

ภาคผนวก จ

หนังสือรับรองการสอบเทียบเครื่องมือ

ภาคผนวก จ-1

บริษัท อินทิเกรตเต็ด รีเซิร์ช เซ็นเตอร์ จำกัด



Certificate of Calibration

Certificate No.: C01243398

Page: 2 of 2

Equipment: Balance
Model: BSA224S-CW
Serial No. (or ID.): 34490341
Manufacturer: Sartorius
Condition: In condition

Certificate No.: C01243398
Issued Date: 06 November 2024
Job No.: WO-00047130
Page: 1 of 2

Customer: Integrated Research Center Co., Ltd.
122 Moo 2, Tambol Thatoom,
Amphur Srimahaphote, Prachinburi 25140 Thailand

Environment Condition: Temperature 24 °C ± 0.4 °C
Humidity 60 %RH ± 3.3 %RH

Calibration Place: Double A (1991) Public Company Limited.
(Water Laboratory IP1 (Balance Room))
1 Moo 2, Thatoom, Srimahaphot,
Prachinburi 25140 Thailand.

Calibration By: Mr. Piyapat Saidoung

Calibration Date: 30 October 2024

The Method used: In-house method, CAL-WI-47, based on UKAS Lab 14

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02231944

Calibration Results:

Without Adjustment

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

			Nominal Test Value 100 (g)				
Reference Points (g)							
A	B	C	D	E			
-	0.0001	0.0001	-0.0001	-0.0001			

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.0001 (g)

Nominal test value (g)	Standard Deviation
20	0.00004
200	0.00006

Error of indication from nominal or conventional mass value., Readability 0.0001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of indication (g)	Uncertainty (g)	k
0.1	0.10001	0.1000	0.0000	0.00011	2.04
0.2	0.20001	0.2000	0.0000	0.00011	2.04
0.5	0.50001	0.5000	0.0000	0.00011	2.04
1	1.00001	1.0000	0.0000	0.00011	2.04
2	2.00002	2.0000	0.0000	0.00011	2.04
5	5.00002	5.0000	0.0000	0.00011	2.04
10	10.00001	10.0000	0.0000	0.00011	2.04
20	20.00001	20.0000	0.0000	0.00012	2.03
50	50.00001	50.0000	0.0000	0.00013	2.02
100	100.00003	100.0000	0.0000	0.00017	2.01
200	200.00000	200.0000	0.0000	0.00030	2.00

The End of Certificate

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

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

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

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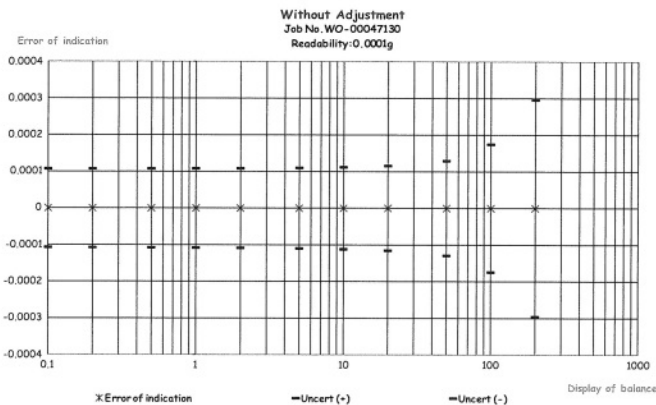
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CAL-FM-C01-14: 12 Sep 2022

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ใบตรวจสอบสภาพเครื่องชั่ง

เลขที่ใบงาน: WO-00047130

ชนิดเครื่องมือ: Balance

รุ่น: BSA224S-CW

หมายเลขเครื่อง: 34490341

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
30 Oct 2024			30 Oct 2024		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
☒	☐	1. สายไฟ/Adapter, power supply 220/110V	☒	☐	
☒	☐	2. ความสมบูรณ์ชุดกระชกกันลม (Cover)	☒	☐	
☒	☐	3. ความสมบูรณ์ชุดของระดับน้ำ	☒	☐	
☒	☐	4. การปรับระดับของขาตั้งเครื่อง	☒	☐	
☒	☐	5. การทดสอบของไม่กด	☒	☐	
☒	☐	6. ความสมบูรณ์ของ Display	☒	☐	
☒	☐	7. การแสดงผลของ Display หลังวางน้ำหนัก	☒	☐	
☒	☐	8. ชุดรองจานแข็ง (Stopper) / pan support	☒	☐	
☒	☐	9. การทำงานของ Function Internal / External	☒	☐	
☒	☐	10. ความสะอาดของตัวเครื่องภายนอกและแกน load cell	☒	☐	
☒	☐	11. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	☒	☐	

หมายเหตุเพิ่มเติม/ข้อแนะนำ :

Mr. Piyapat Saidoung
Service Engineer

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CERTIFICATE OF CALIBRATION

Certificate No. : COF-013-67

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice
MANUFACTURER : TISCH
MODEL/TYPE : TE-5028A
SERIAL NUMBER : 2926
ID NUMBER : -
CONDITION AS-RECEIVED : Used Item
CUSTOMER : Integrated Research Center Company Limited,
122 Moo 2, Thathom, Srimahaphote,
Prachinburi 25140, Thailand.

RECEIVED DATE : 10 May 2024
MEASUREMENT DATE : 05 Jun 2024
ISSUE DATE : 06 Jun 2024

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 22.9 °C and 53.2 %RH.

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

TABULATION OF RESULTS:
The table on next page give the measured values.

Calibration procedure:
The Orifice gas flow device was calibrated against Standard Rotary Displacement Meter (Roots Meter) Model G65/IMC/W2-dp. The W-CL-004 was used as a calibration guideline.

Traceability:
This certificate provides a traceability of the measurement to recognized the national standards and to realization of the international system of units (SI) through the NIMT (National Metrology Institute of Thailand) via Certificate number: MW-0063-23.

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'.

MEASUREMENT RESULTS:

The Orifice gas flow device was calibrated by direct comparison method with the Standard Rotary Displacement Meter (Roots Meter). The humid air was used as a medium in the system. The standard conditions are 25 °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 _a] °C	Temperature [T _m] °C	Ap_meter mmHg	Ap_Orifice inH ₂ O	Y	Standard Flow [Q _s] m ³ /min
1	0.703	754.942	22.82	22.17	58.515	1.094	1.046	0.651
2	1.001	754.951	22.99	22.44	44.435	2.340	1.530	0.944
3	1.117	754.835	23.23	22.73	38.752	2.948	1.716	1.060
4	1.170	754.975	23.31	22.88	35.376	3.257	1.804	1.116
5	1.411	755.078	23.55	23.13	24.261	4.921	2.216	1.365

Slope (m): 1.63522
Intercept (b): -0.01711
Correlation coefficient (r): 0.99975
Uncertainty (k=2): 0.015 m³/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [T _a] °C	Temperature [T _m] °C	Ap_meter mmHg	Ap_Orifice inH ₂ O	Y	Standard Flow [Q _s] m ³ /min
1	0.703	754.942	22.82	22.17	58.515	1.094	0.655	0.650
2	1.001	754.951	22.99	22.44	44.435	2.340	0.958	0.944
3	1.117	754.835	23.23	22.73	38.752	2.948	1.076	1.061
4	1.170	754.975	23.31	22.88	35.376	3.257	1.131	1.117
5	1.411	755.078	23.55	23.13	24.261	4.921	1.391	1.367

Slope (m): 1.02416
Intercept (b): -0.01068
Correlation coefficient (r): 0.99975
Uncertainty (k=2): 0.015 m³/min

End of Certificate of Calibration

Calibrated by:
Mr. Sirawat Thachulad
Mr. Jiraporn Lertsomphol



Approved signature
Mr. Parinya Booncharoen
Calibration Department Manager



THIS CERTIFICATE REPORT MAY NOT BE REPRODUCED EXCEPT IN FULL UNLESS PERMISSION FOR REPRODUCTION HAS BEEN OBTAINED IN WRITING FROM THE LABORATORY



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No.23-68/0221

MTC.No.23-68/0221

Number of page(s) 2

CALIBRATION CERTIFICATE

Nomenclature : PERSONAL AIR PUMP SAMPLING PUMP CALIBRATION

Manufacturer : MesaLabs

Serial No.: 210155

Model : Defender 510

Scale range : 50 ml/min to 5000 ml/min

Subdivision : (0.00001, 0.0001) l/min

Submitted by : INTEGRATED RESEARCH CENTER COMPANY LIMITED.

122 T.Thathom A.Srimahaphote,

Prachinburi 25140, Thailand.

Received date : 15 January 2025 **Condition of measured item :** Normal

Calibration date : 3 February 2025

Standard	Standard	Certificate No.	Date due	Traceability
RTD Thermometer	PSL-T 0811/67	3-Jul-26	TISTR	
Molbox/Pressure Transducer/UpStream	MP-0076-23	2-Apr-25	NIMT	
Primary Flow Calibrator S/N 119521	MW-0033-23	6-Jun-25	NIMT	

Calibrated by :
(Mr.Terasak Panna)

Approved by :
(Ms.Kirana Luangnirun)
Director
Mechanical Engineering Standards Laboratory

Ref. 2013268011500202001

Issued Date 5 February 2025

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Mechanical Engineering Standards Laboratory Soi 1, Bangpoo Industrial Estate, Muang, Samutprakan 10280, Thailand.

Request No.23-68/0221

2/2

MTC.No.23-68/0221

Calibration point : (0.05, 0.5, 1, 1.5, 2) l/min

Ambient condition : Temperature (23 ± 3) °C , Relative humidity (55 ± 15) %

Atmospheric pressure (1010 ± 13) hPa

Calibration method : The flowmeter (UUC) was calibrated by comparison method with standard flowmeter according to CP-370.01.

The reported value is the value that converted to value at reference condition within pressure and temperature of the actual gas entering the UUC

Measurement data :

UUC Value (l/min)	Standard Value (l/min)	Temperature (°C)	Pressure (hPa)	Deviation (%)	Uncertainty (%)
0.05043	0.049841	24.718	1007.90	+1.19	1.4
0.50136	0.49651	24.716	1008.19	+0.98	0.90
1.0045	0.9973	24.693	1008.53	+0.73	0.89
1.5020	1.5012	24.688	1009.04	+0.06	0.89
1.9995	2.0036	24.668	1009.48	-0.20	0.89

The reported expanded uncertainties are based on standard uncertainties multiplied by a coverage factor $k=2$, which provides a level of confidence of approximately 95%.

The end of calibration certificate.

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0159

MTC No. EEL. BP. 80/0168

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2, T.Thatoom, A.Srimahaphote, Pachinburi, 25140.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Calibrator

Manufacturer : ACO

Model : 2127

Serial No. : 100012

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

2. Measuring Amplifier Brüel&Kjaer 2636 S/N 1537484.

3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Panasonic VP-7722A S/N 041477D122.

7. Condenser Microphone B&K 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942:2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt : 14 Jan. 2025

Date of Calibration : 21 Jan. 2025

1/2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0160

MTC No. EEL. BP. 94/0168

CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2, T.Thatoom, A.Srimahaphote, Prachinburi, 25140.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : Delta OHM

Model : HD 2010UC

Serial No. : 11040842479

Microphone : Type UC-52 No.114674

Preamplifier : Delta Type HD2010PNE2 No.11001018

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.

2. Condenser Microphone Brüel&Kjaer 4180 S/N 2889871.

3. Decade Attenuator Ando AL-205 S/N 00464602.

4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.

5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.

6. Sound Calibrator Brüel&Kjaer 4231 S/N 3015154.

7. Measuring Amplifier Brüel&Kjaer 2636 S/N 1537484.

Date of Receipt : 14 Jan. 2025

Date of Calibration : 17-18 Feb. 2025

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Request No. 21-68/0159

MTC No. EEL. BP. 80/0168

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

Acoustic Output in dB re 20µPa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.

1. Sound Pressure Level

Standard Microphone	Measured Sound Pressure	Deviated value	Uncertainty	Tolerance limit
Type	Level (dB)	(dB)	(dB)	IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	93.91	-0.09	± 0.10	±0.40 dB

2. Frequency

Standard Microphone	Measured Frequency	Deviated value	Uncertainty	Tolerance limit
Type	(Hz)	(Hz)	(Hz)	IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	1000.0	0.0	± 1.5	±1.0%

3. Total Distortion

Standard Microphone	Measured Total Distortion	Uncertainty	Tolerance limit
Type	(%)	(%)	IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	1.50	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

(Mr.Weerachai Deechaiyae)

Approved by :

(Mr.Pravit Kluaypa)
DirectorElectrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Ref : 2011268011400184001

Date of Calibration : 21 Jan. 2025

Date of Issue : 23 Jan. 2025

End of Certificate

2/2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0160

MTC No. EEL. BP. 94/0168

8. Power Amplifier Brüel&Kjaer 2706 S/N 1517650.

9. Speaker Tannoy Limited, Great Britain British Patent No. 215300.

10. Digital Multimeter Agilent 34401A S/N MY44005560.

11. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%.

Date of Calibration : 17-18 Feb. 2025

2/9

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
93.95	93.3	94.0	0.1	1.0	0.30	N/A

Note: The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 94.0 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
19.6	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	18.3	0.10	N/A
C-Weight	24.5	0.20	N/A
Flat	26.9	0.30	N/A

Date of Calibration : 17-18 Feb. 2025

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5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 17-18 Feb. 2025

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.4	0.3	0.2	1.5	0.45	0.6
1 000	-0.5	-0.5	-0.5	1.0	0.45	0.6
8 000	-4.0	-3.9	-4.0	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	-0.1	-0.2	-0.3	2.0	0.20	0.6
125	-0.1	-0.1	-0.2	1.5	0.20	0.6
250	0.0	-0.1	-0.1	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	0.0	0.1	0.1	2.0	0.20	0.6
4 000	0.1	0.1	0.1	3.0	0.20	0.6
8 000	0.1	0.1	0.1	5.0	0.20	0.7

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
120	120.0	0.0	1.1	0.30	0.3
119	119.0	0.0	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.0	0.0	1.1	0.30	0.3
74	74.0	0.0	1.1	0.30	0.3
69	69.0	0.0	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
43	43.0	0.0	1.1	0.30	0.3
42	42.1	0.1	1.1	0.30	0.3

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
41	41.1	0.1	1.1	0.30	0.3
40	40.1	0.1	1.1	0.30	0.3
39	39.1	0.1	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
60-140	94.0	94.0	0.0	1.1	0.30	0.3
50-130	94.0	94.0	0.0	1.1	0.30	0.3
40-120	94.0	94.0	0.0	1.1	0.30	0.3
30-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	135.4	135.3	-0.1	3.0	0.20	0.35
Positive half cycle	134.4	134.2	-0.2	2.0	0.20	0.35
Negative half cycle	134.4	134.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
Positive one-half cycle	Negative one-half cycle				
140.5	140.5	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	139.0	0.0	0.3	0.10	0.1
End	139.0				

Calibrated by : 
(Mr. Pannasit Phasingri)

Approved by : 
(Mr. Pravee Khunyapa)

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 17-18 Feb. 2025

Date of Issue : 24 Feb. 2025

Ref : 2011268011400185012

End of Certificate

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
60-140	65	65.0	0.0	1.1	0.30	0.3
50-130	55	55.0	0.0	1.1	0.30	0.3
40-120	45	45.0	0.0	1.1	0.30	0.3
30-110	35	35.2	0.2	1.1	0.30	0.3
20-100	25	25.3	0.3	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.8	-0.2	+1.0; -2.5	0.20	0.3
	0.25	89.6	-0.4	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	±1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 17-18 Feb. 2025

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2, T.Thatoom, A.Srimahaphote, Prachinburi 25140.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Sri IC, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 192015

Microphone : 7052NR No.73304

Preamplifier : -

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
7. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.5) kPa

Date of Receipt : 14 Jan.2025

Date of Calibration : 24-27 Feb.2025

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8. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
9. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
10. Digital Multimeter Agilent 34401A S/N MY44005560.
11. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%.

Date of Calibration : 24-27 Feb.2025

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.4	0.4	0.4	1.5	0.45	0.6
1 000	-0.4	-0.4	-0.4	1.0	0.45	0.6
8 000	-0.8	-1.0	-0.6	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.1	0.0	-0.1	2.0	0.20	0.6
125	0.0	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	0.0	-0.1	2.0	0.20	0.6
4 000	-0.4	-0.4	-0.1	3.0	0.20	0.6
8 000	-0.6	-0.6	-0.2	5.0	0.20	0.7

Date of Calibration : 24-27 Feb.2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
93.99	93.9	-0.1	1.0	0.48	N/A

Note: No adjustment.

2. Self-generated noise**2.1 Normal test**

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
22.0	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	15.7	0.10	N/A
C-Weight	21.5	0.10	N/A
Flat	26.0	0.10	N/A

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5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz**6.1 Frequency weightings at 1 kHz**

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

Date of Calibration : 24-27 Feb.2025

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
122	122.1	0.1	1.1	0.30	0.3
121	121.1	0.1	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.2	0.2	1.1	0.30	0.3
69	69.2	0.2	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.1	0.1	1.1	0.30	0.3
54	54.1	0.1	1.1	0.30	0.3
49	49.1	0.1	1.1	0.30	0.3
44	44.1	0.1	1.1	0.30	0.3
39	39.1	0.1	1.1	0.30	0.3
34	34.2	0.2	1.1	0.30	0.3
33	33.3	0.3	1.1	0.30	0.3

Date of Calibration : 24-27 Feb.2025

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
40-130	45.0	45.0	0.0	1.1	0.30	0.3
30-120	35.0	35.0	0.0	1.1	0.30	0.3
20-110	25.0	25.5	0.5	1.1	0.30	0.3
20-100	25.0	25.4	0.4	1.1	0.30	0.3
20-90	25.0	25.4	0.4	1.1	0.30	0.3
20-80	25.0	25.2	0.2	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
Fast	200	115.8	-0.2	$\pm$ 1.0	0.20	0.3
	2	98.6	-0.4	+1.0; -2.5	0.20	0.3
	0.25	89.0	-1.0	+1.5; -5.0	0.20	0.3
Slow	200	109.4	-0.2	$\pm$ 1.0	0.20	0.3
	2	89.8	-0.2	+1.0; -5.0	0.20	0.3
	200	109.9	-0.1	$\pm$ 1.0	0.20	0.3
SEL	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
32	32.3	0.3	1.1	0.30	0.3
31	31.4	0.4	1.1	0.30	0.3
30	30.4	0.4	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
Complete cycle	125.4	125.5	0.1	3.0	0.20	0.35
Positive half cycle	124.4	124.3	-0.1	2.0	0.20	0.35
Negative half cycle	124.4	124.3	-0.1	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
Positive one-half cycle	Negative one-half cycle				
132.5	132.5	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

Approved by :

.....
(Mr. Tawikiat Iamsamran)

.....
(Mr. Prawate Kluyapka)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 24-27 Feb.2025

Date of Issue : 28 Feb.2025

Ref : 2011268011400185002

End of Certificate

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CALIBRATION CERTIFICATE

Submitted by : Integrated Research Center Company Limited.

Address : 122 Moo 2, T.Thatoom, A.Srimahaphote, Prachinburi 25140.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., A.Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 192014

Microphone : 7052NR No.73303

Preamplifier : -

Standards used :

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Sound Calibrator Brüel&Kjær 4231 S/N 3015154.
7. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

Date of Receipt : 14 Jan.2025

Date of Calibration : 24-27 Feb.2025

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)	Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
93.99	94.0	0.0	1.0	0.48	N/A

Note: No adjustment.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
20.8	0.10	N/A

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

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	13.3	0.10	N/A
C-Weight	18.4	0.10	N/A
Flat	22.4	0.10	N/A

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8. Power Amplifier Brüel&Kjær 2706 S/N 1517650.

9. Speaker Tannoy Limited, Great Britain British Patent No. 215300.

10. Digital Multimeter Agilent 34401A S/N MY44005560.

11. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

Calibration Procedure :

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%.

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.2	0.3	0.2	1.5	0.45	0.6
1 000	0.1	0.1	0.2	1.0	0.45	0.6
8 000	-1.6	-1.5	-1.1	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	0.0	0.0	-0.1	2.0	0.20	0.6
125	0.0	0.0	0.0	1.5	0.20	0.6
250	0.0	0.0	0.0	1.5	0.20	0.6
500	0.0	0.0	0.0	1.5	0.20	0.6
1 000	0.0	0.0	0.0	1.0	0.20	0.6
2 000	-0.1	-0.1	-0.1	2.0	0.20	0.6
4 000	-0.4	-0.4	-0.1	3.0	0.20	0.6
8 000	-0.6	-0.7	-0.2	5.0	0.20	0.7

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5. Long-term stability

Time	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.1	0.1	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
32	32.2	0.2	1.1	0.30	0.3
31	31.2	0.2	1.1	0.30	0.3
30	30.3	0.3	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	94.0	0.0	1.1	0.30	0.3

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured Value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.0	0.0	1.1	0.30	0.3
121	121.1	0.1	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	89.0	0.0	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.1	0.1	1.1	0.30	0.3
69	69.1	0.1	1.1	0.30	0.3
64	64.0	0.0	1.1	0.30	0.3
59	59.0	0.0	1.1	0.30	0.3
54	54.0	0.0	1.1	0.30	0.3
49	49.0	0.0	1.1	0.30	0.3
44	44.0	0.0	1.1	0.30	0.3
39	39.0	0.0	1.1	0.30	0.3
34	34.1	0.1	1.1	0.30	0.3
33	33.1	0.1	1.1	0.30	0.3

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8. Level linearity including the level range control

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45.0	45.0	0.0	1.1	0.30	0.3
30-120	35.0	35.0	0.0	1.1	0.30	0.3
20-110	25.0	25.3	0.3	1.1	0.30	0.3
20-100	25.0	25.2	0.2	1.1	0.30	0.3
20-90	25.0	25.2	0.2	1.1	0.30	0.3
20-80	25.0	25.2	0.2	1.1	0.30	0.3

9. Tone burst response

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	115.8	-0.2	±1.0	0.20	0.3
	2	98.3	-0.7	+1.0; -2.5	0.20	0.3
	0.25	89.2	-0.8	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.7	-0.3	+1.0; -5.0	0.20	0.3
	200	109.9	-0.1	±1.0	0.20	0.3
SEL	2	89.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

Date of Calibration : 24-27 Feb.2025

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

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
Complete cycle	125.4	125.7	0.3	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
Positive one-half cycle	Negative one-half cycle	0.0	1.5	0.20	0.25
132.5	132.5				

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 ($\pm$ dB)	Uncertainty ($\pm$ dB)	Maximum-permitted uncertainty of measurement ($\pm$ dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :

Tawikiat Iamsamran

(Mr. Tawikiat Iamsamran)

Approved by :

Prawate Klaiyapa
(Mr. Prawate Klaiyapa)
Director

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 24-27 Feb.2025

Date of Issue : 28 Feb.2025

Ref : 2011268011400185003

End of Certificate

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ภาคผนวก จ-2

บริษัท ยูไนเต็ด แอนนาลิสต์ แอนด์ เอ็นจิเนียริง คอนซัลแตนท์ จำกัด

List of Instrument Certificates for Environmental Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*
1	Atomic Absorption Spectrometer	CHROMIUM TRIVALENT IRON	Agilent Technologies	AA240FS / MY13160001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	30/1/2025	29/1/2026
2	SCT Meter	CONDUCTIVITY (umhos/cm)	Horiba	LAQUA-EC210 / HC1L0016	Technology Promotion Association (Thailand-Japan)	25CH168	5/2/2025	3/2/2026
3	Ion Selective Electrode Meter	FLUORIDE	Thermo Fisher Scientific, Indonesia And USA	Orion Star A214 / X36836	Science Tech Co.,Ltd.	ST014/25	20/5/2025	19/5/2026
4	Kjeltec Distillation Unit	TOTAL KJELDAHL NITROGEN	FOSS	KT9 / 91905393	FOSS South East Asia	12875	5/7/2024	4/7/2025
5	Spectrophotometer	COLOUR (pH 7.0) COLOUR (pH Sample)	Agilent	Cary 60 G6860A / MY15410009	DQE Services Co.,Ltd.	SP25-019	26/5/2025	25/5/2026
6	UV-VIS Spectrophotometer	NITRATE	Hitachi	U-2900 / 21E22-009	DQE Services Co.,Ltd.	SP25-001	3/1/2025	2/1/2026

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

List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Water									
1	pH Meter	pH	Horiba	LAQUA-PH210 HA4G0060	Technology Promotion Association (Thailand-Japan)	24CH1284/1	15 Oct 24	14 Oct 25	-

Agilent 55 240 280 Series Atomic Absorption Spectroscopy Systems

Preventive Maintenance Checklist

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

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

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

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

Introduction

Customer Information

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

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Important Customer Web Links

- For more information about *Agilent Technologies services*, please visit our website using the following URL: <http://www.agilent.com/en-us/products/crosslab-instrument-services/service-repair>
- To access *Agilent University*, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- A useful *Agilent Resource Center* web page is available, which includes short videos on maintenance, quick lists of consumables for new instruments, and other valuable information. Check out the Resource Page here: <https://www.agilent.com/en-us/agilentresources>
- Need technical support, FAQs, supplies? – visit our *Support Home page* at <http://www.agilent.com/search/support>
- Get answers. Share insights. Build connections: Join the *Agilent Community* at <https://community.agilent.com/welcome>

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Confirm the ability of the instrument to deliver continued safe operation as established via the Agilent AA safe operation flow chart. (**Refer directly to the AA 55/240/280 Preventive Maintenance Scope of Work to make this decision.**)
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Section not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance service in the order of the tasks listed.
- Complete the Service Review section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Complete the total number of pages field in the Service Completion section
- Ask the customer to sign the Service Completion section including the customer's and your signature.

This information is subject to change without notice.

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Instrument Maintenance

System Information

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

Instrument System Name and ID	240 FS AAS
Instrument System Site and Location	United Analyst and Engineering Consultant

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 3432 A	M 13160001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

Preparation, Safe operation and Initial performance checks

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

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

- ☒ Discuss any specific issues with the customer before starting.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. ๓๓๓
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components, settings as defined by current Service Notes
- ☒ Check for required firmware updates and verify with customers if they would like them installed.
- ☒ Use SVD to perform a Full Wavelength Scan for Cu HCL - "As found test_1"
- ☒ Perform a Basic Cu ABS test - "As found test_2"
- ☒ Print the Details page or screen captures of the test results and attach to the end of this checklist.

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Preventive Maintenance Procedures

FLAME SYSTEM section

☐ Section not applicable

Electronic components

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

Mechanical components

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

Optics components

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

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Sample Introduction and Atomization

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

Gas handling components and safety interlocks

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

Analytical performance for Flame systems

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

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FURNACE SYSTEM section

☒ Section not applicable

Electronic components

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

Mechanical components

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

Optics components

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

Gas handling, water system and workhead component checks

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

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- ☐ Tube
- ☐ Electrodes
- ☐ Shroud

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

Analytical performance for Furnace systems

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

PSD autosampler accessory for Furnace systems

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

Sample introduction pump system (SIPS) accessory

- ☒ Section NOT Applicable
- ☐ Re-torque screws securing the hubs, presser arms and pump rotors.
- ☐ Adjust each roller so that it rotates freely.
- ☐ Wipe clean the pump rotor rollers and pump bands with a dry clean cloth.
- ☐ Ensure that the presser arms and the surfaces near the pump are free from dirt and spills.
- ☐ Remove the pump module rear cover and check for the incursion of liquids and any signs of corrosion.
- ☐ Re-torque the nuts that fasten the motor mounting plates to the chassis.
- ☐ Check clips securing the diluents holder and replace if necessary.
- ☐ Disconnect, clean T-piece, and reassemble the tubing using the following steps.

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

Sample preparation system (SPS 4) accessory

☒ Section NOT Applicable

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

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

- ☐ Cleaning the spill tray, rack location mat, end frames and chassis accessories with a damp soft cloth and diluted mild detergent.
- ☐ Cleaning the autosampler cover panels with domestic window cleaner.
- ☐ Checking the X- axis and Z- axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes..
- ☐ Check the X- axis, Theta- axis and Z- axis FFC cables for cracks, incorrect positioning, damaged edge or damaged connectors.

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

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

Sample preparation system (SPS 3) accessory

☒ Section NOT Applicable

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

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Vapor generation accessory VGA (hydride generator)

☐ Section NOT Applicable

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

UltrAA lamp accessory (external)

☒ Section NOT Applicable

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

Restore System

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

Guidance

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

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Signature Page

Service Review

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

Test Results

Test Description	Expected Test Result	Actual Test Result
Flame optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	49 %
Flame performance test with 5 ppm copper sample		
Air /acetylene, mixing paddle removed	Abs value > 0.5	0.559%
Air /acetylene, mixing paddle installed. 10 replicates	%RSD < 1.0	0.2 %
Deuterium furnace optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	—
Deuterium furnace performance test with 25 ppb copper sample (324.8 nm)		
Precision %RSD	≤ 4.0%	—
Abs value	≥ 0.15	—
Zeeman furnace analytical performance: 25 ppb copper sample (327.4 nm)		
Precision %RSD	≤ 4.0%	—
Abs value	≥ 0.10	—
MSRP%	≥ 70 %	—

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AA consumable and parts list table

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

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

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

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

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Service Engineer Comments (optional)

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

Service Completion

Service request number 6007949143 Date service completed 30 Jan 2025
Agilent signature Kanyakorn S. Customer signature Janida Y.
Total number of pages in this document 13

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Frequency:

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

Power Supply:

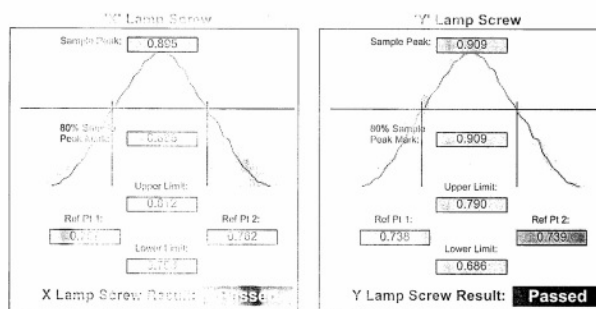
Averaging Period: 30.0
Datapoint Count: 20

	Lower Limit (V)	Actual (V)	Upper Limit (V)	Result:
12.00 V Rail	10.80	12.12	13.20	Passed
-12.00 V Rail	-13.20	-11.90	-10.80	Passed
5.00 V Rail	4.50	5.04	5.50	Passed
310.00 V Rail	279.00	320.00	341.00	Passed

Optics

Beam Balance:

Lamp Type: Copper
Lamp Socket Used: 3
Peak Selected: 324.80
Lamp Alignment: **Performed**



Grating Spectral Alignment:

Lamp Element(s): Copper
Lamp Turret Position: 3
Lamp Current (mA): 4.00
Grating Width (mm): 0.5
1st Order Wavelength (nm): 324.80
Lamp Alignment: **Performed**

	Lower Limit (nm)	Actual (nm)	Upper Limit (nm)	Result:
Zero Order	-0.10	0.00	0.10	Passed
First Order	324.65	324.75	325.15	Passed
Second Order	649.27	649.51	649.97	Passed

Wavelength Repeatable:

Lamp Used: Copper
Peak Used(nm): 324.759
Connected to Socket: 3

Lamp Current(mA): 4
Slit Width(nm): 0.2
Slit Height: Normal

Lamp Alignment:

Lower Limit(nm) 324.758 324.888 Upper Limit(nm)

(Approach from Zero Order)

(Approach from end)

Sample 1: 324.823

Sample 2: 324.823

Sample 3: 324.873

Sample 4: 324.823

Sample 5: 324.823

Sample 6: 324.819

Sample 7: 324.819

Sample 8: 324.819

Sample 9: 324.823

Sample 10: 324.819

Mean: 324.825

Standard Deviation: 0.003

Result: **Passed**

Report Generated At: 1/30/2025 9:47:25 AM

4

SVD Results Report **SVD**

เอกสารไม่ควบคุม

Auto Lamp Recognition:

Lamp 1: Uncoded Lamp/Not Connected
Lamp 2: 87 - Silver/Cadmium/Land/Zinc(UltrAA) (Ag/C Lamp 6: Not Supported
Lamp 3: 14 - Copper (Cu)
Lamp 4: Uncoded Lamp/Not Connected
Lamp 5: Not Supported
Lamp 7: Not Supported
Lamp 8: Not Supported

Result: **Passed**

GTA Temperature Monitoring:

Notes:

Signatures:

Name

Date

Kanyakorn S.

30 Jan 2025

Report Generated At: 1/30/2025 9:47:25 AM

6

SVD Results Report **SVD**

เอกสารไม่ควบคุม

Manual:

Wavelength Drive:

Slit Drive:

Turret Drive:

Auto Burner Adjuster Drive:

Microbalance:

Signal Processing Linearity:

Calculate Mode: New Only Mode

	Lower Limit	Actual	Upper Limit	Result:
S0	134	1	297	Passed
S1	218	14	191	Passed
S2	271	10	332	Passed
C2	474	7	579	Passed
S4	935	1	1008	Passed
S7	1495	8	1754	Passed
S9	2498	109	3053	Passed
S2	4947	1001	5313	Passed

Interlock:

Burner Filled: **Working**
H2O Burner Filled: **Working**
Flame On/Off Closed: **Working**
Gas Control Filled: **Working**
Pressure Release Soling Filled: **Working**
Liquid Trap Filled: **Working**
Flame Detect: **Working**
GCU Active: **Working**
Oxidant Pressure: **Working**
Oxidant Changeover: **Unstated**
Ignition: **Working**

Report Generated At: 1/30/2025 10:53 AM

5

SVD Results Report **SVD**

เอกสารไม่ควบคุม

Sequential by time report

1/30/2025 10:53 AM

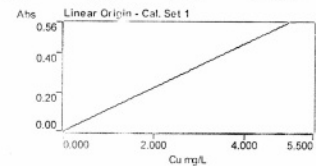
SpectrAA

Page 1 of 1

Analyst
Date Started: 1/30/2025 10:33 AM GMT: 1/30/2025 3:33 AM
Worksheet: Sensitivity Test 01
Comment:
Methods: Cu
Computer name: DESKTOP-RSUIFRS
Serial Number: MY13160001

Method: Cu (Flame)

Sample ID	Conc. mg/L	%RSD	Mean Abs		
CAL ZIRCO	0.000	38.8	0.0002		
Readings	0.0002	0.0003	0.0001	1/30/2025	10:51:46 AM
STANDARD 1	5.000	0.1	0.5571		
Readings	0.5574	0.5563	0.5575	1/30/2025	10:52:22 AM



Curve Fit = Linear Origin
Characteristic Conc = 0.030 mg/L
r = 1.0000
Calculated Conc = 0.002 5.000
Residuals = -0.002 0.000

Abs = 0.11141 x C

5 ppm Cu	5.025	0.3	0.5558		
Readings	0.5552	0.5596	0.5615	1/30/2025	10:52:54 AM

Report Generated At: 1/30/2025 9:47:25 AM

6

SVD Results Report **SVD**

เอกสารไม่ควบคุม

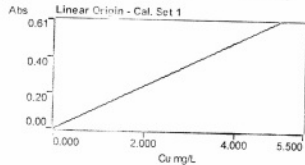
เอกสารไม่ควบคุม

Analyst
Date Started 1/30/2025 10:33 AM GMT: 1/30/2025 3:33 AM
Worksheet Precision Test
Comment
Methods Cu
Computer name DESKTOP-PSUFRS
Serial Number: MY13160001

Method: Cu (Flame)

Sample ID	Conc. mg/L	%RSD	Mean Abs
CAL ZERO	0.000	64.1	-0.0002
Readings	-0.0003	-0.0003	-0.0001
STANDARD 1	5.000	0.3	0.6052

Readings
0.6036 0.6073 0.6047 1/30/2025 10:47:24 AM



Curve Fit = Linear Origin
Characteristic Conc = 0.605 mg/L
 r = 1.0000
Calculated Conc = -0.002 5.000
Residuals = 0.002 0.000

Abs = 0.12105 x C

5 ppm Cu	5.007	0.2	0.6051
Readings	0.6055	0.6052	0.6047
	0.6055	0.6076	0.6064
			0.6079
			1/30/2025 10:48:32 AM

SPS 4

Down height 0.53 (mm)
Pump speed Medium

Key to tube colors
● Sample
● Calibration
● Calibration/QC
● Sample/QC
● Not Assigned

Sensitivity Check 1.5 mg/L gives about 0.2 Abs at 324.8 nm, A/A burner

Optimization: Lamp
HC Lamp 1.30
0.00 0.50 1.00 1.50
0.917
Optimize Lamp
Optimize Sign
Rescale
Inst Zero
Gain 49 %
Ok

Goto Tube
Back 1
Type 1
Goto Tube

Align Probe
Rinse
Stop Rinse
Park

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม



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



Certificate of Calibration

Cert.No.: 25CH168
Page.: 1 of 3

Equipment : Conductivity Meter
Manufacturer : Horiba
Model : LAQUA-EC210
Serial No. : HC1L0016
ID No. : UAE.EFM.014/2565(EFM.SCT.01/65)
Condition As-Received: Used Item
Received Date : 04 February 2025
Calibration Date : 05 February 2025
Reference : 2502-0107WSC-4
Submitted by : United Analyst and Engineering Consultant Co.,Ltd,
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure: In-house method :
- CP-CH6 by direct measurement
with certified reference material (CRM)
- CP-CH8 by comparison with temperature standard
Calibrated by : Warakorn Lerngagtrakul
Approved by : Approved Signatory
() Chakrit Waewwanjua
() Ponpan Paipim
(✓) Sathip Meangmai
Issue Date : 06 February 2025

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.

Cert.No.: 25CH168

Page.: 2 of 3

Condition of this result of calibration

1. Reference Standard Instrument :-

Instrument	Serial No.	ID No.	Certificate No.	Due date
1) Thermometer	1963878	130RC095	241995	09 Sep 2025
2) Ref. Std. Thermometer	4982054	110RC044	241757	14 July 2025

- This Certification 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
1412.9 µS/cm	CPA Chem	1005307	15 June 2025
12.881 mS/cm	CPA Chem	1005308	15 June 2025

- 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 1412.9 µS/cm

Conductivity Electrode Serial No.: 9B1J0042

Standard Conductivity Solution	Before Adjustment UUC* Reading	After Adjustment UUC* Reading	Uncertainty of Measurement (±)	Coverage factor k
1412.9 µS/cm	1355 µS/cm	1413 µS/cm	9.2 µS/cm	2.00
12.881 mS/cm	12.26 mS/cm	12.72 mS/cm	0.086 mS/cm	2.00

Remark : - UUC* = Unit Under Calibration



Cert.No.: 25CH168
Page.: 3 of 3

Calibration Results

Function : Temperature Measurement

This equipment was connected with Temperature Probe;

- Model : 9383
- Serial No. : 9B1J0042

Dimension of probe;

- Length : 110 mm
- Diameter : 16 mm
- Immersion Depth : 100 mm

Calibration Result : Without adjustment

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (± °C)	Coverage factor k
15.0	15.003	15.0	-0.003	0.13	2.00
30.0	30.002	29.9	-0.102	0.13	2.00
45.0	45.001	44.9	-0.102	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 %.

-000-



SCIENCE TECH CO., LTD.

Head Office : 321/43 Nanglinchee Rd. Chongnondsee Yannawa Bangkok 10210 Thailand Tel. 0-2285-4101 Fax. 0-2285-4856 www.sciencetech.th.com
Science Tech Laboratory : 279/27-29 Soi Watpoman Sathupradit 19 Rd. Chongnondsee Yannawa Bangkok 10120 Tel. 0-2285-4101 Fax. 0-2285-4856



Job No. : J014/25

Certificate No. : ST014/25

Page : 1 of 2

Certificate of Calibration

Equipment : pH/ISE Meter
Manufacturer : Orion
Made in : USA
Model : STAR A214
Serial No. : X36836
ID No. : UAE.WAT.025/2560
Range : 0 to 14 pH
Resolution : 0.001 pH 0.1 mV
UUC Condition As-Received : Good
Submitted by : บริษัท ยูไนเทค แอนาไลติก แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด
3 ซอยอุดมสุข 41 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพฯ 10260
Ambient Temperature : (25 ± 3) °C
Relative Humidity : (50 ± 15)%
Calibration Procedure : In - house method : WI-ST-LAB-7.2/1 based on direct measurement by using standard voltage calibrator
Issue date : Wednesday, May 21, 2025

Calibrated by : Khannika Sangkham

Approved by :

(Khannika Sangkham)
Laboratory manager

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 Science Tech Laboratory.

F/W-ST-LAB-7.2/1 #2

เอกสารไม่ควบคุม
แก้ไขครั้งที่ 01 วันที่ประกาศใช้ 1/11/64



Certificate of Calibration

Job No. : J014/25

Certificate No. : ST014/25

Received date : Friday, May 16, 2025

Page : 2 of 2

Calibration date : Tuesday, May 20, 2025

Condition of this calibration result

- Reference standard instrument : Voltage calibrator Yokogawa 7651 S/N. 91H441999 Certificate No. 24E3876
Due date 12 June 2025 TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
- This certificate was certified only for the instrument we calibrated
- This result of calibration was found accurate as shown on date and place of calibration only

Result of Calibration

Function : pH meter

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

Unit Under Calibration	Applied Voltage (mV)	Nominal Value (pH)	UUC Reading (mV)	Correction (mV)	Uncertainty (± mV)	k Factor
pH Meter	177.48	4	177.4	0.1	0.060	2.00
Model STAR A214	0.0	7	0.0	0.0	0.064	2.00
S/N. X36836	-177.48	10	-177.4	-0.1	0.078	2.00

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

-0000- End of Certificate of Calibration -0000-

เอกสารไม่ควบคุม

แก้ไขครั้งที่ 00 วันที่ประกาศใช้ 1/7/63

F/W-ST-LAB-7.2/1 #3



SCIENCE TECH CO., LTD.

Head Office : 321/43 Nanglinchee Rd. Chongnondsee Yannawa Bangkok 10120 Thailand Tel. 0-2285-4101 Fax. 0-2285-4856 www.sciencetech.th.com
Science Tech Laboratory : 279/27-29 Soi Watpoman Sathupradit 19 Rd. Chongnondsee Yannawa Bangkok 10120 Tel. 0-2285-4101 Fax. 0-2285-4856

Job No. : JF006/25

Certificate No. : FT006/25

Page : 1 of 2

Certificate of Calibration

Equipment : pH/ISE Meter
Manufacturer : Orion
Made in : USA
Model : STAR A214
Serial No. : X36836
ID No. : UAE.WAT.025/2560
Ion Selective Model : 9409BN
Serial No. : ZW1-18420
Reference Electrode Model : 900100
Serial No. : ZW1-16834
Range : 0 to 14 pH
Resolution : 0.001 pH 0.1 mV
Submitted by : บริษัท ยูไนเทค แอนาไลติก แอนด์ เอ็นจิเนียริ่ง คอนซัลแตนท์ จำกัด
3 ซอยอุดมสุข 41 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพฯ 10260
Ambient Temperature : (25 ± 3) °C
Relative Humidity : (50 ± 15)%
Issue date : Wednesday, May 21, 2025
Calibrated by : Khannika Sangkham
Approved by : (Khannika Sangkham)
Laboratory manager

เอกสารไม่ควบคุม



Certificate of Calibration

Job No. : JF006/25

Certificate No. : FT006/25

Received date : Friday, May 16, 2025

Page : 2 of 2

Calibration date : Tuesday, May 20, 2025

Condition of this calibration result

1 Reference standard materials : Certified Fluoride standard reference solution (Directly measured by differential potentiometry with the aid of potassium fluoride "quasi without transference" against solutions prepared from primary reference materials from NIST)

2 This certificate was certified only for the instrument we calibrated

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

Result of Calibration

Function : pH/ISE Meter with Probe

Direct Measurement

First Standard concentrated = 0.1 ppm
Secondary Standard concentrated = 1 ppm
Tertiary Standard concentrated = 10 ppm
Fourthly Standard concentrated = 100 ppm
Slope = -58.4 mV/Dec.

Channel : 1

Unit Under Calibration	Standard Concentrated (ppm)	UUC Reading (ppm)	Correction (ppm)	Stdev (ppm)
Model :	0.1	0.109	-0.009	0.00
9409BN S/N. ZW1-18420	1	1.03	-0.02	0.01
900100 S/N. ZW1-16834	10	9.97	0.03	0.03
	100	99.6	0.4	1.17

-00000-

เอกสารไม่ควบคุม

FOSS

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

Customer Service Report

Report No.: 12875

Date: July 5, 2024
Job No.: 8315
Instrument: K9 Distillator

Customer: UAE
Address: Bangkok
Serial: 91405393

Start
Finish
Travel To Customer (Hrs)
09.30
09.30
1

Labour (Hrs)
09.30
14.30
5

Travel From Customer (Hrs)
14.30
16.00
1.5

Job Type			
Application	Special	Standard	
Distributor	Courtesy Visit	Installation	Training
Digital Service	PMA Onboarding	Quote	In House
Internal	Warranty	Repair	PM
Investigate	Sales Support	Remote	Health Check Visit

PMA Type	Smartcare	Smartcare Pro	Fosscore
	Smartcare Advance	Fosscore Pro	N/A

Details of Work / Test	
- Visual Check -	ok
+ No leak	
+ No damage	
- Change PM kit x1 set	ok
- Function Check -	
+ Dilution 80 mL →	
+ Alkali 50 mL →	
+ Receiver N/A → Notice	Pass
+ Hecm / Drain	
Blank =	Follow up
Follow up	Follow up
Instrument Ready for Use	OK

Part No.	Batch	Description	Qty
60100146	03-01-2024	PM kit Bjettec 9 Distillator	1

I confirm this report is accurate and complete			
Signed FOSS		Signed Customer	
Name	Arach / Sankrit	Name	Mr. Kanchan

Email: Customer Contact:

*Remark:

เอกสารไม่ควบคุม

DQE Services Co., Ltd.

DQE Services

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

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



CERTIFICATE OF CALIBRATION

Certificate No. : SP25-019

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 : Instrument room (207)

Equipment : UV-Vis Spectrophotometer

Manufacturer : Agilent Technologies

Model : Cary 60

Serial No. : MY15410009

ID No. : UAE.WAT.020/2558

Received Date : 26 May 2025

Calibration Date : 26 May 2025

Issue Date : 29 May 2025

Condition Instrument : Good

Calibrated by :
(Mr. Tanawut Rittidach)
Technical Manager

Approved by :
(Ms. Chonticha Sangneng)
Quality Manager

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

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

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

DQE Services Co., Ltd.

DQE Services

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. : SP25-019

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	115663	25 October 2025
Absorbance Standard set	25757	115638	25 October 2025
Wavelength Standard set	25806	115657	25 October 2025
Wavelength Standard set	25758	115665	25 October 2025

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

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

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

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


ISO 17025
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP25-019Page 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
	0.5780	0.5739	0.0041	0.0031	2.00
	1.0484	1.0430	0.0054	0.0029	2.00
	2.1876	2.1876	0.0000	0.0084	2.00
440	0.0000	0.0000	0.0000	0.0028	2.00
	0.5595	0.5581	0.0014	0.0034	2.00
	1.0239	1.0219	0.0020	0.0035	2.00
	2.1230	2.1207	0.0023	0.0085	2.00
465	0.0000	0.0000	0.0000	0.0028	2.00
	0.5230	0.5190	0.0040	0.0029	2.00
	0.9633	0.9609	0.0024	0.0029	2.00
	1.9753	1.9719	0.0034	0.0079	2.00
546.1	0.0000	0.0000	0.0000	0.0028	2.00
	0.5181	0.5161	0.0020	0.0031	2.00
	1.0002	0.9979	0.0023	0.0033	2.00
	1.9973	2.0021	-0.0048	0.0102	2.00
590	0.0000	0.0000	0.0000	0.0028	2.00
	0.5517	0.5503	0.0014	0.0030	2.00
	1.0803	1.0808	-0.0005	0.0031	2.00
	2.0373	2.0324	0.0049	0.0105	2.00
635	0.0000	0.0000	0.0000	0.0028	2.00
	0.5591	0.5583	0.0008	0.0031	2.00
	1.0518	1.0513	0.0005	0.0030	2.00
	1.9274	1.9281	-0.0007	0.0102	2.00

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

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


ISO 17025
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP25-019Page 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
	0.7469	0.7488	-0.0019	0.0063	2.00
257	0.0000	0.0000	0.0000	0.0050	2.00
	0.8674	0.8663	0.0011	0.0067	2.00
313	0.0000	0.0000	0.0000	0.0050	2.00
	0.2919	0.2902	0.0017	0.0052	2.00
350	0.0000	0.0000	0.0000	0.0050	2.00
	0.6430	0.6428	0.0002	0.0063	2.00

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

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


ISO 17025
CALIBRATION DATA

REPORT OF CALIBRATION

Certificate No. : SP25-019Page 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	287.6	0.21	0.18	2.00
334.06	333.8	0.26	0.18	2.00
360.93	360.5	0.43	0.18	2.00
418.59	417.9	0.69	0.18	2.00
445.94	445.4	0.54	0.18	2.00
453.66	453.2	0.46	0.18	2.00
460.02	459.6	0.42	0.18	2.00
536.59	536.5	0.09	0.18	2.00
637.98	638.5	-0.52	0.18	2.00
431.38	430.7	0.68	0.18	2.00
472.50	472.3	0.20	0.18	2.00
513.47	513.5	-0.03	0.18	2.00
528.88	528.9	-0.02	0.18	2.00
573.17	573.8	-0.63	0.18	2.00
585.35	585.2	0.15	0.20	2.00
684.40	685.1	-0.70	0.18	2.00
740.72	741.1	-0.38	0.20	2.00
748.55	748.9	-0.35	0.18	2.00
807.03	807.1	-0.07	0.18	2.00
879.28	879.1	0.18	0.18	2.00

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

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


ISO 17025
CALIBRATION DATA

CERTIFICATE OF CALIBRATION

Certificate No. : SP25-001Page 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 213

Equipment : UV-Vis Spectrophotometer

Manufacturer : Hitachi

Model : U-2900

Serial No. : 21E22-009

ID No. : UAE.WAT.051/2564

Received Date : 3 January 2025

Calibration Date : 3 January 2025

Issue Date : 8 January 2025

Condition Instrument : Good

Calibrated by : 
(Mr.Tanawut Rittidach)
Technical Manager

Approved by : 
(Ms. Chonthicha Sangnern)
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 permission of DQE Services Co., Ltd.

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REPORT OF CALIBRATION

Certificate No. : SP25-001

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

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

Certified Reference Materials :

Material	Serial No.	Certificate No.	Due date
Absorbance Standard set	25760	115663	25 October 2025
Absorbance Standard set	25757	115638	25 October 2025
Wavelength Standard set	25806	115657	25 October 2025
Wavelength Standard set	25758	115665	25 October 2025

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 : 200 nm/min

Scan Interval of UUC : 0.1 nm.

Resolution of UUC : Photometric 0.001 Abs.

Wavelength 0.1 nm.

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Certificate No. : SP25-001

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Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5780	0.578	0.0000	0.0031	2.00
	1.0484	1.045	0.0034	0.0029	2.00
	2.1876	2.192	-0.0044	0.0075	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5595	0.560	-0.0005	0.0034	2.00
	1.0239	1.023	0.0009	0.0035	2.00
	2.1230	2.125	-0.0020	0.0079	2.00
465	0.0000	0.000	0.0000	0.0028	2.00
	0.5230	0.521	0.0020	0.0030	2.00
	0.9633	0.961	0.0023	0.0029	2.00
	1.9753	1.977	-0.0017	0.0070	2.00
546.1	0.0000	0.000	0.0000	0.0028	2.00
	0.5181	0.518	0.0001	0.0031	2.00
	1.0002	0.998	0.0022	0.0033	2.00
	1.9973	1.993	0.0043	0.0084	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5517	0.552	-0.0003	0.0030	2.00
	1.0803	1.079	0.0013	0.0030	2.00
	2.0373	2.032	0.0053	0.0079	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5591	0.559	0.0001	0.0031	2.00
	1.0518	1.050	0.0018	0.0030	2.00
	1.9274	1.923	0.0044	0.0079	2.00

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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
	0.7469	0.744	0.0029	0.0057	2.00
257	0.0000	0.000	0.0000	0.0050	2.00
	0.8674	0.863	0.0044	0.0059	2.00
313	0.0000	0.000	0.0000	0.0050	2.00
	0.2919	0.290	0.0019	0.0051	2.00
350	0.0000	0.000	0.0000	0.0050	2.00
	0.6430	0.640	0.0030	0.0055	2.00

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REPORT OF CALIBRATION

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Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	241.1	0.62	0.18	2.00
279.45	279.0	0.45	0.18	2.00
287.81	287.3	0.51	0.18	2.00
334.06	333.8	0.26	0.18	2.00
360.93	360.6	0.33	0.18	2.00
418.59	418.2	0.39	0.18	2.00
445.94	445.5	0.44	0.18	2.00
453.66	453.4	0.26	0.18	2.00
460.02	459.8	0.22	0.18	2.00
536.59	536.6	-0.01	0.18	2.00
637.98	637.7	0.28	0.18	2.00
431.38	431.1	0.28	0.18	2.00
472.50	472.3	0.20	0.18	2.00
513.47	513.4	0.07	0.18	2.00
528.88	528.9	-0.02	0.18	2.00
573.17	573.3	-0.13	0.18	2.00
585.35	585.1	0.25	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	748.8	-0.25	0.18	2.00
807.03	807.3	-0.27	0.18	2.00
879.28	879.6	-0.32	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%

- End of Certificate -

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Certificate of Calibration

Cert.No.: 24CH1284/1
Page.: 1 of 3

This Certificate was issued to replace to the Certificate No. 24CH1284

Equipment : pH Meter
Manufacturer : Horiba
Model : LAQUA-PH210
Serial No. : HA4G0060
ID No. : UAE.EFM.202/2564(EFM.pH.10/64)
Condition As-Received: Used Item
Received Date : 11 October 2024
Calibration Date : 15 October 2024
Reference : 2410-0455WSC-1
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with DC voltage
standard and direct measurement with
certified reference material (CRM)
- CP-CH8 by comparison with temperature standard

Calibrated by : Walalak Sirithean

Approved by :

Approved Signatory

() Unnophol Harachai
() Ponpan Paipim
(✓) Sailthip Meangmai

Issue Date : 1 November 2024

The Uncertainties are for a confidence probability of approximately 95%

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

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Condition of this calibration result

1. Reference Standard Instrument

Instrument	Serial No.	ID No.	Cert. No.	Due Date
1) Document Process Calibrator	54030049	130RC116	24E2759	25 Aug 2025
2) Ref. Standard Thermometer	4982054	110RC044	24I757	14 July 2025

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

2. Certified Reference Materials : The measurement results are traceable to SI through Hach Lenge GmbH Ltd.,
Deutsche Akkreditierungsstelle, Accredited No.D-RM-15184-01-00
: The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1835

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	1034203	27 Sep 2026
pH 6.999	Hach Lenge GmbH	C03145	28 Feb 2026
pH 9.997	CPA chem	970853	25 Apr 2025

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
	pH		mV	pH		
pH Meter S/N.: HA4G0060	4.00	177.48	177.1	4.01	0.058	2.00
	7.00	0.00	0.0	7.00	0.058	2.00
	7.00	0.00	0.0	7.00	0.058	2.00
	10.00	-177.48	-177.1	10.01	0.058	2.00

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Cert.No.: 24CH1284/1
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Calibration Results

Function : pH Measurement

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

Unit Under Calibration	Standard pH Buffer Solution	Actual pH Reading	Actual mV Reading (mV)	Uncertainty of pH Measurement (±)	Coverage factor k
pH Electrode S/N.: Q9AG0067	4.008	4.01	186.0	0.0079	2.00
	6.999	7.00	10.1	0.0084	2.00
	6.999	7.00	10.0	0.0084	2.00
	9.997	10.01	-163.2	0.0092	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9652-10D

- Serial No. : Q9AG0067

Dimension of probe

- Length : 107 mm.

- Diameter : 15 mm.

- Immersion Depth : 85 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (± °C)	Coverage factor k
20.0	20.002	20.0	-0.002	0.13	2.00
25.0	24.999	25.0	0.001	0.13	2.00
45.0	45.001	44.9	-0.101	0.13	2.00

Remark - UUC* = Unit Under Calibration

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

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