-6.68	-9.59

The uncertainty of measurement was ± 0.24 mmHg

* UUC = Unit Under Calibration

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

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Attapol P.
เอกสารไม่ควบคุม
a 1165502



Certificate of Calibration

Certificate No.: 23H1201
Page: 1 of 2

Equipment: Dial Thermo-Hygrometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE.EMA2.014/2355

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 30 May 2023

Reference: 2305-0919WSC

Ambient Temperature: (25 ± 3) °C

Relative Humidity: (50 ± 20) %

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

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

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

Procedure used: Calibration was conducted using in-house calibration procedures CP-1402 according to comparison
with standard chilled mirror sensor for humidity measurement function and comparison with standard
temperature probe for temperature measurement function into humidity / temperature chamber.

Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Hygro-M2 Dew Point Monitor	5112	2360195	20703	02 Aug 2023
2) Handheld Thermometer With Sensor	1523	3240076	231305	15 Mar 2024

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

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

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

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

Calibrated by: Somchai Dumvor

Issue Date: 07 June 2023

Approved Signatory:

Chakrit Watanwanjua

Pornthipos Tameyaykul

Viporn Tantiyawutti

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a 0316275



Cert. No.: 23H1201
Page: 2 of 2

Result of Calibration:- Before Adjustment
Function: Humidity Measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	55	14.9	1.6
25.0	60.0	66	6.0	1.7
25.0	80.0	78	-2.0	1.9

Result of Calibration:- After Adjustment
Function: Humidity Measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	46	5.9	1.6
25.0	60.0	60	0.0	1.7
25.0	80.0	72	-8.0	1.9

Result of Calibration:- Without Adjustment
Function: Temperature Measurement

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
19.967	20.0	0.013	0.72
30.016	30.0	-0.016	0.72
39.944	39.0	-0.944	0.72

UUC*: Unit Under Calibration

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

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a 1165294

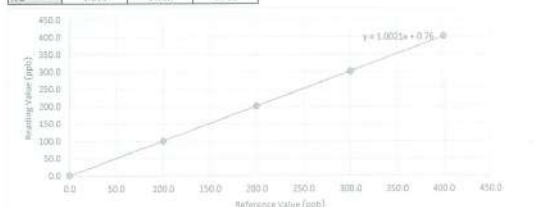


United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phraekhanong, Bangkok 10260
Tel. 0 2763 2828 Fax 0 2763 2800 www.uaecconsultant.com E-mail: uaec@uaecconsultant.com



MULTI-POINT GAS TEST REPORT							
Equipment	Gas Analyzer (NO ₂)		Model	421			
Manufacturer	Thermo Scientific		Serial Number	CH22387036			
Std. gas Concentration			Dilutor Detail				
Sulphur Dioxide (SO ₂)	44.68		Manufacturer	Thermo Scientific			
Nitric Oxide (NO)	45.94		Model	146i			
Carbon Monoxide (CO)	994.8		Serial Number	1180540071			
Cylinder No.	EB01432		Expiration Date	June 21, 2024			

NOx & NO Multi-Point Calibration							
Point	Ref. Value (ppb)	Read. NOx (ppb)	Read. NO (ppb)	Difference Error	Percent Error	[% Error]	Res. Time (min.)
Level 1	0.0	1.5	1.5	1.50	1.50	1.50	5
Level 2	100.0	100.3	100.3	0.30	0.30	0.30	5
Level 3	200.0	200.9	200.9	0.90	0.45	0.45	5
Level 4	300.0	301.6	301.6	1.60	0.53	0.53	5
Level 5	400.0	402.2	402.2	2.20	0.55	0.55	5
R		Slope	Intercept	Average			
NOx	1.000	1.002	0.760	Criteria	5.00	10	
NO	1.000	1.002	0.760				



NO2 Multi-Point Calibration							
Point	Ref. NO	O ₂	NO ₂ Cal	Read. NO ₂	Read. NOx	Read. NO	Res. Time (min.)
1	450.0	100.0	100.0	99.7	452.7	353.6	5
2	450.0	200.0	200.0	198.2	447.8	247.6	5
3	450.0	300.0	300.0	297.4	447.3	145.2	5
4	450.0	400.0	400.0	396.4	447.3	50.9	5
Slope	0.991	Intercept	1.600	R	1.000		
Ref. NO	Read. NO ₂	Read. NOx	Convert NO ₂	%Convert	Avg	Criteria	
1	450.0	351.0	451.5	100.5	100.5		
2	450.0	248.3	446.1	99.8	99.9		
3	450.0	144.1	445.6	100.5	100.5		
4	450.0	50.0	445.6	99.9	99.9		

Calibrate by: Sirichan Gangsai
Calibration Date: 2/7/23

Approved by: P. Thum N.
Approved Date: 2 July 2023

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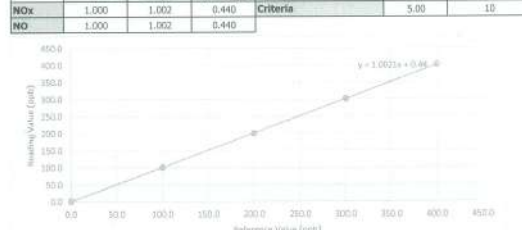


United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phraekhanong, Bangkok 10260
Tel. 0 2763 2828 Fax 0 2763 2800 www.uaecconsultant.com E-mail: uaec@uaecconsultant.com



MULTI-POINT GAS TEST REPORT							
Equipment	Gas Analyzer (NO ₂)		Model	421			
Manufacturer	Thermo Scientific		Serial Number	CH22387037			
Std. gas Concentration			Dilutor Detail				
Sulphur Dioxide (SO ₂)	44.68		Manufacturer	Thermo Scientific			
Nitric Oxide (NO)	45.94		Model	146i			
Carbon Monoxide (CO)	994.8		Serial Number	1180540071			
Cylinder No.	EB01432		Expiration Date	June 21, 2024			

NOx & NO Multi-Point Calibration							
Point	Ref. Value (ppb)	Read. NOx (ppb)	Read. NO (ppb)	Difference Error	Percent Error	[% Error]	Res. Time (min.)
Level 1	0.0	0.9	0.9	0.90	0.90	0.90	5
Level 2	100.0	100.4	100.4	0.40	0.40	0.40	5
Level 3	200.0	200.2	200.2	0.20	0.10	0.10	5
Level 4	300.0	301.3	301.3	1.30	0.43	0.43	5
Level 5	400.0	401.5	401.5	1.50	0.38	0.38	5
R		Slope	Intercept	Average			
NOx	1.000	1.002	0.440	Criteria	5.00	10	
NO	1.000	1.002	0.440				



NO2 Multi-Point Calibration							
Point	Ref. NO	O ₂	NO ₂ Cal	Read. NO ₂	Read. NOx	Read. NO	Res. Time (min.)
1	450.0	100.0	100.0	99.1	452.7	353.6	5
2	450.0	200.0	200.0	200.2	447.8	247.6	5
3	450.0	300.0	300.0	301.5	451.8	150.3	5
4	450.0	400.0	400.0	400.8	449.1	48.3	5
Slope	1.006	Intercept	-1.200	R	1.000		
Ref. NO	Read. NO ₂	Read. NOx	Convert NO ₂	%Convert	Avg	Criteria	
1	450.0	352.4	451.3	98.9	98.9		
2	450.0	246.6	446.4	99.8	99.9		
3	450.0	149.5	450.4	100.9	100.3		
4	450.0	47.8	447.7	100.0	100.0		

Calibrate by: Sirichan Gangsai
Calibration Date: 2/7/23

Approved by: P. Thum N.
Approved Date: 2 July 2023

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United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udomsak 41, Sukhumvit Road, Bangkok, Prachinong, Bangkok 10260

Tel. 0 2763 2826 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Mar 16, 2023

Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Environmental Instruments Serial Number : 42C-70971-367

Standard Gas Concentration

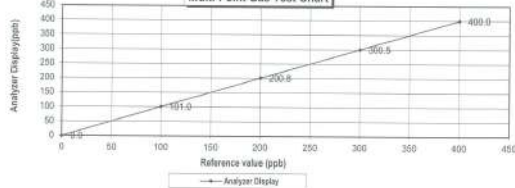
Sulphur Dioxide (SO₂) 44.68 PPM Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM Model : 146i
Methane (CH₄) - PPM Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : E80143262
Expiration Date : Jun 21, 2024

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	1.00	0.99	0.99
Level 3	40.00%	200.0	0.80	0.40	0.40
Level 4	60.00%	300.0	0.50	0.17	0.17
Level 5	80.00%	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

Aphivat K.
16.3.61

Approve by

Pichan W.
16. Mar. 2023

เอกสารไม่ควบคุม



United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udomsak 41, Sukhumvit Road, Bangkok, Prachinong, Bangkok 10260

Tel. 0 2763 2826 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Apr 21, 2023

Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : 1180540064

Standard Gas Concentration

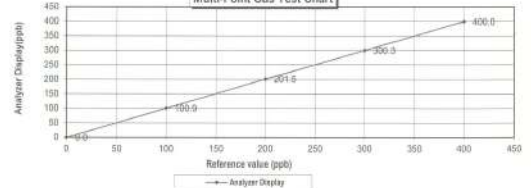
Sulphur Dioxide (SO₂) 44.68 PPM Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM Model : 146i
Methane (CH₄) - PPM Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : E80143262
Expiration Date : Jun 21, 2024

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.9	0.90	0.89
Level 3	40.00%	200.0	201.5	1.50	0.74
Level 4	60.00%	300.0	300.3	0.30	0.10
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb
Average Difference (%) 0.35
Acceptable Limit $\pm 5\%$

Multi-Point Gas Test Chart



Calculate by

Aphivat K.
21.4.61

Approve by

Pichan W.
21. Apr. 2023

เอกสารไม่ควบคุม



CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N96C15A0102 Reference Number: 122-402135167-1
Cylinder Number: E3143262 Cylinder Volume: 144.4 CF
Laboratory: 194 - Durham (SAP) - NC Cylinder Pressure: 2315 PSIG
PQ#P Number: 82202 Value Outlet: 500
Gas Code: CO₂/N₂/O₂/SO₂/BALN Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024

Each Gas product is manufactured to meet the requirements of the EPA protocol for use in the calibration of gas analyzers. The gas is produced by a process that ensures the highest purity and is stored in a clean, dry, and corrosion-resistant container. The gas is delivered to the customer in a clean, dry, and corrosion-resistant container. The gas is delivered to the customer in a clean, dry, and corrosion-resistant container. The gas is delivered to the customer in a clean, dry, and corrosion-resistant container.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Date
HDX	45.00 PPM	45.95 PPM	G1	$\pm 1.4\%$ NIST Traceable	30/03/2021, 30/04/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	$\pm 1.4\%$ NIST Traceable	30/03/2021, 30/04/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	$\pm 1.0\%$ NIST Traceable	30/03/2021, 30/04/2021
CARBON MONOXIDE	984.8 PPM	984.8 PPM	G1	$\pm 0.5\%$ NIST Traceable	30/03/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	2336-20	CO2658	49.52 PPM NITRIC OXIDE/NITROGEN	$\pm 1.0\%$	Feb 20, 2025
PMN	1238	D85026	9.91 PPM NITROGEN DIOXIDE/AIR	$\pm 2.0\%$	Feb 20, 2025
QSPS	43143898102	C052581	4.348 PPM NITROGEN DIOXIDE/NITROGEN	$\pm 2.1\%$	Feb 12, 2023
NTRM	16011043	CC45277	49.00 PPM SULFUR DIOXIDE/NITROGEN	$\pm 0.5\%$	Jun 17, 2022
NTRM	1408112	CC45277	89.5 PPM CARBON MONOXIDE/NITROGEN	$\pm 0.5\%$	Nov 15, 2025

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Model 5700 A-R0801332 CO	FIR	Jun 30, 2021
Model 5700 A-R0801332 NO	FIR	Jun 30, 2021
Model 5700 A-R0801332 NO2	FIR	Jun 30, 2021
Model 5700 A-R0801332 SO2	FIR	Jun 30, 2021

Trade Data Available Upon Request

NOTES: PO #5221032607

CROSS WT: 26.42kg

NET WT: 4.73kg



CERT 3082.01

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United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udomsak 41, Sukhumvit Road, Bangkok, Prachinong, Bangkok 10260

Tel. 0 2763 2826 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Apr 7, 2023

Equipment : Gas Analyzer (SO₂) Model : 43C
Manufacturer : Thermo Environmental Instruments Serial Number : 43C-65007-345

Standard Gas Concentration

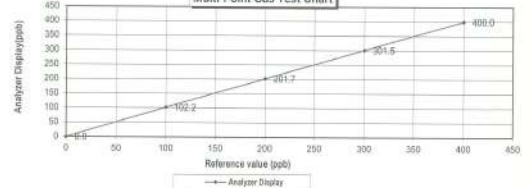
Sulphur Dioxide (SO₂) 44.68 PPM Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM Model : 146i
Methane (CH₄) - PPM Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM
Cylinder No. : E80143262
Expiration Date : Jun 24, 2024

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	102.2	2.20	2.15
Level 3	40.00%	200.0	201.7	1.70	0.84
Level 4	60.00%	300.0	301.5	1.50	0.50
Level 5	80.00%	400.0	400.0	0.00	0.00

Remark : Measuring Range 500.0 ppb
Average Difference (%) 0.70
Acceptable Limit $\pm 5\%$

Multi-Point Gas Test Chart



Calculate by

Aphivat K.
7.4.61

Approve by

Pichan W.
7 Apr. 2023

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 : 22 February, 2024

Certification No. 098/24

Page : 1 of 5

Object : Wind Speed & Wind Direction Data Logger

Manufacturer : SCARLET/TECH

Type : WL-21

Mfg Code : Wireless Receiver : 2111DR0052

Wind Sensor : 2111DT0052

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

81 Soi Udomsuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature : 25.1 °C Barometric Pressure : 1009.5 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Aloft Plotting Board

: Micromanometer : Theodor Friedrichs FC014 Serial No. 9310119 : HOOK GAGE NO 1425

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

: Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer : Model DA-650-3TV (sensor TR-00AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec

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

: Digital Barometer Vaisala Type PTB334 No. V1220001

Calibrated by :

Signed :

(Authorised Signatory)

for the Chief

Mr. Watchapol Subwat

Mr. Watchapol Subwat

Sub-Standard Instrument

Mechanical Engineer

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 098/24

22 February, 2024

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer					
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.0	0.02
11.02	-	-	-	11.0	0.02
13.01	-	-	-	13.0	0.01
15.01	-	-	-	15.0	0.01
17.02	-	-	-	16.9	0.12
20.02	-	-	-	19.9	0.12

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

Calibrated by :

Mr. Watchapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 098/24

22 February, 2024

Page : 3 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mbar
1010.84	1011	-0.16
1010.60	1010	0.60
1011.71	1012	-0.29
1012.17	1012	0.17
1012.31	1012	0.31
1012.25	1012	0.25
1012.70	1013	-0.21
1012.95	1012	0.95
1013.62	1014	-0.48
1014.16	1014	0.16
1015.79	1016	-0.21
1016.02	1016	0.02
1015.88	1016	-0.14
1015.89	1016	0.89
1011.51	1012	-0.49
1011.80	1012	-0.20
1012.06	1012	0.06
1012.81	1013	-0.19
1013.22	1013	0.22
1013.49	1013	0.49

Average : 0.08

Calibrated by :

Mr. Watchapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

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THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 098/24

22 February, 2024

Page : 4 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mmHg
758.19	758	0.19
758.01	758	0.01
758.84	758	-0.16
758.19	758	0.19
758.29	759	0.29
759.25	759	0.25
759.65	760	-0.35
759.77	760	-0.23
760.20	760	0.20
760.88	760	0.88
761.90	762	-0.10
762.08	762	0.08
761.96	762	-0.04
761.83	762	-0.17
758.89	759	-0.31
758.91	759	-0.09
758.11	759	0.11
758.67	760	-0.33
758.98	760	-0.02
760.18	760	0.18

Average : 0.02

Calibrated by :

Mr. Watchapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

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THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 098/24

22 February, 2024

Page : 5 of 5

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.2	45	0.2
30.3	30	0.3
15.8	15	0.8

Calibrated by :

Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 22 February, 2024

Certification No. 097/24

Page : 1 of 5

Object : Wind Speed & Wind Direction Data Logger

Manufacturer : SCARLET/TECH

Type : WL-21

Mfg Code : Wireless Receiver 2112DR0085

Wind Sensor 2112DT0085

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

81 Soi Udomsuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1009.8 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Afloat Plotting Board

: Micromanometer Theodor Friedrich FC014 Serial No. 9310119 : HOOK GAGE NO 1425

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

: Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV

(sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

: Standard Velocity at 0 - 20 m/sec

STANDARD THERMOMETER

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

: Iseto, Iseto 645 Serial No. 02848057

: Thermoschneider No.918802

STANDARD BAROMETER

: Digital Barometer Vaisala Type PTB220 No. V1220015

: Digital Barometer Vaisala Type PTB350 Serial No. 14390901

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Signed :

Mr. Pised Prommat

(Authorized Signatory)

for the Chief

Sub-Standard Instrument

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 097/24

22 February, 2024

Page : 2 of 5

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	2.9	0.12
5.00	-	-	-	4.9	0.10
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.0	0.02
11.02	-	-	-	11.0	0.02
13.01	-	-	-	13.0	0.01
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

Wind Afloat Plotting Board.

US DEPARTMENT OF COMMERCE WEATHER BUREAU

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

Calibrated by :

Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 097/24

22 February, 2024

Page : 3 of 5

Standard Barometer Pressure	Tested Barometer Pressure	Correction mbar
1010.84	1011	-0.16
1010.60	1011	-0.40
1011.71	1011	0.71
1012.17	1012	0.17
1012.31	1012	0.31
1012.25	1012	0.25
1012.79	1013	-0.21
1012.95	1012	0.95
1013.52	1014	-0.48
1014.16	1014	0.16
1015.79	1016	-0.21
1016.02	1016	0.02
1015.86	1016	-0.14
1015.69	1015	0.69
1011.51	1012	-0.49
1011.80	1012	-0.20
1012.06	1012	0.06
1012.81	1013	-0.19
1013.22	1013	0.22
1013.49	1014	-0.51

Average 0.03

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



The Result of Calibration

Certification No. 097/24

22 February, 2024

Page : 4 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mmHg
758.19	758	0.19
758.01	758	0.01
758.84	758	0.84
759.19	759	0.19
759.29	759	0.29
759.25	759	0.25
759.85	759	0.85
759.77	760	-0.23
760.20	760	0.20
760.68	760	0.68
761.90	762	-0.10
762.08	762	0.08
761.96	762	-0.04
761.83	762	-0.17
758.89	759	-0.31
758.91	759	-0.09
759.11	759	0.11
759.67	760	-0.33
759.96	760	-0.02
760.18	760	0.18

Average

0.12

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

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The Result of Calibration

Certification No. 097/24

22 February, 2024

Page : 5 of 5

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.2	45	0.2
30.3	30	0.3
15.8	16	-0.2

Calibrated by :

Mr. Watcharapol Subwat
Mechanical EngineerCalibration & Test Section
Meteorological Instruments Bureau

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7-131 MOO 11, SOI SUTINAKORN 11 TAMBON BANG KAEO,
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10140 THAILAND
TEL : 0660-2116-5900-1 FAX: 0660-2116-7140

Page 1 of 2

Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING
CONSULTANT CO.,LTD.
Address : 81 Soi Udomauk 41, Sukhumvit Road, Bangchak,
Prakanong, Bangkok 10260Certificate No : 23-ACT-117
Request No : Req-2023-1546

Unit Under Calibration Details

Measurement Item : Acoustic Calibrator
Manufacturer : SVANTEK
Model : SV 36
Serial Number : 107224
ID : UAE.EFM.171/2564Class : I
Range : 94 , 114 dB / 1000 Hz
Instrument Status : Used

Calibration Environment and Details

Temperature : (23 ± 2 °C)
Humidity : (50 ± 20 %RH)
Barometric Pressure : (1013 ± 10.0 hPa)
Received Date : 21 July 2023
Calibration Date : 4 August 2023
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 2024
THD Multimeter	2015	1047765	NIMT	31 January 2024

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 EngineerApproved By :
Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 4 August 2023

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

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Certificate No : 23-ACT-117

Request No : Req-2023-1546

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	94.03	0.03	-	-	0.13	0.25
114 dB / 1000 Hz	114.11	0.11	-	-	0.13	0.25

Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 1 (± %)
	Measured (Hz)	Error (%)	Measured (Hz)	Error (%)		
94 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70
114 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70

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

Calibration Range (Hz)	Without Adjustment	Adjustment	Uncertainty (± %)	Acceptance limit Class 1 (± %)
	Measured (%)	Measured (%)		
94 dB / 1000 Hz	0.26	-	0.40	2.5
114 dB / 1000 Hz	0.38	-	0.40	2.5

Note :

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

End of Calibration

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

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Calibration Certificate

Certificate Number 2023003657

Customer:

United Analyst and Engineering Consultant Co Ltd
No. 81 Soi Udonnuk 41, Sukhumvit Road,
Bangkok, Phra Khanong,
Bangkok, 10260, Thailand

Model Number

LXT1

Serial Number

0007301

Test Results

Pass

Initial Condition

As Manufactured

Description

SoundTrack LxT Class 1
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number

D0001.8384

Technician

Jacob Cannon

Calibration Date

23 Mar 2023

Calibration Due

23 Mar 2024

Temperature

23.56 °C ± 0.25 °C

Humidity

49.4 %RH ± 2.0 %RH

Static Pressure

86.02 kPa ± 0.13 kPa

Evaluation Method

Tested with:

Data reported in dB re 20 µPa.

Larson Davis CAL291, S/N 0108
Larson Davis PRMLxT1, S/N 077636
PCB 377B02, S/N 344253
Larson Davis CAL200, S/N 9079

Compliance Standards

Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

IEC 60651:2001 Type 1

ANSI S1.4-2014 Class 1

IEC 60804:2000 Type 1

ANSI S1.4 (R2006) Type 1

IEC 61252:2002

ANSI S1.11 (R2009) Class 1

IEC 61260:2001 Class 1

ANSI S1.25 (R2007)

IEC 61672:2013 Class 1

ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.

Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert LxT, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrators and the Larson Davis ADP043 1/4" to

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Certificate Number 2023003657

1/2" adaptor is used with the preamplifier.

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014 Part 3.

Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014 Part 1 successfully completed by Physikalisch-Technische Bundesanstalt (PTB) on 2007-10-09 reference number PTB-1.72-4934218.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014 Part 3, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organization responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013 / ANSI/ASA S1.4-2014 Part 2, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014 Part 1; the sound level meter submitted for testing conforms to the class 1 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014 Part 1.

Standards Used			
Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2023-09-09	2025-09-09	001250
Hart Scientific 2625-H Temperature Probe	2021-06-25	2023-05-25	006798
Larson Davis CAL200 Acoustic Calibrator	2023-07-31	2025-07-31	007017
Larson Davis Model 831	2023-03-22	2024-03-22	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2023-01-06	2024-01-06	007185
SRS DS360 Ultra Low Distortion Generator	2022-03-29	2024-03-29	007635
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2022-09-28	2023-09-28	PCB0004783

Acoustic Calibration

Measured according to IEC 61672-3:2013 10 and ANSI S1.4-2014 Part 3: 10

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.01	113.80	114.20	0.14	Pass

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-49.52	-52.44	-46.33	0.14	Pass

— End of measurement results—

Acoustic Signal Tests, C-weighting

Measured according to IEC 61672-3:2013 12 and ANSI S1.4-2014 Part 3: 12 using a comparison coupler with Unit Under Test (UUT) and reference SLM using slow time-weighted sound level for compliance to IEC 61672-1:2013 5.5, ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.17	-0.20	-1.20	0.90	0.23	Pass
1000	0.18	0.00	-0.70	0.70	0.23	Pass
8000	-3.84	-3.00	-5.50	-1.50	0.32	Pass

— End of measurement results—

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Certificate Number 2023003657

Self-generated Noise

Measured according to IEC 61672-3:2013 11.1 and ANSI S1.4-2014 Part 3: 11.1

Measurement	Test Result [dB]
A-weighted	40.35

— End of measurement results—

— End of Report—

Signature: Jacob Cannon

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Calibration Certificate

Certificate Number 2023003632

Customer:

United Analyst and Engineering Consultant Co Ltd
No. 81 Soi Udonnuk 41, Sukhumvit Road,
Bangkok, Phra Khanong,
Bangkok, 10260, Thailand

Model Number

LxT1

Serial Number

0007301

Test Results

Pass

Initial Condition

As Manufactured

Description

SoundTrack LxT Class 1
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number

D0001.8378

Technician

Jacob Cannon

Calibration Date

23 Mar 2023

Calibration Due

23 Mar 2024

Temperature

23.58 °C ± 0.25 °C

Humidity

49.3 %RH ± 2.0 %RH

Static Pressure

86.12 kPa ± 0.13 kPa

Evaluation Method

Tested electrically using Larson Davis PRMLxT1 S/N 077636 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards

Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1

ANSI S1.4-2014 Class 1

IEC 60804:2000 Type 1

ANSI S1.4 (R2006) Type 1

IEC 61252:2002

ANSI S1.25 (R2007)

IEC 61672:2013 Class 1

ANSI S1.43 (R2007) Type 1

IEC 61260:2001 Class 1

ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert LxT, I770.01 Rev O Supporting Firmware Version 4.0.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

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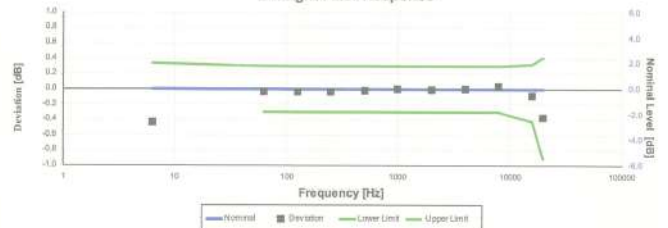
D0001.8407 Rev G

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Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
SRS DS360 Ultra Low Distortion Generator	2022-03-29	2023-03-29	007635

เอกสารไม่ควบคุม

Z-weight Filter Response



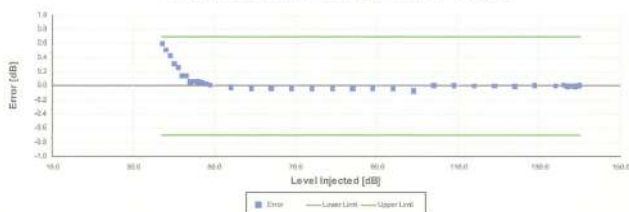
Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1993 (R2006) 5.1 and 6.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.44	-0.44	-1.11	0.33	0.15	Pass
63.10	-0.04	-0.04	-0.30	0.30	0.15	Pass
125.89	-0.04	-0.04	-0.30	0.30	0.15	Pass
251.19	-0.04	-0.04	-0.30	0.30	0.15	Pass
501.19	-0.02	-0.02	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.02	-0.02	-0.30	0.30	0.15	Pass
3,981.07	0.00	0.00	-0.30	0.30	0.15	Pass
7,943.28	0.03	0.03	-0.30	0.30	0.15	Pass
15,848.93	-0.09	-0.09	-0.42	0.32	0.15	Pass
19,952.62	-0.37	-0.37	-0.91	0.41	0.15	Pass

– End of measurement results–

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A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6; IEC 60604:2000 6.2; IEC 61252:2002 8; ANSI S1.4 (R2006) 6.9; ANSI S1.4-2014 Part 1: 5.6; ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Results
37.00	0.60	-0.70	0.70	0.16	Pass
38.00	0.51	-0.70	0.70	0.16	Pass
39.00	0.43	-0.70	0.70	0.16	Pass
40.00	0.31	-0.70	0.70	0.16	Pass
41.00	0.26	-0.70	0.70	0.15	Pass
42.00	0.14	-0.70	0.70	0.16	Pass
43.00	0.14	-0.70	0.70	0.16	Pass
44.00	0.06	-0.70	0.70	0.17	Pass
45.00	0.07	-0.70	0.70	0.16	Pass
46.00	0.06	-0.70	0.70	0.16	Pass
47.00	0.06	-0.70	0.70	0.16	Pass
48.00	0.02	-0.70	0.70	0.16	Pass
49.00	0.01	-0.70	0.70	0.16	Pass
50.00	-0.02	-0.70	0.70	0.16	Pass
51.00	-0.04	-0.70	0.70	0.16	Pass
52.00	-0.03	-0.70	0.70	0.16	Pass
53.00	-0.03	-0.70	0.70	0.16	Pass
54.00	-0.04	-0.70	0.70	0.16	Pass
55.00	-0.04	-0.70	0.70	0.16	Pass
56.00	-0.04	-0.70	0.70	0.16	Pass
57.00	-0.04	-0.70	0.70	0.16	Pass
58.00	-0.03	-0.70	0.70	0.16	Pass
59.00	-0.03	-0.70	0.70	0.16	Pass
60.00	-0.03	-0.70	0.70	0.16	Pass
61.00	-0.04	-0.70	0.70	0.16	Pass
62.00	-0.04	-0.70	0.70	0.16	Pass
63.00	-0.04	-0.70	0.70	0.16	Pass
64.00	-0.04	-0.70	0.70	0.16	Pass
65.00	-0.04	-0.70	0.70	0.16	Pass
66.00	-0.03	-0.70	0.70	0.16	Pass
67.00	-0.03	-0.70	0.70	0.16	Pass
68.00	-0.03	-0.70	0.70	0.16	Pass
69.00	-0.03	-0.70	0.70	0.16	Pass
70.00	-0.04	-0.70	0.70	0.16	Pass
71.00	-0.04	-0.70	0.70	0.16	Pass
72.00	-0.04	-0.70	0.70	0.16	Pass
73.00	-0.04	-0.70	0.70	0.16	Pass
74.00	-0.04	-0.70	0.70	0.16	Pass
75.00	-0.04	-0.70	0.70	0.16	Pass
76.00	-0.04	-0.70	0.70	0.16	Pass
77.00	-0.04	-0.70	0.70	0.16	Pass
78.00	-0.04	-0.70	0.70	0.16	Pass
79.00	-0.04	-0.70	0.70	0.16	Pass
80.00	-0.03	-0.70	0.70	0.16	Pass
81.00	-0.03	-0.70	0.70	0.16	Pass
82.00	-0.03	-0.70	0.70	0.16	Pass
83.00	-0.03	-0.70	0.70	0.16	Pass
84.00	-0.04	-0.70	0.70	0.16	Pass
85.00	-0.04	-0.70	0.70	0.16	Pass
86.00	-0.04	-0.70	0.70	0.16	Pass
87.00	-0.04	-0.70	0.70	0.16	Pass
88.00	-0.04	-0.70	0.70	0.16	Pass
89.00	-0.04	-0.70	0.70	0.16	Pass
90.00	-0.04	-0.70	0.70	0.16	Pass
91.00	-0.04	-0.70	0.70	0.16	Pass
92.00	-0.04	-0.70	0.70	0.16	Pass
93.00	-0.04	-0.70	0.70	0.16	Pass
94.00	-0.04	-0.70	0.70	0.16	Pass
95.00	-0.04	-0.70	0.70	0.16	Pass
96.00	-0.04	-0.70	0.70	0.16	Pass
97.00	-0.04	-0.70	0.70	0.16	Pass
98.00	-0.04	-0.70	0.70	0.16	Pass
99.00	-0.04	-0.70	0.70	0.16	Pass
100.00	-0.04	-0.70	0.70	0.16	Pass
101.00	-0.04	-0.70	0.70	0.16	Pass
102.00	-0.04	-0.70	0.70	0.16	Pass
103.00	-0.04	-0.70	0.70	0.16	Pass
104.00	-0.04	-0.70	0.70	0.16	Pass
105.00	-0.04	-0.70	0.70	0.16	Pass
106.00	-0.04	-0.70	0.70	0.16	Pass
107.00	-0.04	-0.70	0.70	0.16	Pass
108.00	-0.04	-0.70	0.70	0.16	Pass
109.00	-0.04	-0.70	0.70	0.16	Pass
110.00	-0.04	-0.70	0.70	0.16	Pass
111.00	-0.04	-0.70	0.70	0.16	Pass
112.00	-0.04	-0.70	0.70	0.16	Pass
113.00	-0.04	-0.70	0.70	0.16	Pass
114.00	-0.04	-0.70	0.70	0.16	Pass
115.00	-0.04	-0.70	0.70	0.16	Pass
116.00	-0.04	-0.70	0.70	0.16	Pass
117.00	-0.04	-0.70	0.70	0.16	Pass
118.00	-0.04	-0.70	0.70	0.16	Pass
119.00	-0.04	-0.70	0.70	0.16	Pass
120.00	-0.04	-0.70	0.70	0.16	Pass
121.00	-0.04	-0.70	0.70	0.16	Pass
122.00	-0.04	-0.70	0.70	0.16	Pass
123.00	-0.04	-0.70	0.70	0.16	Pass
124.00	-0.04	-0.70	0.70	0.16	Pass
125.00	-0.04	-0.70	0.70	0.16	Pass
126.00	-0.04	-0.70	0.70	0.16	Pass
127.00	-0.04	-0.70	0.70	0.16	Pass
128.00	-0.04	-0.70	0.70	0.16	Pass
129.00	-0.04	-0.70	0.70	0.16	Pass
130.00	-0.04	-0.70	0.70	0.16	Pass
131.00	-0.04	-0.70	0.70	0.16	Pass
132.00	-0.04	-0.70	0.70	0.16	Pass
133.00	-0.04	-0.70	0.70	0.16	Pass
134.00	-0.04	-0.70	0.70	0.16	Pass
135.00	-0.04	-0.70	0.70	0.16	Pass
136.00	-0.04	-0.70	0.70	0.16	Pass
137.00	-0.04	-0.70	0.70	0.16	Pass
138.00	-0.04	-0.70	0.70	0.16	Pass
139.00	-0.04	-0.70	0.70	0.16	Pass
140.00	-0.04	-0.70	0.70	0.16	Pass

– End of measurement results–

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Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1993 (R2006) 8.4.4

Amplitude [dB]	Duration [μs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
137.85	40	Negative Pulse	134.70	133.25	135.26	0.15	Pass
		Positive Pulse	134.70	133.25	135.26	0.15	Pass
	30	Negative Pulse	133.75	133.25	135.26	0.15	Pass
		Positive Pulse	133.71	133.25	135.25	0.15	Pass
— End of measurement results —							

– End of measurement results–

Positive Pulse Crest Factor

200 μs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1993 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
126.85	3	-0.14	± 0.50	0.15 ±	Pass
	5	-0.12	± 1.00	0.16 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
116.85	3	-0.14	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.18	± 1.50	0.15 ±	Pass
106.85	3	-0.14	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.07	± 1.50	0.15 ±	Pass

– End of measurement results–

Negative Pulse Crest Factor

200 μs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1993 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
126.85	3	-0.12	± 0.50	0.15 ±	Pass
	5	-0.12	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
116.85	3	-0.14	± 0.50	0.15 ±	Pass
	5	-0.11	± 1.00	0.15 ±	Pass
	10	-0.17	± 1.50	0.15 ±	Pass
106.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.12	± 1.00	0.15 ±	Pass
	10	-0.07	± 1.50	0.15 ±	Pass

– End of measurement results–

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Certificate Number 2023003632

Gain

Gain measured according to IEC 61672-3:2013 17.3 and 17.4 and ANSI S1.4-2014 Part 3: 17.3 and 17.4

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.96	93.90	94.10	0.15	Pass
0 dB Gain, Linearity	41.13	40.30	41.70	0.16	Pass
OBA Low Range	94.00	93.90	94.10	0.15	Pass
OBA Normal Range	94.00	93.20	94.80	0.15	Pass

Broadband Noise Floor

Self-generated noise measured according to IEC 61672-3:2013 11.2 and ANSI S1.4-2014 Part 3: 11.2

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	27.07	35.00	Pass
C-weight Noise Floor	26.76	35.00	Pass
Z-weight Noise Floor	32.72	39.00	Pass

— End of measurement results—

Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.30	135.05	136.65	0.15	Pass
THD	-66.99	-58.00	-58.00	0.00 ±	Pass
THD+N	-62.98	-58.00	-58.00	0.00 ±	Pass

— End of measurement results—

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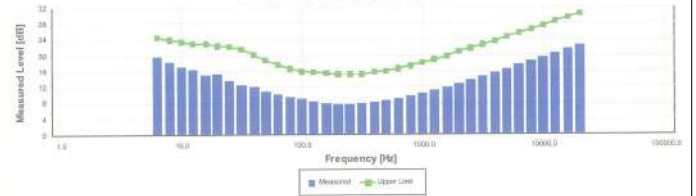
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1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	19.71	24.60	Pass
8.00	18.39	24.00	Pass
10.00	17.27	23.50	Pass
12.50	16.38	23.00	Pass
16.00	15.17	22.90	Pass
20.00	16.37	22.40	Pass
25.00	13.75	22.30	Pass
31.50	12.63	21.50	Pass
40.00	12.07	20.20	Pass
50.00	10.80	18.80	Pass
63.00	10.30	17.60	Pass
80.00	9.46	16.60	Pass
100.00	8.97	15.90	Pass
125.00	8.47	15.70	Pass
160.00	7.89	15.50	Pass
200.00	7.72	15.20	Pass
250.00	7.61	15.20	Pass
315.00	7.89	15.20	Pass
400.00	8.05	15.70	Pass
500.00	8.56	16.00	Pass
630.00	9.04	16.60	Pass
800.00	9.65	17.30	Pass
1,000.00	10.40	18.10	Pass
1,250.00	11.21	18.90	Pass
1,600.00	11.94	19.80	Pass
2,000.00	12.67	20.80	Pass
2,500.00	13.75	21.70	Pass
3,150.00	14.69	22.60	Pass
4,000.00	15.38	23.50	Pass
5,000.00	16.56	24.50	Pass
6,300.00	17.54	25.50	Pass
8,000.00	18.55	26.50	Pass
10,000.00	19.51	27.40	Pass
12,500.00	20.51	28.50	Pass
16,000.00	21.47	29.50	Pass
20,000.00	22.48	30.40	Pass

— End of measurement results—

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Certificate Number 2023003632

Calibration Certificate

Certificate Number 2023003659

Customer:
United Analyst and Engineering Consultant Co Ltd
No. 81 Soi Udonrak 41, Sukhumvit Road,
Bangkok, Ploa Khannag,
Bangkok, 10260, ThailandModel Number: LXT1
Serial Number: 0007302
Test Results: Pass
Initial Condition: As Manufactured
Description: SoundTrack LxT Class 1
Class 1 Sound Level Meter
Firmware Revision: 2.404Procedure Number: D0001.8384
Technician: Jacob Cannon
Calibration Date: 23 Mar 2023
Calibration Due:
Temperature: 23.49 °C ± 0.25 °C
Humidity: 49.6 %RH ± 2.0 %RH
Static Pressure: 98.01 kPa ± 0.13 kPaEvaluation Method: Tested with:
PCB 377802, S/N 344896
Larson Davis PRLxT1, S/N 077657
Larson Davis CAL251, S/N 0106
Larson Davis CAL200, S/N 9079

Data reported in dB re 20 µPa.

Compliance Standards: Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8378:

IEC 60681:2001 Type 1
IEC 60904:2000 Type 1
IEC 61262:2002
IEC 61260:2001 Class 1
IEC 61672:2013 Class 1
ANSI S1.4-2014 Class 1
ANSI S1.4 (R2006) Type 1
ANSI S1.11 (R2009) Class 1
ANSI S1.25 (R2007)
ANSI S1.43 (R2007) Type 1

Issuing lab certifies that the instrument described above meets or exceeds of specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017.

Test results marked with a § in the uncertainties column do not fall within this laboratory's scope of accreditation.

This quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the stability of the test device due to wear, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert LxT, 1770.01 Rev D Supporting Firmware Version 4.0.5, 2019-09-19.

For 1/4" microphones, the Larson Davis ADP024 1/4" to 1/2" adaptor is used with the calibrator and the Larson Davis ADP043 1/4" to

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Certificate Number 2023003659

1/2" adaptor is used with the preamplifier.

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 / ANSIASA S1.4-2014Part 3.

Pattern approval for IEC 61672-1:2013 / ANSIASA S1.4-2014Part 1 successfully completed by Physikalisch-Technische Bundesanstalt (PTB) on 2007-10-09 reference number PTB-1.72-0324218.

The sound level meter submitted for testing successfully completed the periodic tests of IEC 61672-3:2013 / ANSIASA S1.4-2014Part 3, for the environmental conditions under which the tests were performed. As evidence was publicly available, from an independent testing organization responsible for approving the results of pattern-evaluation tests performed in accordance with IEC 61672-2:2013 / ANSIASA S1.4-2014Part 2, to demonstrate that the model of sound level meter fully conformed to the class 1 specifications in IEC 61672-1:2013 / ANSIASA S1.4-2014Part 1; the sound level meter submitted for testing conforms to the class 1 specifications in IEC 61672-1:2013 / ANSIASA S1.4-2014Part 1.

Standards Used			
Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL201 Residual Intensity Calibrator	2023-09-09	2023-09-09	001250
Hart Scientific 2626-II Temperature Probe	2021-06-25	2023-05-25	006798
Larson Davis CAL200 Acoustic Calibrator	2022-07-21	2023-07-21	007027
Larson Davis Model 831	2023-02-22	2024-02-22	007182
PCB 377A13 1/2 inch Pre-polarized Pressure Microphone	2023-03-06	2024-03-06	007185
SRS DS360 Ultra Low Distortion Generator	2023-03-29	2023-03-29	007613
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2023-09-28	2023-09-28	PCB0004793

Acoustic Calibration

Measured according to IEC 61672-3:2013 10 and ANSI S1.4-2014 Part 3: 10

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
1000 Hz	114.01	113.80	114.20	0.14	Pass

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-50.14	-52.44	-48.33	0.14	Pass

— End of measurement results—

Acoustic Signal Tests, C-weighting

Measured according to IEC 61672-3:2013 12 and ANSI S1.4-2014 Part 3: 12 using a comparison coupler with Unit Under Test (UUT) and reference SLM using slow time-weighted sound level for compliance to IEC 61672-1:2013 5.5; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.24	-0.20	-1.20	0.80	0.23	Pass
1000	0.15	0.00	-0.70	0.70	0.23	Pass
8000	-2.72	-3.00	-5.50	-1.50	0.32	Pass

— End of measurement results—

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Certificate Number 2023003659

Self-generated Noise

Measured according to IEC 61672-3:2013 11.1 and ANSI S1.4-2014 Part 3: 11.1

Measurement	Test Result [dB]
A-weighted	40.86

— End of measurement results—

— End of Report—

Signature: Jacob Cannon

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Calibration Certificate

Certificate Number 2023003638

Customer:

United Analyst and Engineering Consultant Co Ltd
No. 81 Soi Udonrak 41, Sukhumvit Road,
Bangkok, Ploa Khaoeng,
Bangkok, 10260, Thailand

Model Number LX11
Serial Number 0507302
Test Results Pass
Initial Condition As Manufactured
Description SoundTrack LX1 Class 1
Class 1 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8378
Technician Jacob Cannon
Calibration Date 23 Mar 2023
Calibration Due
Temperature 23.62 °C ± 0.25 °C
Humidity 50.3 %RH ± 2.0 %RH
Static Pressure 86.12 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLX1 S/N 077637 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

Compliance Standards Compliant to Manufacturer Specifications and the following standards when combined with Calibration Certificate from procedure D0001.8384:

IEC 60651:2001 Type 1	ANSI S1.4-2014 Class 1
IEC 60804:2000 Type 1	ANSI S1.4 (R2006) Type 1
IEC 61252:2002	ANSI S1.25 (R2007)
IEC 61672:2013 Class 1	ANSI S1.43 (R2007) Type 1
IEC 61260:2001 Class 1	ANSI S1.11 (R2009) Class 1

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the International System of Units (SI) through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2017. Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.

The quality system is registered to ISO 9001:2015.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Correction data from Larson Davis LX1 Manual for SoundTrack LX1 & SoundExpert LX1, 1773.01 Rev O Supporting Firmware Version 4.6.5, 2019-09-10

Calibration Check Frequency: 1000 Hz; Reference Sound Pressure Level: 114 dB re 20 µPa

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Certificate Number 2023003638

Standards Used			
Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-II Temperature Probe	2021-09-23	2023-05-25	006798
SRS DS360 Ultra Low Distortion Generator	2022-09-02	2023-09-02	007167

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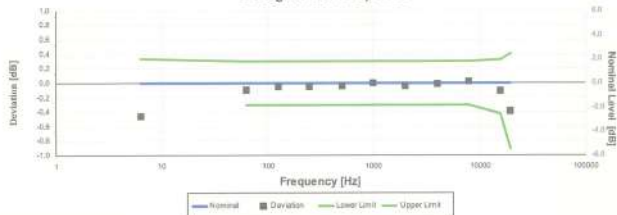
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Certificate Number 2023003635

Z-weight Filter Response



Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60681:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4-1983 (R2006) 5.1 and 8.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.45	-0.45	-1.11	0.33	0.15	Pass
63.10	-0.09	-0.09	-0.30	0.30	0.15	Pass
125.89	-0.05	-0.05	-0.30	0.30	0.15	Pass
251.19	-0.05	-0.05	-0.30	0.30	0.15	Pass
501.19	-0.04	-0.04	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.04	-0.04	-0.30	0.30	0.15	Pass
3,981.07	-0.02	-0.02	-0.30	0.30	0.15	Pass
7,943.28	0.02	0.02	-0.30	0.30	0.15	Pass
15,846.93	-0.11	-0.11	-0.42	0.32	0.15	Pass
19,952.62	-0.39	-0.39	-0.91	0.41	0.15	Pass

-- End of measurement results--

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Certificate Number 2023003635

A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6; IEC 60804:2000 8.2; IEC 61252:2002 8; ANSI S1.4 (R2006) 6.5; ANSI S1.4-2014 Part 1: 5.6; ANSI S1.4-3 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
36.00	0.69	-0.70	0.70	0.16	Pass
37.00	0.51	-0.70	0.70	0.16	Pass
38.00	0.45	-0.70	0.70	0.16	Pass
39.00	0.33	-0.70	0.70	0.16	Pass
40.00	0.23	-0.70	0.70	0.16	Pass
41.00	0.16	-0.70	0.70	0.16	Pass
42.00	0.13	-0.70	0.70	0.16	Pass
43.00	0.11	-0.70	0.70	0.17	Pass
44.00	0.06	-0.70	0.70	0.17	Pass
45.00	0.04	-0.70	0.70	0.16	Pass
46.00	0.03	-0.70	0.70	0.16	Pass
47.00	0.02	-0.70	0.70	0.16	Pass
48.00	-0.01	-0.70	0.70	0.16	Pass
49.00	-0.02	-0.70	0.70	0.16	Pass
50.00	-0.06	-0.70	0.70	0.16	Pass
51.00	-0.05	-0.70	0.70	0.16	Pass
52.00	-0.05	-0.70	0.70	0.16	Pass
53.00	-0.05	-0.70	0.70	0.16	Pass
54.00	-0.05	-0.70	0.70	0.16	Pass
55.00	-0.05	-0.70	0.70	0.16	Pass
56.00	-0.05	-0.70	0.70	0.16	Pass
57.00	-0.05	-0.70	0.70	0.16	Pass
58.00	-0.05	-0.70	0.70	0.16	Pass
59.00	-0.05	-0.70	0.70	0.16	Pass
60.00	-0.05	-0.70	0.70	0.16	Pass
61.00	-0.05	-0.70	0.70	0.16	Pass
62.00	-0.05	-0.70	0.70	0.16	Pass
63.00	-0.05	-0.70	0.70	0.16	Pass
64.00	-0.05	-0.70	0.70	0.16	Pass
65.00	-0.05	-0.70	0.70	0.16	Pass
66.00	-0.05	-0.70	0.70	0.16	Pass
67.00	-0.05	-0.70	0.70	0.16	Pass
68.00	-0.05	-0.70	0.70	0.16	Pass
69.00	-0.05	-0.70	0.70	0.16	Pass
70.00	-0.05	-0.70	0.70	0.16	Pass
71.00	-0.05	-0.70	0.70	0.16	Pass
72.00	-0.05	-0.70	0.70	0.16	Pass
73.00	-0.05	-0.70	0.70	0.16	Pass
74.00	-0.05	-0.70	0.70	0.16	Pass
75.00	-0.05	-0.70	0.70	0.16	Pass
76.00	-0.05	-0.70	0.70	0.16	Pass
77.00	-0.05	-0.70	0.70	0.16	Pass
78.00	-0.05	-0.70	0.70	0.16	Pass
79.00	-0.05	-0.70	0.70	0.16	Pass
80.00	-0.05	-0.70	0.70	0.16	Pass
81.00	-0.05	-0.70	0.70	0.16	Pass
82.00	-0.05	-0.70	0.70	0.16	Pass
83.00	-0.05	-0.70	0.70	0.16	Pass
84.00	-0.05	-0.70	0.70	0.16	Pass
85.00	-0.05	-0.70	0.70	0.16	Pass
86.00	-0.05	-0.70	0.70	0.16	Pass
87.00	-0.05	-0.70	0.70	0.16	Pass
88.00	-0.05	-0.70	0.70	0.16	Pass
89.00	-0.05	-0.70	0.70	0.16	Pass
90.00	-0.05	-0.70	0.70	0.16	Pass
91.00	-0.05	-0.70	0.70	0.16	Pass
92.00	-0.05	-0.70	0.70	0.16	Pass
93.00	-0.05	-0.70	0.70	0.16	Pass
94.00	-0.05	-0.70	0.70	0.16	Pass
95.00	-0.05	-0.70	0.70	0.16	Pass
96.00	-0.05	-0.70	0.70	0.16	Pass
97.00	-0.05	-0.70	0.70	0.16	Pass
98.00	-0.05	-0.70	0.70	0.16	Pass
99.00	-0.05	-0.70	0.70	0.16	Pass
100.00	-0.05	-0.70	0.70	0.16	Pass
101.00	-0.05	-0.70	0.70	0.16	Pass
102.00	-0.05	-0.70	0.70	0.16	Pass
103.00	-0.05	-0.70	0.70	0.16	Pass
104.00	-0.05	-0.70	0.70	0.16	Pass
105.00	-0.05	-0.70	0.70	0.16	Pass
106.00	-0.05	-0.70	0.70	0.16	Pass
107.00	-0.05	-0.70	0.70	0.16	Pass
108.00	-0.05	-0.70	0.70	0.16	Pass
109.00	-0.05	-0.70	0.70	0.16	Pass
110.00	-0.05	-0.70	0.70	0.16	Pass
111.00	-0.05	-0.70	0.70	0.16	Pass
112.00	-0.05	-0.70	0.70	0.16	Pass
113.00	-0.05	-0.70	0.70	0.16	Pass
114.00	-0.05	-0.70	0.70	0.16	Pass
115.00	-0.05	-0.70	0.70	0.16	Pass
116.00	-0.05	-0.70	0.70	0.16	Pass
117.00	-0.05	-0.70	0.70	0.16	Pass
118.00	-0.05	-0.70	0.70	0.16	Pass
119.00	-0.05	-0.70	0.70	0.16	Pass
120.00	-0.05	-0.70	0.70	0.16	Pass
121.00	-0.05	-0.70	0.70	0.16	Pass
122.00	-0.05	-0.70	0.70	0.16	Pass
123.00	-0.05	-0.70	0.70	0.16	Pass
124.00	-0.05	-0.70	0.70	0.16	Pass
125.00	-0.05	-0.70	0.70	0.16	Pass
126.00	-0.05	-0.70	0.70	0.16	Pass
127.00	-0.05	-0.70	0.70	0.16	Pass
128.00	-0.05	-0.70	0.70	0.16	Pass
129.00	-0.05	-0.70	0.70	0.16	Pass
130.00	-0.05	-0.70	0.70	0.16	Pass

-- End of measurement results--

LARSON DAVIS - A PCB DIVISION
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Provo, UT 84601, United States
716-684-0001



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2023-3-27/13/54/02

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Certificate Number 2023003635

Peak Rise Time

Peak rise time performed according to IEC 60681:2001 9.4.4 and ANSI S1.4-1983 (R2006) 8.4.4

Test time and parameters according to test plan since start of test (see test plan for details)							
Amplitude [dB]	Duration [μs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
137.85	40	Negative Pulse	135.39	133.91	135.91	0.15	Pass
		Positive Pulse	136.36	133.88	135.88	0.15	Pass
	30	Negative Pulse	134.11	133.91	135.91	0.15	Pass
		Positive Pulse	134.04	133.88	135.88	0.15	Pass
- End of measurement results							

-- End of measurement results--

Positive Pulse Crest Factor

200 μs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60681:2001 9.4.2 and ANSI S1.4-1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
126.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
116.85	3	-0.12	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.25	± 1.50	0.15 ±	Pass
106.85	3	-0.13	± 0.50	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
	10	-0.22	± 1.50	0.15 ±	Pass

-- End of measurement results--

Negative Pulse Crest Factor

200 μs pulse tests at 2.0, 12.0, 22.0, 32.0 dB below Overload Limit

Crest Factor measured according to IEC 60681:2001 9.4.2 and ANSI S1.4-1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
126.85	3	-0.10	± 0.50	0.15 ±	Pass
	5	-0.10	± 1.00	0.15 ±	Pass
	10	OVLD	± 1.50	0.15 ±	Pass
116.85	3	-0.11	± 0.50	0.15 ±	Pass
	5	-0.10	± 1.00	0.15 ±	Pass
	10	-0.23	± 1.50	0.15 ±	Pass
106.85	3	-0.11	± 0.50	0.15 ±	Pass
	5	-0.11	± 1.00	0.15 ±	Pass
	10	-0.16	± 1.50	0.15 ±	Pass

-- End of measurement results--

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Certificate Number 2023003635

Gain

Gain measured according to IEC 61672-3:2013 17.3 and 17.4 and ANSI S1.4-2014 Part 3: 17.3 and 17.4

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.95	93.90	94.10	0.15	Pass
0 dB Gain Linearity	41.17	40.30	41.70	0.16	Pass
OBA Low Range	94.00	93.90	94.10	0.15	Pass
OBA Normal Range	94.00	93.20	94.80	0.15	Pass

-- End of measurement results--

Broadband Noise Floor

Self-generated noise measured according to IEC 61672-3:2013 11.2 and ANSI S1.4-2014 Part 3: 11.2

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	27.13	36.00	Pass
C-weight Noise Floor	26.92	35.00	Pass
Z-weight Noise Floor	33.10	39.00	Pass

-- End of measurement results--

Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.91	135.05	136.65	0.15	Pass
THD	-66.52	-68.00	-65.00	0.01 ±	Pass
THD+N	-62.48	-64.00	-60.00	0.01 ±	Pass

-- End of measurement results--

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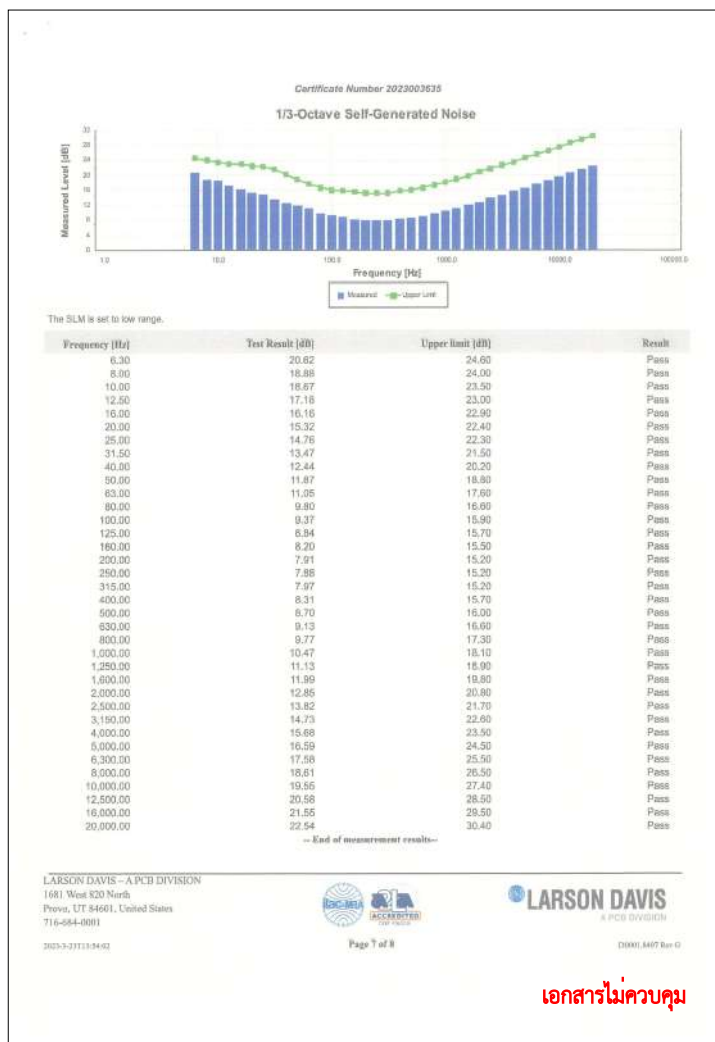


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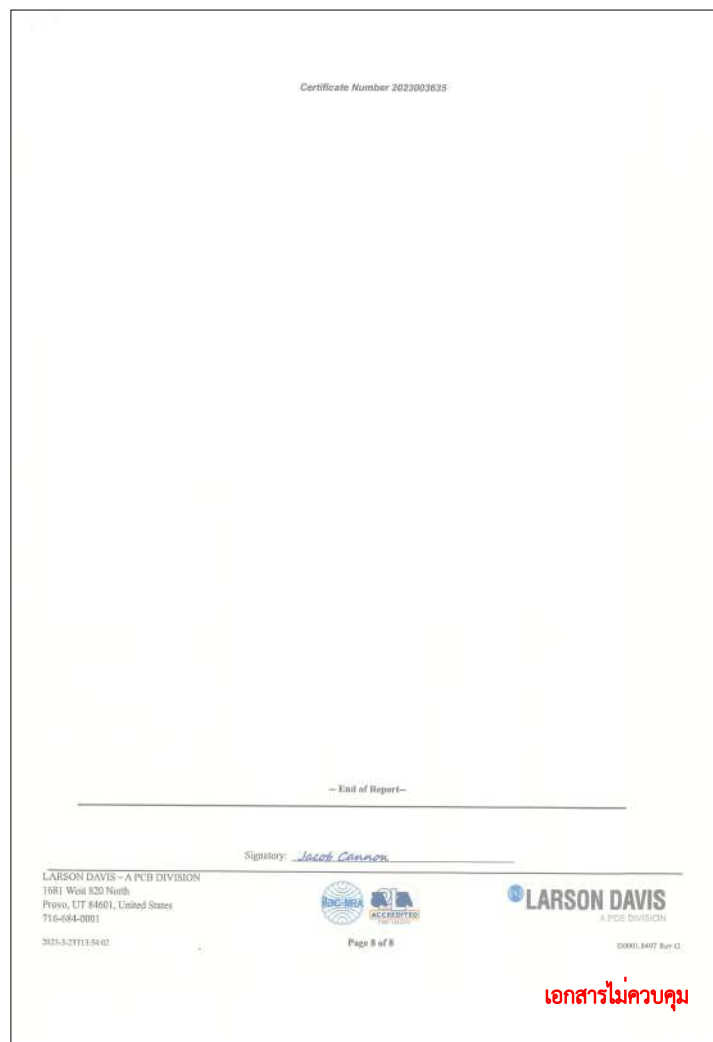
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เอกสารไม่ควบคุม

TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATION FOR EQUIPMENT CALIBRATION AND TESTING SERVICES
5541 PATTAYASARADH ROAD SOI 5, S. 1, ANULANG, HUAJONGKARANG, BANGKOK
TEL : +66 2 5609 70 FAX : 02 5609 654

Cert.No.: 24CH237
Page: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Ecosensa
Model : pH100A
Serial No. : JC03335
ID No. : UAE EFM.052/2562(ENV.pH.02/E2)
Condition As-Received: Used Item
Received Date : 19 February 2024
Calibration Date : 20 February 2024
Reference : 2402-0594WVS-1
Submitted by : United Analytical and Engineering Consultant Co. Ltd.
3 Soi Udonisuk 41, Sukhumvit Road, Bangkok,
Phra Khanong, Bangkok 10260

Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In-house method :
- CP-CH5 by direct measurement with DC Voltage Standard and direct measurement with certified reference material (CRM)
- CP-CH5 by comparison with temperature standard

Calibrated by : Wakjakk Sirithean
Approved by : *Satthip*
Approved Signatory

() Pornthippe Tamsayakul
() Unnopphol Harachai
(x) Satthip Meangmai

Issue Date : 22 February 2024

The Uncertainties are for a confidence probability of approximately 95 %
This certificate requires the use of the 12.1.1.1111 computer program
Appendix 1: The local measurement services : Equipment Calibration and Testing Services

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Cert.No.: 24CH237
Page: 2 of 3

Condition of this calibration result

1. Reference Standard instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030048	130RC116	23E2802	27 Aug 2024
2) Ref. Standard Thermometer	4882054	110RC044	23I908	26 July 2024

This certification is traceable to the International System of Unit maintained through:
- Technology Promotion Association (Thailand-Japan)
- Technology Promotion Association (Thailand-Japan)
- ANSI-ASQ National Accreditation Board, Accredited No. AN-1835

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	940102	27 Nov 2025
pH 6.868	CPA chem	940104	02 Nov 2024
pH 9.997	CPA chem	940108	02 Nov 2024

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 Document Process Calibrator at pH (4.7)(7.10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (mV)	Coverage factor k
			mV	pH		
pH Meter S/N: JC03335	4.00	177.48	177	4.01	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	7.00	0.00	0	7.00	0.58	2.00
	10.00	-177.48	-177	10.01	0.58	2.00

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Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2312-0278WSC-2

Cert. No.: 23LM201
Page: 2 of 2

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-QTO1 according to comparison with Industrial Platinum Resistance Thermometer (IPRT) into Temperature Bath.
The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Digital Thermometer	3240076	231305	TPA	15 Mar 2024

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

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

Remark : TPA Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (°) Without Adjustment

Function : Temperature measurement

This instrument was connected with temperature sensor, ID No.: 9K0EC162

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	60	24.987	25.0	0.003	0.16	2.00
30.0	60	29.995	30.0	0.005	0.16	2.00
35.0	60	34.997	35.0	0.003	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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เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
334-11/11, AN KORN ROAD SOI 11, AN LUANG 3, AN LUANG BANGKOK 10230
TEL: 0-2712 500-29 FAX: 0-2712 500-31



Cert.No.: 23CH1571
Page: 1 of 3

Certificate of Calibration

Equipment : Conductivity Meter
Manufacturer : HANNA
Model : LAQUA-EC210
Serial No. : HQJ00020
ID No. : UAE.EFM.078/2564(EFM.SCT.04/64)
Condition As-Received : Used Item
Received Date : 13 December 2023
Calibration Date : 14 December 2023
Reference : 2312-0277WSC-2
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road
Bangkok, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 5) %
Calibration Procedure :
In-house method :
- CP-CH0 by direct measurement with certified reference material (CRM);
- CP-CHB by comparison with standard thermometer

Calibrated by : Waleak Srinhean

Approved by :
Approved Signatory

(✓) Sathip Meangmai
() Warakorn Lemgagrakul
() Ponpan Paiporn

Issue Date : 18 December 2023

The Uncertainties are for a confidence probability of approximately 95%

This certificate and the associated other documents are the property of the customer. It is to be returned to the customer upon request.

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Cert.No.: 23CH1571
Page: 2 of 3

Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	9549224	130RC003	231435	10 Apr 2024
2) Ref. STD Thermometer	4982054	110RC044	231906	26 July 2024

- This Certificate is traceable to SI Through Technology Promotion Association (Thailand - Japan)

2. Certified Reference Materials :-

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

Conductivity Solution	Manufacturer	Lot No.	Exp. date
1413.0 µS/cm	CPA Chem	931955	30 Sep 2024
12.880 mS/cm	CPA Chem	913597	14 July 2024

- Control Conductivity calibration solution temperature by Water bath (25.0 ± 1) °C

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

Calibration results

Function : Conductivity Measurement

(*) After Adjustment at 1413.0 µS/cm
Conductivity Electrode Serial No.: 985DK0167

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
1413.0 µS/cm	1402 µS/cm	1413 µS/cm	9.2 µS/cm	2.00
12.880 mS/cm	12.30 mS/cm	12.64 mS/cm	0.086 mS/cm	2.00

Remark : - UUC* = Unit Under Calibration

Sathip

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Cert.No.: 23CH1571
Page: 3 of 3

Calibration Results

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9383
- Serial No : 9BOK0167

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 k
25.0	25.001	25.0	-0.001	0.13	2.00
30.0	30.001	30.0	-0.001	0.13	2.00
35.0	35.000	35.1	0.100	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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Sathip

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Certificate of Calibration

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

Certificate No : 23-ACT-117
Request No : Req-2023-1546

Unit Under Calibration Details
Measurement item : Acoustic Calibrator
Manufacturer : SVANTEK
Model : SV 36
Serial Number : 107224
ID : UAE.EFM.171/2564

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

Calibration Environment and Details
Temperature : (23 ±2 °C)
Humidity : (50 ± 20 %RH)
Barometric Pressure : (1013 ±10.0 hPa)
Received Date : 21 July 2023
Calibration Date : 4 August 2023
Location of Calibration : LAB-1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEL	31 May 2024
THD Multimeter	2015	1047765	NIMT	31 January 2024

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. Noppadol Luangart
Service Calibration Engineer

Approved By : Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 4 August 2023

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

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Certificate No : 23-ACT-117
Request No : Req-2023-1546

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	94.03	0.03	-	-	0.13	0.25
114 dB / 1000 Hz	114.11	0.11	-	-	0.13	0.25

Frequency of Sound pressure level		Calibration Results : Without Adjustment				
Calibration Range (Hz)	Measured (Hz)	Without Adjustment (%)		Adjustment (%)		Acceptance limit Class 1 (± %)
		Measured (%)	Error (%)	Measured (%)	Error (%)	
94 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70
114 dB / 1000 Hz	1000.00	0.00	-	-	0.01	0.70

Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)		Calibration Results : Without Adjustment				
Calibration Range (Hz)	Measured (%)	Without Adjustment (%)		Adjustment (%)		Acceptance limit Class 1 (± %)
		Measured (%)	Error (%)	Measured (%)	Error (%)	
94 dB / 1000 Hz	0.26	-	-	-	0.40	2.5
114 dB / 1000 Hz	0.38	-	-	-	0.40	2.5

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

End of Calibration

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

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Certificate of Calibration

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

Certificate No : 23-NDM-268
Request No : Req-2023-1465

Unit Under Calibration Details
Measurement item : Noise Dosimeter
Manufacturer : SVANTEK
Model : SV 104
Serial Number : 110B33
ID : -
Resolution : 0.1 dB

Microphone Class : 2
Microphone Model : SV27
Microphone S/N : 103079
Preamplifier Model : -
Preamplifier S/N : -
Instrument Status : Used

Calibration Environment and Details
Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 5 July 2023
Calibrated Date : 27 October 2023
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2017
Location of Calibration : Lab Acoustic

Instrument	Brand	Model	SN	Due calibration	Traceability
Multifrequency Calibrator	Quest	Quest-cal	188272	25 July 2024	TSI
Standard Microphone	GRAS	40AN	188273	21 August 2024	GRAS
Sine Generator	Svanvik	Svan01	131	9 October 2024	WK Electric
Timer	EXTech	-	05-ACT	20 March 2024	TPA

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

Calibrated By : Mr. Noppadol Luangart
Calibration Office

Approved By : Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 27 October 2023

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

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Certificate No : 23-NDM-268
Request No : Req-2023-1465

1. Absolute acoustical sensitivity							
UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
FAST / A / 55-140	Ref	UUC	Ref	UUC	Error		Limit
Calibrator Setting	(a)	(b)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
1000 Hz 114 dB	120	120	3.18	3.13	-1.57	3.3	-21, +26

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

2. Frequency weightings		Deviation from various Frequency Weighting				UNCERTAINTY		Tolerances
UUC Setting		Frequency Weighting						Limit
FAST / 55-140		A	C					
STD Setting		(dB)	(dB)			(± dB)		(± dB)
*63 Hz		0.2	0.0			0.40		2.0
125 Hz		-0.1	0.0			0.40		1.5
250 Hz		-0.2	-0.1			0.40		1.5
500 Hz		0.0	0.1			0.40		1.5
1000 Hz		0.0	0.0			0.40		-
2000 Hz		0.2	0.3			0.40		2.0
4000 Hz		2.5	2.5			0.40		3.0
8000 Hz		-3.0	-3.1			0.40		3.0

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

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Certificate No : 23-NDM-268
Request No : Req-2023-1465

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting	Ref	FAST / A / High									
		(dB)	55.0	60.0	65.0	70.0	75.0	80.0	85.0	90.0	95.0
1000 Hz	Level A	(dB)	54.7	60.5	66.2	72.0	77.8	83.5	89.3	95.0	100.8
	Error	(dB)	-0.3	0.5	1.2	2.0	2.8	3.5	4.3	5.0	5.8
		(dB)									
8000 Hz	Level A	(dB)				88.9	98.9	108.9	118.9	128.9	138.9
	Error	(dB)									
		(dB)									
63 Hz	Level A	(dB)							87.8	93.8	103.8
	Error	(dB)									
		(dB)									
Tolerances Limit		(dB)	1.0								
UNCERTAINTY		(dB)	0.3								

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
1000 Hz 110 dB	27	27	0.30	0.30	0.00	5.6	-21, +26
1000 Hz 110 dB	45	45	0.50	0.51	+2.00		
1000 Hz 110 dB	90	90	1.00	1.01	+1.00		
1000 Hz 110 dB	180	180	2.00	2.02	+1.00		
1000 Hz 120 dB	36	36	4.00	4.03	+0.75		
1000 Hz 120 dB	72	72	8.00	8.05	+0.63	5.6	-21, +26
1000 Hz 120 dB	90	90	10.00	10.13	+1.30		
1000 Hz 120 dB	180	180	20.00	20.22	+1.10		
1000 Hz 120 dB	360	360	40.00	40.34	+0.85		
1000 Hz 120 dB	720	720	80.00	80.49	+0.61		

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

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Certificate No : 23-NDM-268
Request No : Req-2023-1465

4. Response to short duration

a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(Pa ² h)	(Pa ² h)	(Pa ² h)
Calibrator Setting	(s)	(s)	(Pa ² h)	(Pa ² h)	(Pa ² h)	(Pa ² h)	(Pa ² h)
4000 Hz 95 dB	2846	2846	1.00	1.00	0.00	0.052	-0.29, +0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Burst 1 ms, 95 dB	2846	2846	1.00	1.00	0.00	5.6	-21, +26
Burst 1 ms, 100 dB	900	900	1.00	1.00	0.00		
Burst 1 ms, 105 dB	143	143	1.00	1.01	+1.00		

5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Different		
FAST / A / 55-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Continuous Rectangle +	29	29	10.37	10.37	0.00	3.7	-21, +26
Continuous Rectangle -							

* Indicates non accredited

End of Certificate

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

เอกสารไม่ควบคุม

Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address : 81 Soi Udomsak 41, Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
Certificate No : 23-NDM-178
Request No : Req-2023-1488

Unit Under Calibration Details

Measurement Item : Noise Dosimeter
Manufacturer : SVANTEK
Model : SV 104
Serial Number : 143224
ID : -
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : SV 27
Microphone SN : 132054
Preamplifier Model : -
Preamplifier SN : -
Instrument Status : New

Calibration Environment and Details


Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 12 July 2023
Calibrated Date : 7 August 2023
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2017
Location of Calibration : Lab Acoustic


Reference Standard

Instrument	Brand	Model	SN	Due calibration	Traceability
Multi-frequency Calibrator	Quest	Quest-cal	188272	25 July 2024	TSI
Standard Microphone	GRAS	40AN	188373	6 October 2023	GRAS
Signal Generator	Svantech	Svantech	331	12 October 2023	WK Electric
Timer	EXTECH	-	05-ACT	20 March 2024	TPA

Note

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

Calibrated By : 
Mr. Noppadol Luangrat
Calibration Officer

Approved By : 
Mr. Patch Mallavorn
Calibration Engineer Supervisor
Issue Date : 7 August 2023

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-178
Request No : Req-2023-1488

1. Absolute acoustical sensitivity

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
1000 Hz 114 dB	120	120	3.18	3.13	-1.57	3.1	-21, +26

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

2. Frequency weightings

UUC Setting	Deviation from various Frequency Weighting		UNCERTAINTY	Tolerances
	A	C		
FAST / 55-140	(dB)	(dB)	(± dB)	(± dB)
STD Setting	(dB)	(dB)	(± dB)	(± dB)
50 Hz	0.0	0.1	0.40	2.0
125 Hz	0.3	0.2	0.40	1.5
250 Hz	-0.2	0.3	0.40	1.5
500 Hz	-0.1	0.3	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	-0.1	0.3	0.40	2.0
4000 Hz	2.4	2.5	0.40	3.0
8000 Hz	-2.9	-2.9	0.40	5.0

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เอกสารไม่ควบคุม

Certificate No : 23-NDM-178
Request No : Req-2023-1488

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting	Ref	FAST / A / High									
		(dB)	55.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0
1000 Hz	Level A	(dB)	54.7	80.1	90.2	100.1	110.0	114.0	120.2	130.2	140.2
	Error	(dB)	-0.3	0.1	0.2	0.1	0.0	0.0	0.2	0.2	0.2
8000 Hz	Ref	(dB)									
	Level A	(dB)		88.9	98.9	108.9	112.9	118.9	128.9	138.9	
	Error	(dB)									
63 Hz	Ref	(dB)									
	Level A	(dB)						87.8	93.8	103.8	113.8
	Error	(dB)									
Tolerances Limit		(±dB)	1.0								
UNCERTAINTY		(±dB)	0.3								

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
1000 Hz 110 dB	27	27	0.30	0.30	0.00	5.6	-21 ~ +26
1000 Hz 110 dB	45	45	0.50	0.50	0.00		
1000 Hz 119 dB	90	90	1.00	0.99	-1.00		
1000 Hz 110 dB	180	180	2.00	1.95	-1.00		
1000 Hz 120 dB	36	36	4.00	4.03	+0.75		
1000 Hz 120 dB	72	72	8.00	8.05	+0.63	5.6	-21 ~ +26
1000 Hz 120 dB	90	90	10.00	10.13	+1.30		
1000 Hz 120 dB	180	180	20.00	20.22	+1.10		
1000 Hz 120 dB	360	360	40.00	40.34	+0.85		
1000 Hz 120 dB	720	720	80.00	80.49	+0.61		

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-178
Request No : Req-2023-1488

4. Response to short duration

a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
4000 Hz 95 dB	2846	2846	1.00	1.00	0.00	0.052	-0.29 ~ +0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Burst 1 ms, 95 dB	2846	2846	1.00	1.00	0.00	5.6	-21 ~ +26
Burst 1 ms, 100 dB	800	800	1.00	1.00	0.00		
Burst 1 ms, 108 dB	143	143	1.00	1.01	+1.09		

5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Continuous Rectangle +	29		10.37	10.37	0.00	3.7	-21 ~ +26
Continuous Rectangle -							

* Indicates notes accredited

End of Certificate

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

เอกสารไม่ควบคุม

Certificate of Calibration

Customer

Name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD. Certificate No : 23-NDM-187
Address: 81 Soi Udomsak 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260 Request No : Req-2023-1488

Unit Under Calibration Details

Measurement item : Noise Dosimeter Microphone Class : 2
Manufacturer : SVANTEK Microphone Model : SV 27
Model : SV 104 Microphone S/N : 132041
Serial Number : 143233 Pre-amplifier Model : -
ID : - Pre-amplifier S/N : -
Resolution : 0.1 dB Instrument Status : New

Calibration Environment and Details


Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 12 July 2023
Calibrated Date : 7 August 2023
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2017
Location of Calibration : Lab Acoustic


Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Multi-frequency Calibrator	Quest	Quest-val	188272	25 July 2024	TSI
Standard Microphone	GRAS	40AN	188273	6 October 2023	GRAS
Sine Generator	SvanteK	Svan401	131	12 October 2023	WK Electric
Timer	EXTECH	-	05-ACT	20 March 2024	TPA

Note

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

Calibrated By : 
Mr. Noppadol Luangrat
Calibration Officer

Approved By : 
Mr. Paet Mathavorn
Calibration Engineer Supervisor
Issue Date : 7 August 2023

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-187
Request No : Req-2023-1488

1. Absolute acoustical sensitivity

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
1000 Hz 114 dB	120	120	3.18	3.13	-1.57	3.1	-21 ~ +26

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

2. Frequency weightings

UUC Setting	Deviation from various Frequency Weighting		UNCERTAINTY	Tolerances
	A	C		
FAST / 55-140	(dB)	(dB)	(± dB)	(± dB)
STD Setting	(dB)	(dB)	(± dB)	(± dB)
*63 Hz	0.2	0.3	0.40	2.0
125 Hz	0.0	0.5	0.40	1.5
250 Hz	-0.2	0.3	0.40	1.5
500 Hz	-0.1	0.3	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	-0.1	0.3	0.40	2.0
4000 Hz	0.8	0.9	0.40	3.0
8000 Hz	-1.7	-1.7	0.40	5.0

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เอกสารไม่ควบคุม

Certificate No : 23-NDM-187
Request No : Req-2023-1488

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting	Ref (dB)	FAST / A / High									
		35.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0	
1000 Hz	Level A (dB)	54.7	80.4	90.1	100.0	110.0	114.0	120.0	130.0	140.0	
	Error (dB)	-0.3	0.4	0.1	0.0	0.0	0.0	0.0	0.0	0.0	
8000 Hz	Ref (dB)		88.9	98.9	108.9	118.9	128.9	138.9	148.9		
	Level A (dB)		88.9	98.9	108.9	118.9	128.9	138.9	148.9		
	Error (dB)										
63 Hz	Ref (dB)										
	Level A (dB)										
	Error (dB)										
Tolerances Limit (±dB)		±0.3									
UNCERTAINTY (±dB)		0.3									

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (%)	Tolerances Limit (%)
	Ref	UUC	Ref (Pa ² h)	UUC (Pa ² h)	Error (%)		
FAST / A / 55-140							
Calibrator Setting	(h)	(h)	(Pa ² h)	(Pa ² h)	(%)		
1000 Hz 110 dB	27	27	0.30	0.30	0.00	5.6	-21, +26
1000 Hz 110 dB	45	45	0.50	0.50	0.00		
1000 Hz 110 dB	90	90	1.00	0.99	-1.00		
1000 Hz 110 dB	180	180	2.00	2.02	+1.00		
1000 Hz 120 dB	36	36	4.00	4.03	+0.75		
1000 Hz 120 dB	72	72	8.00	8.05	+0.63	5.6	-21, +26
1000 Hz 120 dB	90	90	10.00	9.90	-1.00		
1000 Hz 120 dB	180	180	20.00	20.22	+1.10		
1000 Hz 120 dB	360	360	40.00	40.34	+0.85		
1000 Hz 120 dB	720	720	80.00	80.49	+0.61		

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เอกสารไม่ควบคุม

Certificate No : 23-NDM-187
Request No : Req-2023-1488

4. Response to short duration

a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (Pa ² h)	Tolerances Limit (Pa ² h)
	Ref	UUC	Ref (Pa ² h)	UUC (Pa ² h)	Error (Pa ² h)		
FAST / A / 55-140							
Calibrator Setting	(h)	(h)	(Pa ² h)	(Pa ² h)	(Pa ² h)		
4000 Hz 95 dB	2846	2846	1.00	1.00	0.00	0.032	-0.29 - +0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (%)	Tolerances Limit (%)
	Ref	UUC	Ref (Pa ² h)	UUC (Pa ² h)	Error (%)		
FAST / A / 55-140							
Calibrator Setting	(h)	(h)	(Pa ² h)	(Pa ² h)	(%)		
Burst 1 ms, 95 dB	2846	2846	1.00	1.00	0.00	5.6	-21 - +26
Burst 1 ms, 100 dB	900	900	1.00	1.00	0.00		-29 - +41
Burst 1 ms, 108 dB	143	143	1.00	1.01	+1.00		-29 - +41

5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (%)	Tolerances Limit (%)
	Ref	UUC	Ref (Pa ² h)	UUC (Pa ² h)	Different (%)		
FAST / A / 55-140							
Calibrator Setting	(h)	(h)	(Pa ² h)	(Pa ² h)	(%)		
Continuous Rectangle +			10.13			3.7	-21 - +26
Continuous Rectangle -	20		10.13		0.00		

* Indicates non accredited

End of Certificate

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

เอกสารไม่ควบคุม

Certificate of Calibration

Customer
Name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 81 Soi Udonnith 41, Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
Certificate No : 23-NDM-177
Request No : Req-2023-1488

Unit Under Calibration Details

Measurement item : Noise Dosimeter
Manufacturer : SVANTEK
Model : SV 1045
Serial Number : 131127
ID : -
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : SV 2755
Microphone S/N : 136428
Preamplifier Model : -
Preamplifier S/N : -
Instrument Status : New

Calibration Environment and Details


Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 12 July 2023
Calibrated Date : 7 August 2023
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2013
Location of Calibration : Lab Acoustic


Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Multi-frequency Calibrator	Quest	Quest val	183272	25 July 2024	TSI
Standard Microphone	GRAS	40AN	183273	6 October 2023	GRAS
Sine Generator	SvanteK	Svm401	331	12 October 2023	WK Electric
Timer	EXTech	-	05-ACT	20 March 2024	TPA

Note

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

Calibrated By : 
Mr. Noppadon Luangrat
Calibration Officer

Approved By : 
Mr. Paiti Mathavorn
Calibration Engineer Supervisor
Issue Date : 7 August 2023

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-177
Request No : Req-2023-1488

1. Absolute acoustical sensitivity

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (%)	Tolerances Limit (%)
	Ref	UUC	Ref (Pa ² h)	UUC (Pa ² h)	Error (%)		
FAST / A / 60-140							
Calibrator Setting	(h)	(h)	(Pa ² h)	(Pa ² h)	(%)		
1000 Hz 114 dB	120	120	3.18	3.20	+0.63	3.1	-21, +26

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

2. Frequency weightings

UUC Setting	Deviation from various Frequency Weighting		UNCERTAINTY (± dB)	Tolerances Limit (± dB)
	A	C		
FAST / 60-140				
STD Setting (dB)				
*63 Hz	0.1	0.2	0.40	2.0
125 Hz	0.1	0.4	0.40	1.5
250 Hz	-0.2	0.3	0.40	1.5
500 Hz	-0.3	0.3	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	-0.3	0.1	0.40	2.0
4000 Hz	1.0	0.8	0.40	3.0
8000 Hz	-1.4	-1.3	0.40	3.0

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-177
Request No : Req-2023-1488

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting	Ref	(dB)	FAST / A / High									
			60.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0	
1000 Hz	Level A	(dB)	60.4	80.3	90.1	100.0	110.0	114.0	120.0	130.0	140.0	
	Error	(dB)	0.4	0.3	0.1	0.0	0.0	0.0	0.0	0.0	0.0	
8000 Hz	Ref	(dB)				86.9	98.9	108.9	112.9	118.9	128.9	138.9
	Level A	(dB)				86.9	98.9	108.9	112.9	118.9	128.9	138.9
	Error	(dB)				0.0	0.0	0.0	0.0	0.0	0.1	0.2
63 Hz	Ref	(dB)							87.8	93.8	101.8	111.8
	Level A	(dB)							87.8	93.8	101.8	111.8
	Error	(dB)							0.0	0.0	0.0	0.0
Tolerances Limit		(±dB)	1.0									
UNCERTAINTY		(±dB)	0.3									

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 60-140	(s)	(s)	(Pa ² ·h)	(Pa ² ·h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² ·h)	(Pa ² ·h)	(%)	(%)	(%)
1000 Hz 110 dB	27	27	0.30	0.30	0.00	5.6	-21, +26
1000 Hz 110 dB	45	45	0.50	0.50	0.00		
1000 Hz 110 dB	90	90	1.00	0.99	-1.00		
1000 Hz 110 dB	180	180	2.00	1.98	-1.00		
1000 Hz 120 dB	36	36	4.00	3.94	-1.50		
1000 Hz 120 dB	72	72	8.00	7.87	-1.63	5.6	-21, +26
1000 Hz 120 dB	90	90	10.00	9.90	-1.00		
1000 Hz 120 dB	180	180	20.00	19.76	-1.20		
1000 Hz 120 dB	360	360	40.00	39.42	-1.45		
1000 Hz 120 dB	720	720	80.00	78.66	-1.68		

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-177
Request No : Req-2023-1488

4. Response to short duration

a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 60-140	(s)	(s)	(Pa ² ·h)	(Pa ² ·h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² ·h)	(Pa ² ·h)	(%)	(%)	(%)
4000 Hz 95 dB	2846	2846	1.00	1.00	0.00	0.052	-0.29 ~ +0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 60-140	(s)	(s)	(Pa ² ·h)	(Pa ² ·h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² ·h)	(Pa ² ·h)	(%)	(%)	(%)
Burst 1 ms, 95 dB	2846	2846	1.00	1.00	0.00	5.6	-21 ~ +26
Burst 1 ms, 100 dB	900	900	1.00	1.00	0.00		-29 ~ +41
Burst 1 ms, 108 dB	143	143	1.00	1.01	+1.00		-29 ~ +41

5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Different		
FAST / A / 60-140	(s)	(s)	(Pa ² ·h)	(Pa ² ·h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² ·h)	(Pa ² ·h)	(%)	(%)	(%)
Continuous Rectangle +	28		10.13		0.00	3.7	-21 ~ +26
Continuous Rectangle -			10.13				

* Indicates non accredited

End of Certificate

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

เอกสารไม่ควบคุม

Certificate of Calibration

Customer
Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address : 81 Soi Udomrak 41, Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
Certificate No : 23-NDM-105
Request No : Req-2023-0951

Unit Under Calibration Details

Measurement item : Noise Dosimeter
Manufacturer : SVANTER
Model : SV 104
Serial Number : 117596
ID : -
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : SV 27
Microphone S/N : 112004
Preamplifier Model : -
Preamplifier S/N : -
Instrument Status : Used

Calibration Environment and Details


Temperature : 23.7 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 4 May 2023
Calibrated Date : 12 May 2023
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252: 2017
Location of Calibration : Lab Acoustic


Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Multi-frequency Calibrator	Quest	Quest-cal	188272	29 June 2023	TSI
Standard Microphone	GRAS	40AN	188273	6 October 2023	GRAS
Sine Generator	Svanick	Svan401	131	12 October 2023	WK Electric
Timer	EXTECH	-	05-ACCT	20 March 2024	TPA

Note

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

Calibrated By : 
Mr. Nopadon Luangman
Calibration Officer

Approved By : 
Mr. Pait Mahavorn
Calibration Engineer Supervisor
Issue Date : 12 May 2023

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-105
Request No : Req-2023-0951

1. Absolute acoustical sensitivity

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140	(s)	(s)	(Pa ² ·h)	(Pa ² ·h)	(%)	(%)	(%)
Calibrator Setting	(s)	(s)	(Pa ² ·h)	(Pa ² ·h)	(%)	(%)	(%)
1000 Hz 114 dB	120	120	3.19	3.20	+0.31	3.1	-21, +26

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTER, Model SV 35A, S/N: 58079.

2. Frequency weightings

UUC Setting	Deviation from various Frequency Weighting		UNCERTAINTY	Tolerances
	A	C		
FAST / 55-140	(dB)	(dB)	(± dB)	(± dB)
STD Setting	(dB)	(dB)	(± dB)	(± dB)
*63 Hz	-0.1	-0.2	0.40	2.0
125 Hz	-0.8	-0.3	0.40	1.5
250 Hz	-0.4	0.1	0.40	1.5
500 Hz	-0.1	0.3	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	-0.1	0.3	0.40	2.0
4000 Hz	1.7	1.8	0.40	3.0
8000 Hz	-2.2	-2.3	0.40	5.0

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-105
Request No : Req-2023-0951

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting	Ref	(dB)	FAST / A / High									
			55.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0	
1000 Hz	Level A	(dB)	54.4	80.1	90.2	100.0	110.0	114.0	120.0	130.0	140.0	
	Error	(dB)	0.5	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	
8000 Hz	Ref	(dB)	88.9	98.9	108.9	112.9	118.9	128.9	138.9			
	Level A	(dB)	88.9	98.9	108.9	112.9	118.9	128.9	138.9			
	Error	(dB)										
63 Hz	Ref	(dB)										
	Level A	(dB)										
	Error	(dB)										
Tolerances Limit			1.0									
UNCERTAINTY			0.3									

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140							
Calibrator Setting	(s)	(s)	(Pa ² /h)	(Pa ² /h)	(%)	(%)	(%)
1000 Hz 110 dB	27	27	0.30	0.30	0.00		
1000 Hz 110 dB	45	45	0.50	0.50	0.00		
1000 Hz 110 dB	90	90	1.00	0.99	-1.00	5.6	
1000 Hz 110 dB	180	180	2.00	1.98	-1.00		
1000 Hz 120 dB	36	36	4.00	4.03	+0.75		
1000 Hz 120 dB	72	72	8.00	8.05	+0.63		
1000 Hz 120 dB	90	90	10.00	10.12	+1.20		
1000 Hz 120 dB	180	180	20.00	20.22	+1.10	5.6	
1000 Hz 120 dB	360	360	40.00	40.34	+0.85		
1000 Hz 120 dB	720	720	80.00	80.49	+0.61		

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-105
Request No : Req-2023-0951

4. Response to short duration

a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140							
Calibrator Setting	(s)	(s)	(Pa ² /h)	(Pa ² /h)	(%)	(%)	(%)
4000 Hz 95 dB	2846	2846	1.00	1.00	0.00	0.052	-0.29 ~ +0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 55-140							
Calibrator Setting	(s)	(s)	(Pa ² /h)	(Pa ² /h)	(%)	(%)	(%)
Burst 1 ms, 95 dB	2846	2846	1.00	1.00	0.00		-21 ~ +26
Burst 1 ms, 100 dB	900	900	1.00	1.00	0.00	5.6	-29 ~ +41
Burst 1 ms, 105 dB	143	143	1.00	1.01	+1.00		-29 ~ +41

5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Different		
FAST / A / 55-140							
Calibrator Setting	(s)	(s)	(Pa ² /h)	(Pa ² /h)	(%)	(%)	(%)
Continuous Rectangle +			10.37				
Continuous Rectangle -	29		10.37		0.00	3.7	-21 ~ +26

* Indicates non accredited

End of Certificate

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

เอกสารไม่ควบคุม

Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address : 81 Soi Udomsak 41, Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
Certificate No : 23-NDM-174
Request No : Req-2023-1488

Unit Under Calibration Details

Measurement item : Noise Desimeter
Manufacturer : SVANTER
Model : SV 10415
Serial Number : 131124
ID :
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : SV 2705
Microphone S/N : 136416
Preamplifier Model : -
Preamplifier S/N : -
Instrument Status : New

Calibration Environment and Details


Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 12 July 2023
Calibrated Date : 7 August 2023
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2017
Location of Calibration : Lab Acoustic


Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Multifrequency Calibrator	Quest	Quest-cal	188272	25 July 2024	TSI
Standard Microphone	GRAS	40AN	188273	6 October 2023	GRAS
Sine Generator	Scantek	Scantek01	131	12 October 2022	WK Electric
Timer	EXTech	-	95-ACT	20 March 2024	TPA

Note

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

Calibrated By : 
Mr. Noppidon Luangrat
Calibration Officer

Approved By : 
Mr. Pachi Mathasoom
Calibration Engineer Supervisor
Issue Date : 7 August 2023

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-174
Request No : Req-2023-1488

1. Absolute acoustical sensitivity

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 60-140							
Calibrator Setting	(s)	(s)	(Pa ² /h)	(Pa ² /h)	(%)	(%)	(%)
1000 Hz 114 dB	120	120	3.18	3.13	-1.57	3.1	-21, -26

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

2. Frequency weightings

UUC Setting	Deviation from various Frequency Weighting		UNCERTAINTY	Tolerances
	A	C		
FAST / 60-140	(dB)	(dB)	(± dB)	(± dB)
STD Setting				
50 Hz	0.5	0.6	0.40	2.0
125 Hz	0.2	0.6	0.40	1.5
250 Hz	0.2	0.7	0.40	1.5
500 Hz	0.2	0.6	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	-0.2	0.2	0.40	2.0
4000 Hz	1.0	0.8	0.40	3.0
8000 Hz	-1.2	-1.1	0.40	5.0

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เอกสารไม่ควบคุม

Certificate No : 23-NDM-174
Request No : Req-2023-1488

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting	Ref	FAST / A / High									
		(dB)	50.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0
1000 Hz	Level A	(dB)	60.1	80.0	90.1	100.0	110.0	114.0	120.0	130.0	140.0
	Error	(dB)	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0
8000 Hz	Ref	(dB)				88.9	98.9	108.9	112.9	118.9	128.9
	Level A	(dB)				88.9	98.9	108.9	112.9	118.9	128.9
	Error	(dB)				0.0	0.0	0.0	0.0	0.0	0.0
63 Hz	Ref	(dB)							87.8	93.8	103.8
	Level A	(dB)							87.8	93.8	103.8
	Error	(dB)							0.0	0.0	0.0
Tolerances Limit		(±dB)	1.0								
UNCERTAINTY		(±dB)	0.3								

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
FAST / A / 60-140	Ref	UUC	Ref	UUC	Error		Limit
Calibrator Setting	(s)	(s)	(Pa² h)	(Pa² h)	(%)	(%)	(%)
1000 Hz 110 dB	27	27	0.30	0.30	0.00	5.6	-21, +26
1000 Hz 110 dB	45	45	0.50	0.50	0.00		
1000 Hz 110 dB	90	90	1.00	0.99	-1.00		
1000 Hz 110 dB	180	180	2.00	1.95	-1.00		
1000 Hz 120 dB	36	36	4.00	4.03	+0.75		
1000 Hz 120 dB	72	72	8.00	8.05	+0.63	5.6	
1000 Hz 120 dB	90	90	10.00	9.90	-1.00		
1000 Hz 120 dB	180	180	20.00	20.22	+1.10		
1000 Hz 120 dB	360	360	40.00	40.34	+0.85		
1000 Hz 120 dB	720	720	80.00	80.49	+0.61		

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-174
Request No : Req-2023-1488

4. Response to short duration

a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 60-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting							
4000 Hz 95 dB	2846	2846	1.00	1.00	0.00	0.052	-0.29 ~ +0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 60-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting							
Burst 1 ms, 95 dB	2846	2846	1.00	1.00	0.00	5.6	-21 ~ +26
Burst 1 ms, 100 dB	900	900	1.00	1.00	0.00		-29 ~ +41
Burst 1 ms, 108 dB	143	143	1.00	1.01	-1.00		-29 ~ +41

5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Different		
FAST / A / 60-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting							
Continuous Rectangle +	28		10.13		0.00	3.7	-21 ~ +26
Continuous Rectangle -			10.13				

* Indicates non accredited

End of Certificate

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

เอกสารไม่ควบคุม

Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Name : 81 Soi Udonsook 41, Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260
Address :
Certificate No : 23-NDM-093
Request No : Req-2023-0902

Unit Under Calibration Details

Measurement item : Noise Dosimeter
Microphone Class : 2
Manufacturer : SVANTEK
Microphone Model : SV 2715
Model : SV 1040S
Microphone S/N : 88645
Serial Number : 128472
Preamplifier Model : -
ID : -
Preamplifier S/N : -
Resolution : 0.1 dB
Instrument Status : New

Calibration Environment and Details

Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 25 April 2023
Calibrated Date : 9 May 2023
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2017
Location of Calibration : Lab Acoustic

Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Multi-frequency Calibrator	Quest	Quest-cal	188272	29 June 2023	TSI
Standard Microphone	GRAS	40AN	188273	6 October 2023	GRAS
Sine Generator	Svanick	Svan901	131	12 October 2022	WK Electric
Timer	EXTECH	-	05-ACT	20 March 2024	TPA

Note:

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

Calibrated By : 
Mr. Niapadon Laungam
Calibration Officer

Approved By : 
Mr. Pachi Mathavom
Calibration Engineer Supervisor
Issue Date : 9 May 2023

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-093
Request No : Req-2023-0902

1. Absolute aoustical sensitivity

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances
	Ref	UUC	Ref	UUC	Error		
FAST / A / 60-140	(s)	(s)	(Pa ² h)	(Pa ² h)	(%)	(%)	(%)
Calibrator Setting							
1000 Hz 114 dB	120	120	3.19	3.13	-1.88	3.1	-21 ~ +26

Note : Absolute sensitivity was established by the use of Sound Calibrator brand SVANTEK, Model SV 35A, SN. S8079.

2. Frequency weightings

UUC Setting	Deviation from various Frequency Weighting		UNCERTAINTY	Tolerances
	A	C		
FAST / 60-140	(dB)	(dB)	(± dB)	(± dB)
STD Setting				
*63 Hz	0.4	0.5	0.40	2.0
125 Hz	-0.2	0.2	0.40	1.5
250 Hz	-0.2	0.3	0.40	1.5
500 Hz	-0.1	0.3	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	0.1	0.5	0.40	2.0
4000 Hz	0.6	0.4	0.40	3.0
8000 Hz	-0.8	-0.7	0.40	5.0

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-093
Request No : Req-2023-0902

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting	Ref (dB)	FAST / A / High									
		60.0	80.0	90.0	100.0	110.0	120.0	130.0	140.0	150.0	160.0
1000 Hz	Level A	(dB)	60.4	80.4	90.2	100.1	110.1	120.0	130.0	140.0	150.0
	Error	(dB)	0.4	0.4	0.2	0.1	0.1	0.0	0.0	0.0	0.0
8000 Hz	Ref	(dB)	88.9	98.9	108.9	118.9	128.9	138.9	148.9	158.9	168.9
	Level A	(dB)									
	Error	(dB)									
63 Hz	Ref	(dB)					87.8	93.8	103.8	113.8	123.8
	Level A	(dB)									
	Error	(dB)									
Tolerances Limit		(±dB)	±0.3								
UNCERTAINTY		(±dB)	0.3								

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (%)	Tolerances Limit (%)
	Ref	UUC	Ref (Pa ¹ h)	UUC (Pa ¹ h)	Error (%)		
FAST / A / 60-140							
Calibrator Setting	(h)	(h)					
1000 Hz 110 dB	27	27	0.30	0.30	0.00		
1000 Hz 110 dB	45	45	0.50	0.50	0.00		
1000 Hz 110 dB	90	90	1.00	0.99	-1.00	5.8	-21, +26
1000 Hz 110 dB	180	180	2.00	1.98	-1.00		
1000 Hz 120 dB	36	36	4.00	4.03	+0.75		
1000 Hz 120 dB	72	72	8.00	8.05	+0.63		
1000 Hz 120 dB	90	90	10.00	10.13	+1.30		
1000 Hz 120 dB	180	180	20.00	20.22	+1.10	5.8	-21, +26
1000 Hz 120 dB	360	360	40.00	40.34	+0.85		
1000 Hz 120 dB	720	720	80.00	80.49	+0.61		

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-093
Request No : Req-2023-0902

4. Response to short duration

a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (%)	Tolerances Limit (%)
	Ref	UUC	Ref (Pa ¹ h)	UUC (Pa ¹ h)	Error (Pa ¹ h)		
FAST / A / 60-140							
Calibrator Setting	(h)	(h)					
4000 Hz 95 dB	2848	2848	1.00	1.00	0.00	0.052	-0.29 - +0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (%)	Tolerances Limit (%)
	Ref	UUC	Ref (Pa ¹ h)	UUC (Pa ¹ h)	Error (%)		
FAST / A / 60-140							
Calibrator Setting	(h)	(h)					
Burst 1 ms, 95 dB	2848	2848	1.00	1.00	0.00		-21 - +26
Burst 1 ms, 100 dB	900	900	1.00	1.00	0.00	5.8	-29 - +41
Burst 1 ms, 108 dB	143	143	1.00	1.01	+1.00		-29 - +41

5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (%)	Tolerances Limit (%)
	Ref	UUC	Ref (Pa ¹ h)	UUC (Pa ¹ h)	Error (%)		
FAST / A / 60-140							
Calibrator Setting	(h)	(h)					
Continuous Rectangle +			10.13				
Continuous Rectangle -	29		10.13		0.00	3.7	-21 - +26

* Indicates non accredited

End of Certificate

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

เอกสารไม่ควบคุม

Certificate of Calibration

Customer
Name : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Prakanong, Bangkok 10250
Certificate No : 23-NDM-181
Request No : Req-2023-1488

Unit Under Calibration Details

Measurement item : Noise Dosimeter
Manufacturer : SVANTEK
Model : SV 104
Serial Number : 143227
ID : -
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : SV 27
Microphone S/N : 103025
Preamplifier Model : -
Preamplifier S/N : -
Instrument Status : New

Calibration Environment and Details

Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 12 July 2023
Calibrated Date : 7 August 2023
Calibration Procedure : In-house method CP-NDM-01 based on IEC 61252 : 2017
Location of Calibration : Lab Acoustic

Reference Standard

Instrument	Brand	Model	S/N	Due calibration	Traceability
Multi-frequency Calibrator	Quest	Quest-cal	188272	25 July 2024	TSI
Standard Microphone	GRAS	40AN	188273	6 October 2023	GRAS
Sine Generator	Svantech	Svsn401	131	12 October 2023	WK Electric
Timer	EXTECH	-	05-ACT	20 March 2024	TPA

Note

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

Calibrated By : 
Mr. Noppadol Luangrat
Calibration Officer
Approved By : 
Mr. Paitit Mathavorn
Calibration Engineer Supervisor
Issue Date : 7 August 2023

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-181
Request No : Req-2023-1488

1. Absolute acoustical sensitivity

UUC Setting	Time		Exposure Measurement			UNCERTAINTY (%)	Tolerances Limit (%)
	Ref	UUC	Ref (Pa ¹ h)	UUC (Pa ¹ h)	Error (%)		
FAST / A / 55-140							
Calibrator Setting	(h)	(h)					
1000 Hz 114 dB	120	120	3.18	3.13	-1.57	3.1	-21, +26

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

2. Frequency weightings

UUC Setting	Deviation from various Frequency Weighting		UNCERTAINTY (± dB)	Tolerances Limit (± dB)
	A	C		
FAST / 55-140				
STD Setting	(dB)	(dB)		
63 Hz	0.2	0.3	0.40	2.0
125 Hz	-0.1	0.4	0.40	1.5
250 Hz	-0.4	0.1	0.40	1.5
500 Hz	-0.2	0.2	0.40	1.5
1000 Hz	0.0	0.0	0.40	-
2000 Hz	0.5	0.7	0.40	2.0
4000 Hz	1.9	2.0	0.40	3.0
8000 Hz	-2.2	-2.2	0.40	5.0

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

เอกสารไม่ควบคุม

Certificate No : 23-NDM-181
Request No : Req-2023-1488

3. Linearity of response to steady signals

a. Sound exposure meter, linearity of response for changes of input sinusoidal signal level

UUC Setting	Ref	[dB]	FAST / A / High									
			55.0	80.0	90.0	100.0	110.0	114.0	120.0	130.0	140.0	
1000 Hz	Level A	[dB]	54.9	80.4	90.1	100.1	110.0	114.0	120.0	130.0	140.0	
	Error	[dB]	-0.1	0.4	0.1	0.1	0.0	0.0	0.0	0.0	0.0	
8000 Hz	Ref	[dB]										
	Level A	[dB]										
	Error	[dB]										
63 Hz	Ref	[dB]										
	Level A	[dB]										
	Error	[dB]										
Tolerances Limit			1.0									
UNCERTAINTY			0.3									

b. Sound exposure meter linearity of error

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances Limit
	Ref	UUC	Ref (Pa ² h)	UUC (Pa ² h)	Error (%)		
FAST / A / 55-140	(s)	(s)					
Calibrator Setting							
1000 Hz 110 dB	27	27	0.30	0.30	0.00		
1000 Hz 110 dB	45	45	0.50	0.51	+2.00		
1000 Hz 110 dB	90	90	1.00	1.01	+1.00	5.6	
1000 Hz 110 dB	180	180	2.00	2.02	+1.00		
1000 Hz 120 dB	36	36	4.00	4.03	+0.75		
1000 Hz 120 dB	72	72	8.00	8.05	+0.63		
1000 Hz 120 dB	90	90	10.00	10.13	+1.30		
1000 Hz 120 dB	180	180	20.00	20.22	+1.10	5.6	
1000 Hz 120 dB	360	360	40.00	40.34	+0.85		
1000 Hz 120 dB	720	720	80.00	80.49	+0.61		

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Certificate No : 23-NDM-181
Request No : Req-2023-1488

4. Response to short duration

a. Response for sinusoidal signals - reference level

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances Limit
	Ref	UUC	Ref (Pa ² h)	UUC (Pa ² h)	Error (%)		
FAST / A / 55-140	(s)	(s)					
Calibrator Setting							
4000 Hz 95 dB	2846	2846	1.00	1.00	0.00	0.052	-0.29 ~ +0.41

b. Sound exposure meter response for series of toneburst impulses

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances Limit
	Ref	UUC	Ref (Pa ² h)	UUC (Pa ² h)	Error (%)		
FAST / A / 55-140	(s)	(s)					
Calibrator Setting							
Burst 1 ms, 95 dB	2846	2846	1.00	1.00	0.00		-21 ~ +26
Burst 1 ms, 100 dB	900	900	1.00	1.00	0.00	5.6	-29 ~ +41
Burst 1 ms, 108 dB	143	143	1.00	1.01	+1.00		-29 ~ +41

5. Response to unipolar pulse

UUC Setting	Time		Exposure Measurement			UNCERTAINTY	Tolerances Limit
	Ref	UUC	Ref (Pa ² h)	UUC (Pa ² h)	Different (%)		
FAST / A / 55-140	(s)	(s)					
Calibrator Setting							
Continuous Rectangle +			10.37				
Continuous Rectangle -	29		10.37		0.00	3.7	-21 ~ +26

* Indicates non accredited

End of Certificate

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Certificate of Calibration

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

Certificate No : 23-AFM-146
Request No : Req-2023-1509

Unit Under Calibration Details

Measurement Item : Primary Flow Calibrator
Manufacturer : TSI
Model : 4146
Serial Number : 4146327004
ID : -

Sensor Model : -
Sensor Serial Number : -

Location of Calibration : LAB 4 AIR VELOCITY METER

Calibration Environment and Details

Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 20 %RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 18 July 2023
Calibration Date : 24 July 2023

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


Reference Standard	Model	Serial Number	Traceable	Due Calibration
Air Flow Meter	Gilibrator 3 Standard flow	19031011003	Sensidyne	11 July 2024
Temperature meter	GT 11	12008077	Qtechom	27 February 2024
Pressure meter	CPG2400	41000KDU/851882	TPA	7 November 2023


Traceability :

This Certificate is traceable to SI Unit through Sensidyne A2LA Accreditation No. 3943.01

Note :

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

Calibration By : 
Mr. Nipaporn Luangut
Service Calibration Engineer

Approved By : 
Mr. Pacit Mathavorn
Calibration Engineer Supervisor
Issue Date : 24 July 2023

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

เอกสารไม่ควบคุม

Certificate No : 23-AFM-146
Request No : Req-2023-1509

Result of Calibration :

Temperature	Pressure	STD	UUC	Error	Uncertainty
(°C)	(kPa)	(L/min)	(L/min)	(L/min)	(L/min)
24.60	100.46	0.020	0.020	0.000	0.001
24.70	100.46	0.050	0.051	0.001	0.003
24.70	100.46	0.101	0.101	0.000	0.003
24.70	100.46	0.201	0.201	0.000	0.006
24.70	100.46	0.504	0.506	0.002	0.007
24.70	100.43	1.003	0.998	-0.015	0.014
24.70	100.46	1.703	1.684	-0.019	0.024
24.70	100.46	2.003	1.984	-0.019	0.028
24.70	100.44	3.006	2.987	-0.019	0.041
24.70	100.45	4.008	3.979	-0.029	0.055
24.60	100.45	5.007	4.976	-0.031	0.069

Note

- STD : Standard
- UUC : Unit Under Calibration
- UUC Reference Condition : At atmospheric pressure and room temperature condition
- Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{meas} = Q_{ref} \times \frac{P_{ref}}{P_{meas}} \times \frac{T_{meas}}{T_{ref}}$$

where : Q = Flow Rate P = Absolute Pressure T = Absolute Temperature
Meas = Measurement Condition ref = Standard Condition

* Indicates non accredited

End of Certificate

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
53/44 PATTANAKARN ROAD SOI 14, SUANLUANG, SUANLUANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 23H1102
Page: 1 of 2

Equipment: Digital Thermo-Hygrometer
Manufacturer: Digicon
Model: TH-02
Serial No.: 395034174

ID No.: UAE EFM.185/2565

Condition As-Received: Used Item

Received Date: 18 May 2023

Calibration Date: 22 May 2023

Reference: 2305-0641WSC

Ambient Temperature: (25 ± 3) °C

Relative Humidity: (50 ± 20) %

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

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

81 Soi Udomsak 41, Sukhumvit Road, Bangkok,
Phra Khanong, Bangkok 10260

Procedure used: Calibration were conducted using in-house calibration procedure CP-H03 according to comparison
with standard chilled mirror sensor for humidity measurement function and comparison with standard
temperature probe for temperature measurement function into humidity / temperature chamber.

Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Chilled Mirror Hygrometer	Dew Master	44730	20503A	14 Jun 2023
2) Handheld Thermometer With Sensor	1521	ASA338	2211251	12 Oct 2023

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

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

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

Calibrated by: Kripiop Onrat
Issue Date: 25 May 2023

Approved Signatory:

[✓] Chakrit Woonwanjua
[] Ponthippa Tamayakul
[] Viporn Tantiyawutti

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B 0314980



Cert. No.: 23H1102
Page: 2 of 2

Result of Calibration:- Function:

Without Adjustment
Humidity Measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	40	-0.1	1.3
25.0	50.1	50	-0.1	1.6
25.0	60.0	58	-1.0	1.6
25.0	70.2	68	-2.2	1.6

Result of Calibration:- Function:

Without Adjustment
Temperature Measurement

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
20.014	20.4	0.386	0.42
25.022	25.6	0.578	0.42
30.033	30.2	0.167	0.42
40.000	39.9	-0.100	0.42

UUC*: Unit Under Calibration

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

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/19 MOO 11, SOI SUTINAKORN 11 TAMBON BANG KAO,
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 0660-2116-5600-1 FAX: 0660-2116-7140



Certificate of Calibration

Customer: UNITED ANALYST AND ENGINEERING
Name: CONSULTANT CO., LTD.
Address: 81 Soi Udomsak 41, Sukhumvit Road, Bangkok, Phra Khanong, Bangkok 10260
Page: 1/2

Unit Under Calibration Details

Calibration Parameter: Temperature
Instrument Name: Thermal Environment Monitor
Manufacturer: TSI QUEST
Model: QT-34
Serial Number: OTE1010003
Resolution: 0.1 °C
ID Number: UAE/EMA2-099-2553
Range Calibration: 20 °C to 60 °C
Type of Sensor: RTD
Sensor Diameter (mm): 4.5
Calibration Position (mm): 67.5
Instrument Status: Used

Calibration Environment and Details

Temperature: 23 °C ± 3 °C
Humidity: 55 %RH ± 15 %RH
Received Date: 21 July 2023
Calibrated Date: 15 November 2023

Calibration Procedure: In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard: Digital Thermometer with Sensor, Manufacturer: GINGO GINGO, Model: GT11/RTD100, SN: 0000057, ID: 02-TPM Which was calibrated on 27 February 2023, Calibration Certificate No.: QRC23-0494

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

Note

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

Approved By: Mr. Noppadol Luangart

Technical Manager

Issue Date: 15 November 2023

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

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/19 MOO 11, SOI SUTINAKORN 11 TAMBON BANG KAO,
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 0660-2116-5600-1 FAX: 0660-2116-7140



Calibration Note

UUC Adjustment: Not Adjust

Certificate No.: 23-TPM-523

Request No.: Req-2023-1528

Page: 2/2

Result of Calibration:

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (±°C)
WET	20.031	20.2	-0.2	0.13
	25.034	25.2	-0.2	0.13
	30.033	30.2	-0.2	0.13
	35.036	35.2	-0.2	0.13
	40.041	40.2	-0.2	0.13
	45.041	45.2	-0.2	0.13
	50.044	50.2	-0.2	0.13

DRY	20.032	20.2	-0.2	0.13
	25.033	25.2	-0.2	0.13
	30.035	30.2	-0.2	0.13
	35.038	35.2	-0.2	0.13
	40.038	40.2	-0.2	0.13
	45.041	45.2	-0.2	0.13
	50.042	50.2	-0.2	0.13

GLOBE	20.03	20.2	-0.2	0.13
	25.034	25.2	-0.2	0.13
	30.035	30.2	-0.2	0.13
	35.036	35.2	-0.2	0.13
	40.038	40.2	-0.2	0.13
	45.040	45.2	-0.2	0.13
	50.041	50.2	-0.2	0.13

End of Certificate

Calibrated By: Mr. Sittichok Jongsakulchai

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Certificate of Calibration

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

Certificate No : 23-TPM-193
Request No : Req-2023-0709
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Thermal Environment Monitor
Manufacturer : TSI QUEST
Model : QT-32
Serial Number : TPW20005
Resolution : 0.1 °C
ID Number : UAE-EFM-122/2565

Range Calibration : 20 °C to 60 °C
Type of Sensor : RTD
Sensor Diameter (mm) : 4.5
Calibration Position (mm) : 67.5
Instrument Status : Used

Calibration Environment and Details


Temperature : 23 °C ± 3 °C
Humidity : 55 %RH ± 15 %RH
Received Date : 28 March 2023
Calibrated Date : 3 April 2023
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO GINGO, Model: GT11/RTD100, SN: 08090057, ID: 02-TPM Which was calibrated on 27 February 2023, Calibration Certificate No.: QR23-0494

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

Note

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

Approved By : 
Mr. Noppadol Luangrat
Technical Manager
Issue Date : 3 April 2023


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Calibration Note
UCC Adjustment : Not Adjust
Certificate No : 23-TPM-193
Request No : Req-2023-0709
Page : 2/2

Result of Calibration :

UCC Sensor	Standard Temperature (°C)	UCC Reading (°C)	Correction (°C)	Uncertainty (± °C)
WET	20.030	20.2	-0.2	0.13
	25.034	25.2	-0.2	0.13
	30.034	30.2	-0.2	0.13
	35.038	35.2	-0.2	0.13
	40.041	40.2	-0.2	0.13
	45.043	45.2	-0.2	0.13
	50.046	50.2	-0.2	0.13
DRY	20.033	20.2	-0.2	0.13
	25.037	25.2	-0.2	0.13
	30.037	30.2	-0.2	0.13
	35.036	35.2	-0.2	0.13
	40.039	40.2	-0.2	0.13
	45.040	45.2	-0.2	0.13
	50.042	50.2	-0.2	0.13
GLDRE	20.032	20.2	-0.2	0.13
	25.033	25.2	-0.2	0.13
	30.036	30.2	-0.2	0.13
	35.039	35.2	-0.2	0.13
	40.042	40.2	-0.2	0.13
	45.042	45.2	-0.2	0.13
	50.043	50.2	-0.2	0.13

End of Certificate

Calibrated By : 
Mr. Sittichok Jengpadevanon

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