

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*
10	DO Meter	DO	Hanna	LAQJA-D0210 / H18M020	Technology Promotion Association (Thailand-Japan)	23T060	20 Jan 23	23 Mar 24
11	DO Meter	DO	Hanna	LAQJA-D0210 / H18K0504	Technology Promotion Association (Thailand-Japan)	23T010	16 Jan 23	15 Jan 24
12	DO Meter	DO	Hanna	LAQJA-D0210 / H18K0508	Technology Promotion Association (Thailand-Japan)	23T003	5 Jan 23	4 Jan 24
13	DO Meter	BIOCHEMICAL OXYGEN DEMAND BIOCHEMICAL OXYGEN DEMAND	YSI	5100 / 110 / 101803	Hakko Science	HSL00102	1 Mar 23	29 Feb 24
14	Digestion Unit	TOTAL KELLUMER NITROGEN N-BPC	VELP	EXL201 / 21517	National Food Institute Ministry of Industry, Thailand	2304455-001-01	20 Aug 23	27 Aug 24
15	Gas Chromatography		Agilent	GC-7890A / G11021007	Agilent Technologies (Thailand) Co., Ltd	Certificate of System Qualification GC-CQ	23 Feb 23	23 Feb 24
16	Heating Block	CHEMICAL OXYGEN DEMAND	Hanna Instruments	H18 E000042 / H18E0001	Hanna Instruments (Thailand) Ltd	HT-2312-0242	10 Mar 23	9 Mar 24
17	Mercury Analyzer	MERCURY	HIC Japan	HIC-4200 / 1770278	Core Group Corporation Ltd	Prevention Maintenance Report	11 Jul 23	10 Jul 24
18	Hot Air Oven	TOTAL DISSOLVED SOLIDS TOTAL SUSPENDED SOLIDS	Mettler	9F55 / ECT10411	Technology Promotion Association (Thailand-Japan)	23T0473	11 Apr 23	10 Apr 24
19	Incubator	TOTAL COLIFORM BACTERIA	Bioher	H4080 / 2023000022476	DXR Technology	0212191078	7 Aug 23	6 Aug 24
20	Inductively Coupled Plasma - Optical Emission Spectrometer (ICP-OES)	SELENIUM (dry weight) CADMIUM (dry weight) POTASSIUM SODIUM (dry weight)	Agilent	5110 / V01087055A1 / M1600001	Agilent Technologies (Thailand) Co., Ltd	Prevention Maintenance Checklist	13 Nov 23	12 Nov 24
21	Fluorim Detection Unit	TOTAL KELLUMER NITROGEN	FOSS	F4100 / 91800002	FOSS South East Asia	0411	20 May 23	20 May 24

United Analytical and Engineering Consultant Co., Ltd. (UAE)

Certified Laboratory (DOEC 11025)

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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	ARSENIC SELENIUM ARSENIC (dry weight) CADMIUM COPPER LEAD MANGANESE ZINC NICKEL CADMIUM COPPER LEAD MANGANESE NICKEL ZINC CADMIUM IRON LEAD MANGANESE NICKEL MERCURY NICKEL SOLUBLE SALTS (dry weight) NICKEL (dry weight) MANGANESE AND COPPOURIDES (dry weight) MANGANESE (dry weight)	Agilent Technologies	AAZEPS / N11310001	Thailand Institute of Scientific and Technological Research (TIST)	MIT-ACE No.307.66	2 Feb 23	1 Feb 24

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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*
22	pH Meter	pH	Hanna	LAQJA-PH10 / H18E0001	Technology Promotion Association (Thailand-Japan)	23O45	5 Jan 23	4 Jan 24
23	pH Meter	pH	Hanna	LAQJA-PH10 / H18E0002	Technology Promotion Association (Thailand-Japan)	23O469	16 Jan 23	15 Jan 24
24	pH Meter and pH Electrode	pH (1:1)	Mettler Toledo	pH 120 SmartEyeTM / 121155210	National Food Institute Ministry of Industry, Thailand	2301846-001-01	24 Feb 23	27 Feb 24
25	Spectrophotometer	O-FORMALDEHYDE O-FORMALDEHYDE-VALENT (dry weight) CHEMICAL OXYGEN DEMAND AMMONIA NITROGEN NITRATE NITROGEN	Agilent	Cary 60 / 94600A / N411541000	EOE Services Co., Ltd	SPT3101	20 May 23	19 May 24
26	UV-VIS Spectrophotometer	CHEMICAL OXYGEN DEMAND AMMONIA NITROGEN NITRATE NITROGEN	Hach	U-1800 / 20011064	EOE Services Co., Ltd	SPT31007	6 Jan 23	5 Jan 24
27	UV-VIS Spectrophotometer	NITRATE	Hach	U-2000 / 11521000	EOE Services Co., Ltd	SPT31008	6 Jan 23	5 Jan 24

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

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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*
2	Atomic Absorption Spectrometer	LEAD (dry weight) CADMIUM AND COPPOURIDES (dry weight) CADMIUM (dry weight) SELENIUM (dry weight) MERCURY (dry weight) MERCURY AND COPPOURIDES (dry weight)	Agilent Technologies	242Z AA / 9460A.M11110003	Agilent Technologies (Thailand) Co., Ltd	System Preventive Maintenance Checklist	17 Oct 23	16 Oct 24
3	Atomic Absorption Spectrometer	ARSENIC SELENIUM NICKEL	Perkin Elmer	PyroAute 800P / F180001902	Technology Promotion Association (Thailand-Japan)	WD-0227373	26 Jan 23	25 Jan 24
4	Analytical Balance	FA1 DL AND REFRAZE	Mettler Toledo	AUS24.04FA2 / 1120261010	National Ministry of Industry, Thailand	2000274.001.01	27 May 23	25 May 24
5	Analytical Balance	TOTAL DISSOLVED SOLIDS MOISTURE	Mettler Toledo	X2P32000 / C170002504	Technology Promotion Association (Thailand-Japan)	23M0113	26 Apr 23	25 Apr 24
6	Analytical Balance	TOTAL DISSOLVED SOLIDS TOTAL SUSPENDED SOLIDS	Mettler Toledo	X2P32000 / C200011072	Technology Promotion Association (Thailand-Japan)	23M0112	26 Apr 23	25 Apr 24
7	Auto Clave	TOTAL COLIFORM BACTERIA	AUF Co., Ltd (Japan)	CL-405 / 810010	DCH Technology	CT1320106	19 Jan 23	8 Jan 24
8	BOD Incubator	BIOCHEMICAL OXYGEN DEMAND	AVOQ	UGA-1320 / 13BPG-6013201	Technology Promotion Association (Thailand-Japan)	23T0449	15 Feb 23	14 Feb 24
9	Continuous Flow Analytical (CFA)	CHLORIDE	Skalar Analytical B.V. The Netherlands	San-5000/02 / 115008	The Union Co., Ltd	50022921613	27 Feb 23	20 Feb 24

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3-EQUIPMENT CALIBRATION AND TESTING SERVICES
554/4 PATTANAKARN ROAD OLD IN, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2715-3000-29 FAX: 0-2718-0484



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

Certificate of Calibration

Equipment : Electronic Balance
Manufacturer : Mettler Toledo
Model : XPe
Serial No. : B322373893
ID No. : UAE.AIR.019/2556
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Balance Room 2
Received order : 07 April 2023
Calibration Date : 07 April 2023
Ambient Temperature : 15 °C to 40 °C
Relative Humidity : 30 % to 90 %
Calibrated by :
Approved by :
() Ponthipha Tameyakul
(/) Malee Butkruea
Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 - Equipment Calibration and Testing Services

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

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

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

Range capacity : 0 g to 6.1 g Resolution 0.000001 g

Before Adjustment :

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
(g)	(g)	(g)	(± mg)	(k)
3	2.999667	+0.000013	0.026	2.00
6	6.000003	-0.000003	0.036	2.00

After Adjustment :

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

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

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

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

Result of calibration

2. Effect of off center loading

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

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

3. Departure from nominal value

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
(g)	(g)	(g)	(± mg)	(k)
Unload	0.000000	0.000000	0.0060	2.37
0.01	0.009998	+0.000002	0.0060	2.13
0.05	0.050003	-0.000003	0.0070	2.05
0.1	0.100007	-0.000007	0.0090	2.03
0.15	0.150000	0.000000	0.011	2.00
0.17	0.169998	+0.000002	0.014	2.00
0.2	0.200002	-0.000002	0.014	2.00
1.5	1.500001	-0.000001	0.020	2.00
3	2.999990	+0.000010	0.026	2.00
4.5	4.499984	+0.000016	0.036	2.00
6	5.999982	+0.000018	0.036	2.00

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3-EQUIPMENT CALIBRATION AND TESTING SERVICES
554/4 PATTANAKARN ROAD OLD IN, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2715-3000-29 FAX: 0-2718-0484



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

Certificate of Calibration

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

The Uncertainties are for a confidence probability of approximately 95%

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Approval of the head of Corporate Services 3 - Equipment Calibration and Testing Services

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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This result of calibration was made on requested at the point specified by customer.

4. This certificate is not certified for any commercial transaction.

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

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

Range capacity : 0 g to 220 g Resolution 0.0001 g

Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
100	100.0002	-0.0002	0.21	2.06
200	200.0003	-0.0003	0.28	2.00

After Adjustment :

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

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

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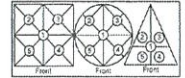
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-00150C-2

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

Result of calibration

2. Effect of off center loading

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



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

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

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.0000	0.0000	0.18	2.17
0.1	0.0999	+0.0001	0.16	2.17
1	0.9998	+0.0002	0.16	2.17
5	5.0000	0.0000	0.18	2.17
10	10.0000	0.0000	0.18	2.17
20	20.0000	0.0000	0.18	2.15
50	50.0001	-0.0001	0.19	2.11
70	70.0001	-0.0001	0.20	2.07
100	100.0002	-0.0002	0.21	2.06
150	150.0004	-0.0004	0.29	2.00
200	200.0005	-0.0005	0.29	2.00

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534-4 PATTANAKARN ROAD 801 JR. SUKUM VANG, SUKUM VANG BANGKOK 10250
TEL: 0-2717-3000-29 FAX: 0-2717-9484



Cert.No.: 23MM331
Page: 1 of 3

Certificate of Calibration

Equipment : Electronic Balance

Manufacturer : Mettler Toledo

Model : AB204-S

Serial No. : 1128312528

ID No. : UAE AIR.019/2550

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

Location : Balance Room 2

Received order : 07 April 2023

Calibration Date : 07 April 2023

Ambient Temperature : 15 °C to 40 °C

Relative Humidity : 30 % to 90 %

Calibrated by :

Approved by :

() Pomsitipha Tameyankul
(/) Malee Bulkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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

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

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

4. This certificate is not certified for any commercial transaction.

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

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

Range capacity : 0 g to 220 g Resolution 0.0001 g

Before Adjustment :

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

After Adjustment :

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

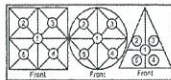
Applied Weight (g)	Standard Deviation of Reading (g)
100	0.00007
200	0.00007

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

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



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

Result of calibration

2. Effect of off center loading

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

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

3. Departure from nominal value

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

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

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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. : SP23-021Page 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

The calibration result is applied only to the above calibration 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 required in the corresponding national standards laboratory. This certificate may not be reproduced other than in full, except with the prior written approval of the DQE Services Co., Ltd.

FM-706-02 B01 1/11/2023

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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. : SP23-021Page 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 Sterna Scientific Limited

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min.

Scan Interval of UUC : 0.15 nm.

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

FM-706-02 B01 1/11/2023

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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. : SP23-021Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

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

FM-706-02 B01 1/11/2023

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

REPORT OF CALIBRATION

Certificate No. : SP23-021 Page 4 of 5

Photometric Accuracy :

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

FM-706-02 R01 1/11/2021

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

REPORT OF CALIBRATION

Certificate No. : SP23-021 Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	242.0	-0.28	0.18	2.00
279.45	279.5	-0.05	0.18	2.00
287.81	287.5	0.31	0.18	2.00
334.06	335.5	0.56	0.18	2.00
360.93	360.3	0.63	0.18	2.00
418.59	418.0	0.59	0.18	2.00
445.94	445.3	0.64	0.18	2.00
453.66	453.0	0.66	0.18	2.00
460.02	459.6	0.42	0.18	2.00
536.59	536.4	0.19	0.18	2.00
637.98	638.3	-0.32	0.18	2.00
431.38	431.0	0.38	0.18	2.00
472.50	472.5	0.00	0.18	2.00
513.47	513.5	-0.03	0.18	2.00
528.88	529.0	-0.12	0.18	2.00
573.17	573.0	0.17	0.18	2.00
585.35	585.0	0.35	0.20	2.00
684.40	684.5	-0.10	0.18	2.00
740.72	741.0	-0.28	0.20	2.00
748.55	748.5	0.05	0.18	2.00
807.03	807.0	0.03	0.18	2.00
879.28	879.5	-0.22	0.18	2.00

Remark : UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k, which for a normal distribution corresponds to a coverage probability of approximately 95%

- * Indicates non TISI accredited

- End of Certificate -

FM-706-02 R01 1/11/2021

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
5541 PATTANAKARN ROAD SOI 18, RUANLIANG, SIANGLIANG BANGKOK 10230
TEL. 0-2717-3000-27 FAX. 0-2719-9484

Certificate of Calibration

Cert.No.: 23CH59 Page: 1 of 3

Equipment : pH Meter
Manufacturer : Horiba
Model : LAQUA-PH210
Serial No. : HA0C082
ID No. : UAE EFM.072/2564 (EFM pH 05/64)
Condition As-Received: Used Item
Received Date : 13 January 2023
Calibration Date : 16 January 2023
Reference : 2301-0432VSC-1
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In-house method :
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer
Calibrated by : [Signature]
Approved by : [Signature]
() Malee Buksuea
() Sallip Meangmal
() Wankorn Lemgagtrakul
Issue Date : 19 January 2023
The Uncertainties are for a confidence probability of approximately 95%
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Approval of the head of Corporate Services 3: Equipment Calibration and Testing Services.

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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	2211306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT

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

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	826508	08 July 2024
pH 6.867	CPA chem	826589	08 July 2023
pH 10.008	CPA chem	826560	08 July 2023

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

Calibration Results
Function : mV Measurement
Performing standard curve by Fluke at pH (4.7)(7,10)

Unit Under Calibration	Nominal Value	Standard Voltage Input	Actual Reading		Uncertainty of Measurement (±mV)	Coverage factor k
	pH	mV	mV	pH		
pH Meter	4.00	177.48	177.5	4.01	0.058	2.00
S/N: HA0D082	7.00	0.00	0.2	7.00	0.058	2.00
	7.00	0.00	0.2	7.00	0.058	2.00
	10.00	-177.48	-177.1	10.01	0.058	2.00

เอกสารไม่ควบคุม



Cert.No.: 23CH59
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: 992C0037	4.008	4.01	165.2	0.0079	2.00
	6.987	7.00	-8.3	0.011	2.00
	6.987	7.00	-8.2	0.011	2.00
	10.008	10.02	-182.5	0.0095	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9652

- Serial No. : 992C0037

Dimension of probe;

- Length : 103 mm.

- Diameter : 18 mm.

- Immersion Depth : 90 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 & EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANASAKARN ROAD SOI 15, SUANLUANG, SUANLUANG BANGKOK, 10250
TEL. 0-2717-3600-27 FAX. 0-2719-9181



Cert.No.: 23CH5
Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Horiba
Model : LAQUA-PH210
Serial No. : HAOE0041
ID No. : UAE.EFM.069/2564(EFM.pH.02/64)
Condition As-Received : Used Item
Received Date : 04 January 2023
Calibration Date : 05 January 2023
Reference : 2301-0090WSC-1
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 \pm 2.5) °C
Relative Humidity : (50 \pm 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

Calibrated by : Warakorn Lermagatrakul

Approved by :

(/) Malee Butkruea
() Sathip Meangmal
() Warakorn Lermagatrakul

Issue Date :

The Uncertainties are for a confidence probability of approximately 95 %

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Cert.No.: 23CH5
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	22I1306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at -
- Traceable to National Institute of Metrology (Thailand), NIMT

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

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

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

Calibration Results

Function : mV Measurement

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

Unit Under Calibration	Nominal Value		Standard Voltage Input		Actual Reading		Uncertainty of Measurement (\pm mV)	Coverage factor k
	pH	mV	mV	pH	mV	pH		
pH Meter S/N: HAOE0041	4.00	177.48	177.4	4.01	0.058	2.00	0.058	2.00
	7.00	0.00	0.1	7.00	0.058	2.00	0.058	2.00
	7.00	0.00	0.1	7.00	0.058	2.00	0.058	2.00
	10.00	-177.48	-177.3	10.01	0.058	2.00	0.058	2.00

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Cert.No.: 23CH5
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: 990K0104	4.008	4.01	134.9	0.0086	2.05
	6.987	6.99	-34.7	0.011	2.00
	6.987	7.00	-35.0	0.011	2.00
	10.008	10.01	-207.7	0.0092	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 9652

- Serial No. : 990K0104

Dimension of probe;

- Length : 102 mm.

- Diameter : 15.5 mm.

- Immersion Depth : 85 mm.

Calibration Point (°C)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of measurement (\pm °C)	Coverage factor k
25.0	25.003	25.0	-0.003	0.13	2.00
30.0	30.005	30.0	-0.005	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: 0-2717-3000-29 FAX: 0-2718-9484



Cert.No.: 23MM112
Page: 1 of 3

Certificate of Calibration

Equipment : Electronic Balance
Manufacturer : Mettler Toledo
Model : XSR205
Serial No. : C009071872
ID No. : UAE.WAO.012/2563
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phakhanong,
Bangkok 10260
Location : Balance Room
Received order : 26 April 2023
Calibration Date : 26 April 2023
Ambient Temperature : 15 °C to 40 °C
Relative Humidity : 30 % to 90 %
Calibrated by : Man Pattanapongpalboon
Approved by :
() Ponthippa Tamoyakul
() Malee Burkrua
(✓) Suwit Imjai
Issue Date : 2 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0459OC-1
Procedure used :-

Cert.No.: 23MM112
Page: 2 of 3

Calibration were conducted using in-house calibration procedure CP-CB01 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	24063	70RC007	MM-0010-22	20 Jan 2024

2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This result of calibration was made on requested at the point specified by customer.

4. This certificate is not certified for any commercial transaction.

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

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

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

Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
80	80.00005	-0.00005	0.15	2.00
200	199.9999	+0.0001	0.29	2.00

After Adjustment :

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

Applied Weight (g)	Standard Deviation of Reading (g)
80	0.000007
200	0.00000

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Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0459OC-1

Cert.No.: 23MM112
Page: 3 of 3

Result of calibration

2. Effect of off center loading

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

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

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.00000	0.00000	0.014	2.13
0.05	0.05001	-0.00001	0.015	2.09
0.1	0.10001	-0.00001	0.015	2.09
1	1.00001	-0.00001	0.018	2.04
5	5.00003	-0.00003	0.028	2.00
20	20.00008	-0.00008	0.045	2.00
50	50.00006	-0.00006	0.080	2.00
80	80.00004	-0.00004	0.15	2.00
100	100.0000	0.0000	0.16	2.00
150	150.0000	0.0000	0.29	2.00
200	200.0000	0.0000	0.29	2.00

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

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เอกสารไม่ควบคุม



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-3000-29 FAX: 0-2718-9484



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

Certificate of Calibration

Equipment : Electronic Balance
Manufacturer : Mettler Toledo
Model : XSR205
Serial No. : C210685394
ID No. : UAE.WAO.010/2565
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phakhanong,
Bangkok 10260
Location : Balance Room
Received order : 26 April 2023
Calibration Date : 26 April 2023
Ambient Temperature :
Relative Humidity :
Calibrated by :
Approved by :
() Ponthippa Tamoyakul
() Malee Burkrua
(✓) Suwit Imjai
Issue Date :

The Uncertainties are for a confidence probability of approximately 95%

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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
161 g to 220 g Resolution 0.0001 g

Before Adjustment :

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

After Adjustment :

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

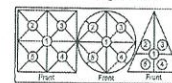
Applied Weight (g)	Standard Deviation of Reading (g)
80	0.000007
200	0.00004

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

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



2. Effect of off center loading

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

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

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.00000	0.00000	0.014	2.11
0.05	0.04999	+0.00001	0.015	2.09
0.1	0.09999	+0.00001	0.015	2.07
1	1.00000	0.00000	0.018	2.04
5	5.00000	0.00000	0.026	2.00
20	20.00002	-0.00002	0.045	2.00
50	50.00002	-0.00002	0.080	2.00
80	80.00002	-0.00002	0.15	2.00
100	100.00000	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 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
55/4 PATTANAKARN ROAD SOI 38, SUKHUMVIT ROAD, SUKUMVIT 38 BANGKOK 10250
TEL: 0-271 7-3000-29 FAX: 0-2719-9484



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

Certificate of Calibration

Equipment : BOD Incubator
Manufacturer : Arca
Model : UIC4-1320
Serial No. : 13URC45013201
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 :
Approved by :
() Pornthippa Tameyakul
(✓) Mailee Butkruea
() Suwit Imjai

Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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A 0051476



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

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

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

Condition of this result of calibration

1. Reference standard instrument:-

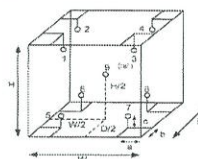
Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available



Probe Installation Details :	Dimension of Chamber :
a = 10 cm	D = 0.62 m
b = 10 cm	W = 1.2 m
c = 10 cm	H = 1.2 m
	Capacity = 0.89 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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Equipment : BOD Incubator
 Condition As-Received : Used Item
 Reference : 2302-02970C-1
 Result of Calibration :- (*) Without Adjustment
 Function of UUC* : Temperature Source
 Fresh air setting : Not Available

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

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

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
20.0	20.086	19.916	20.386	19.976	19.973	19.836	19.637	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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 TEL. 0-2717-3900-29 FAX. 0-2719-9454



Cert. No.: 23TM373
 Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
 Manufacturer : Memmert
 Model : UF 55
 Serial No. : B212.0411
 ID No. : UAE.WAO.003/2556
 Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
 3 Soi Udomsak 41, Sukhumvit Road,
 Bangkok, Phrakhanong,
 Bangkok 10260
 Location : Lab Floor 2
 Received Order : 11 April 2023
 Calibration Date : 11 - 12 April 2023
 Ambient Temperature : (26 ± 10) °C
 Relative Humidity : (50 ± 30) %

Calibrated by : 
 Approved by : 
 () Ponthipha Tamee
 (✓) Malee Butkruea
 () Suwit Imjai

Issue Date : 24 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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 A 0053359



Equipment : Hot Air Oven
 Condition As-Received : Used Item
 Reference : 2304-01560C-1

Cert. No.: 23TM373
 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) and Thermocouple Type T.

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

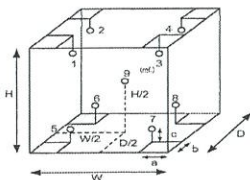
Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34972A	MY59003411	22LM165	26 Nov 2023

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.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details : Dimension of Chamber :
 a = 5.0 cm D = 0.50 m
 b = 5.0 cm W = 0.80 m
 c = 5.0 cm H = 0.75 m
 Capacity = 0.30 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	28
REL.Humid. (%)	45	44
AC Supply (Volt)	221	220

Ref. Std. ID No.: @ Calibration Point		
Position :	(120 to 180) °C	(104) °C
1	18-20TC-01	20RTD-2/1
2	18-20TC-02	20RTD-2/2
3	18-20TC-03	20RTD-2/3
4	18-20TC-04	20RTD-2/4
5	18-20TC-05	20RTD-2/5
6	18-20TC-06	20RTD-2/5
7	18-20TC-07	20RTD-2/7
8	18-20TC-08	20RTD-2/8
9 (ref.)	18-20TC-09	20RTD-2/9

เอกสารไม่ควบคุม
 a 1158261



Equipment : Hot Air Oven
 Condition As-Received : Used Item
 Reference : 2304-01560C-1
 Result of Calibration :- (*) Without Adjustment
 Function of UUC* : Temperature Source
 Fresh air setting : Close

Cert. No.: 23TM373
 Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
104.0	104.0	104.0	0.054	0.59	0.95	2
120.0	120.0	120.0	0.12	0.89	1.5	2
180.0	180.0	180.0	0.12	1.5	2.5	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	Position									
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.512	104.016	104.542	104.407	103.704	103.728	104.167	104.168	104.001	0.42
120.0	120.317	119.768	120.524	120.232	119.363	119.208	119.888	119.797	119.735	1.1
180.0	180.678	179.819	181.357	180.871	179.303	179.139	180.230	180.055	179.960	1.1

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

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

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เอกสารไม่ควบคุม
 a 1158260



Cert.No.: 23TW3
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE0H0008
ID No. : UAE.EFM.086/2564(EFM.DO.05/04)
Received Date : 04 January 2023
Test Date : 05 January 2023
Reference : 2301-0081WSC-5
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-CH-9
by Comparison Technique with Azide Modification Method

Tested by :

Approved by :

(/) Malee Butkrusa
() Saithip Maangmai
() Warakorn Lemgagtrekul

Issue Date : 6 January 2023

เอกสารไม่ควบคุม



Cert.No.: 23TW3
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	AM17B3316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: 9K0L0009

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



Cert. No.: 23LM3
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter With Sensor
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE0H0008
ID No. : UAE EFM 086/2564(EFM DO 05/04)
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangkok, Phrakhanong,
Bangkok 10260
Location : TPA On Site Calibration Laboratory
Received Order : 4 January 2023
Calibrated Date : 6 January 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V

Calibrated by :

Approved by :

() Pornthippa Tamayakul
(/) Suwit Injail

Issue Date : 10 January 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



Equipment : DO Meter With Sensor
Condition As-Received : Used Item
Reference : 2301-0081WSC-6
Procedure Used :-

Cert. No.: 23LM3
Page.: 2 of 2

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

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	2186080	22H1285	21 Oct 2023

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

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

Result of Calibration :- (°) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 9K0L0009

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	80	24.996	25.0	0.004	0.16	2.00
30.0	80	29.995	30.1	0.105	0.16	2.00
35.0	80	34.996	35.0	0.004	0.16	2.00

UUC* : Unit Under Calibration

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

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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 FAX. 0-2719-9484

Cert.No.: 23TW10
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE0H0004
ID No. : UAE.EFM.084/2564(EFM.DO.03/64)
Received Date : 13 January 2023
Test Date : 16 January 2023
Reference : 2301-0434WSC-3
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomek 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 Sinthean
Approved by :
(/) Malee Butkruesa
() Sathip Meangmai
() Warakorn Lemgagrakul
Issue Date : 18 January 2023

เอกสารไม่ควบคุม
a 0305697



Cert.No.: 23TW10
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.: 9KOF0045

Titration Method (Azide Modification Method)	DO Meter Reading	Standard Deviation
(mg/L)	(mg/L)	(mg/L)
8.14	8.14	0.0089

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

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a 1143663



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.: 23LM10
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter with Sensor
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE0H0004
ID No. : UAE.EFM.084/2564(EFM.DO.03/64)
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomek 41, Sukhumvit Road,
Bangkok, Phrakhanong,
Bangkok 10260
Location : TPA Onsite Calibration Laboratory
Received Order : 13 January 2023
Calibrated Date : 17 January 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by :
Approved by :
() Pornthippa Tameyakul
(/) Suwit Imjai
Issue Date : 19 January 2023

The Uncertainties are for a confidence probability of approximately 95 %

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

เอกสารไม่ควบคุม
A 0050105



Equipment : DO Meter with Sensor
Condition As-Received : Used Item
Reference : 2301-0434WSC-4
Procedure Used :-

Cert. No.: 23LM10
Page.: 2 of 2

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Model	Serial No.	Cert. No.	Due Date
1) Digital Thermometer	1523	2188080	2211285	21 Oct 2023

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

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

Result of Calibration :- (') Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 9KOF0045

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	100	24.996	25.0	0.004	0.16	2.00
30.0	100	30.000	30.0	0.000	0.16	2.00
35.0	100	34.999	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 1143786



Cert.No.: 23TW90
Page.: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE1M0020
ID No. : UAE.EFM.019/2565(EFM.DO.03/65)
Received Date : 28 March 2023
Test Date : 29 March 2023
Reference : 2303-0996WSC-7
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 : 
Approved by : 
(/) Malee Butkruea
() Sathip Maangmai
() Warakorn Lernagatrakul

Issue Date : 31 March 2023

เอกสารไม่ควบคุม



Cert.No.: 23TW90
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	23CG1172	22 Mar 2025
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.: 9K1K0080

Titration Method (Azide Modification Method)	DO Meter Reading	Standard Deviation
(mg/L)	(mg/L)	(mg/L)
8.16	8.15	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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Malee

เอกสารไม่ควบคุม



Cert. No.: 23LM61
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter With Sensor
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE1M0020
ID No. : UAE.EFM.019/2565(EFM.DO.03/65)
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 : 28 March 2023
Calibrated Date : 31 March 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : Malee Butkruea
Approved by : 
() Ponthippa Tameyakul
(/) Suwit Imjai
Issue Date : 12 April 2023

The Uncertainties are for a confidence probability of approximately 95 %

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

เอกสารไม่ควบคุม



Equipment : DO Meter With Sensor
Condition As-Received : Used Item
Reference : 2303-0996WSC-8
Procedure Used :-

Cert. No.: 23LM61
Page.: 2 of 2

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	A52847	22H1325	31 Oct 2023

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

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

Result of Calibration :- (') Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N.: 9K1K0080

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	90	24.999	25.0	0.001	0.16	2.00
30.0	90	29.997	30.0	0.003	0.16	2.00
35.0	90	35.009	35.0	-0.008	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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Suwit

เอกสารไม่ควบคุม

Calibration Report

Certificate No.: 2301846-001-01
Equipment: Digital Thermometer with RTD
Resolution: 0.1 °C Model: SevenEasy TM 520 pH
Serial No.: 1231155210 ID No.: UAE.WAT.010/2553
Manufacturer: Mettler Toledo
Date of Calibration: 24 February 2023

Page 4 of 5

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

Condition of this results of Calibration:

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

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1523	2118154	PSL-T 0673/65	07-Jun-23	TJSTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

Support Equipment : - Low Temperature Bath (Micro Bath), Model: 7103, S/N: A39538, AN65 A85181.

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

FC-S-012 Revision: 01 Date: 20-04-65

Calibration Report

Certificate No.: 2301846-001-01
Equipment: Digital Thermometer with RTD
Resolution: 0.1 °C Model: SevenEasy TM 520 pH
Serial No.: 1231155210 ID No.: UAE.WAT.010/2553
Manufacturer: Mettler Toledo
Date of Calibration: 24 February 2023

Page 5 of 5

Calibration point: 15.0, 25.0 and 35.0 °C

Calibration result:

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

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.1	15.015	- 0.1	0.11
25.0	25.014	0.0	0.11
35.1	35.016	- 0.1	0.11

Note

- UUC* : Unit Under Calibration

The report uncertainty of measurement was based on standard uncertainty multiplied by covers providing a level of confidence of approximately 95 %.

----- End -----

FC-S-012 Revision: 01 Date: 20-04-65

Calibration Certificate

Certificate No.: 2303074-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Sol Udomsuk 41, Sukhumvit Road,
Bangchack, Prakanong, Bangkok 10260

Page 1 of 3

Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: AB204-S/FACT
Serial No.: 1129361010
ID No.: UAE.WAS.002/2552
Order No.: 2303074
Operation No.: 2303074-001
Date of Receipt: 26 May 2023
Date of Calibration: 26 May 2023

Calibrated by Mr.Pheraphat Tuanjit
Scientist

Approved

Vice P

Date of Issue: 29 May 2023

Responsible for the Technical Management Team

The uncertainties are for a confidence probability of approximately 95%

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

FC-S-009 Revision: 01 Date: 20-04-65

Calibration Report

Certificate No.: 2303074-001-01
Equipment: Electronic Balance
Manufacturer: METTLER TOLEDO
Model: AB204-S/FACT
Serial No.: 1129361010
ID No.: UAE.WAS.002/2552
Capacity: 220 g
Date of Calibration: 26 May 2023

Page 2 of 3

Environment Condition: Ambient Temperature: 23.7 ± 0.1 °C Relative Humidity: 61 ± 2.2 %

Place of Calibration: Room 108 Balance Room, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

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

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	8505667572	TCS	M23045535	8 April 2024
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFI.BTH 018/23	Quality Reborn	QR23-0491	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	0.000048
200	0.000048

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)
99.9995	99.9995	99.9995	99.9999	99.9999	99.9997	0.0003

FC-S-012 Revision: 01 Date: 20-04-65



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



Calibration Report

Certificate No.: 2303074-001-01

Equipment: Electronic Balance

Model: AB204-S/FACT

Serial No.: 112961010

Capacity: 220 g

Manufacturer: METTLER TOLEDO

Resolution: 0.0001 g

ID No.: UAE.WAS.002/2552

Date of Calibration: 26 May 2023

Page 3 of 3

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
Unloaded	0.0000	0.0000	0.0000	0.000088	2.00
0.01	0.01000	0.0100	0.0000	0.000088	2.00
0.05	0.05000	0.0500	0.0000	0.000088	2.00
0.1	0.10001	0.0999	0.0001	0.000088	2.00
0.2	0.20001	0.1999	0.0001	0.000088	2.00
0.5	0.50002	0.5000	0.0000	0.000088	2.00
1	1.00000	1.0000	0.0000	0.000088	2.00
2	2.00002	2.0000	0.0000	0.000089	2.00
5	5.00002	5.0000	0.0000	0.000090	2.00
10	10.00001	9.9999	0.0001	0.000091	2.00
20	20.00003	20.0000	0.0000	0.000095	2.00
50	50.00003	49.9999	0.0001	0.00011	2.00
70	70.00006	69.9999	0.0002	0.00013	2.00
100	100.00006	99.9999	0.0002	0.00016	2.00
150	150.00009	149.9999	0.0002	0.00021	2.00
200	200.00016	199.9996	0.0004	0.00028	2.00

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor of approximately 95 %.

----- End -----

FCS-012 Revision: 01 Date: 28-04-65

2008 ซ. 36, Anu Anom Road, Bang Yai Kruai Subdistr., Bang Phai Sanc., Bangkok 10700, Thailand
Tel: 0662 6432 6558 Fax: 0662 6432 6556



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

Verification Certificate

Certificate No.: 2304455-001-01

Client name:

Address:

UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

3 Soi Udomsuk 41, Sukhumvit Road,

Bangchack, Prakhonong, Bangkok 10260

Page 1 of 4

Equipment:

Digestion Unit (Heating Block)

Manufacturer:

VELP SCIENTIFICA

Model:

DKL20

Serial No.:

213517

ID No.:

UAE.WAS.005/2555

Order No.:

2304455

Operation No.:

2304455-001

Date of Receipt:

28 August 2023

Date of Calibration:

28-29 August 2023

Calibrated by

Mr. Manas Somsak
Specialist

Approved

Date of Issue:

1 September 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 ซ. 36, Anu Anom Road, Bang Yai Kruai Subdistr., Bang Phai Sanc., Bangkok 10700, Thailand
Tel: 0662 6432 6558 Fax: 0662 6432 6556



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

Verification Report

Certificate No.: 2304455-001-01

Equipment: Digestion Unit (Heating Block)

Model: DKL20

Serial No.: 213517

Resolution: 1 °C ID No.: UAE.WAS.005/2555

Manufacturer: VELP SCIENTIFICA

Date of Calibration: 28-29 August 2023

Page 2 of 4

Location:

Dry Laboratory (312), UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Environment Condition:

Ambient Temperature (28 ± 1) °C

Relative Humidity (56 ± 3) %

Line Voltage (224 ± 2) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert standard thermocouples type R into its Digestion blocks and Calibration according to NFI Method W-TE-026 based on BS 4309 : 1968
- 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	1944045576/1944194483	TC23/0048	2-Jun-2024	N.M. Technical Center Laboratory
	Type R	R/CH1 to R/CH3			

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

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

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

6. Condition of Calibrated item : Good

UUC* Description

Time of Record 1 Hour 6 Minute At 380 °C

7. Result of Calibration :

☒

Without adjustment

☐

After adjustment

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

2008 ซ. 36, Anu Anom Road, Bang Yai Kruai Subdistr., Bang Phai Sanc., Bangkok 10700, Thailand
Tel: 0662 6432 6558 Fax: 0662 6432 6556



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

Verification Report

Certificate No.: 2304455-001-01

Equipment: Digestion Unit (Heating Block)

Model: DKL20

Serial No.: 213517

Resolution: 1 °C ID No.: UAE.WAS.005/2555

Manufacturer: VELP SCIENTIFICA

Date of Calibration: 28-29 August 2023

Page 3 of 4

Calibration point:

380 °C

Calibration result:

Table 1: Reporting of Temperature

Block No.	UUC* Setting (°C)	UUC* Reading (°C)	Stability (±°C)	Standard Thermometer (°C)	Uncertainty (±°C)
1	380	380	0.16	378.59	2.0
2	380	380	0.18	378.65	2.0
3	380	380	0.18	381.62	2.0
4	380	380	0.24	380.23	2.0
5	380	380	0.26	379.86	2.0
6	380	380	0.26	380.93	2.0
7	380	380	0.25	381.11	2.0
8	380	380	0.19	382.35	2.0
9	380	380	0.26	381.55	2.0
10	380	380	0.25	380.20	2.0
11	380	380	0.29	382.08	2.0
12	380	380	0.19	382.26	2.0
13	380	380	0.19	382.26	2.0
14	380	380	0.21	382.15	2.0
15	380	380	0.12	382.15	2.0
16	380	380	0.20	381.91	2.0
17	380	380	0.15	381.09	2.0
18	380	380	0.13	381.42	2.0
19	380	380	0.13	381.77	2.0
20	380	380	0.29	382.08	2.0

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 providing a level of confidence of approximately 95 %.

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

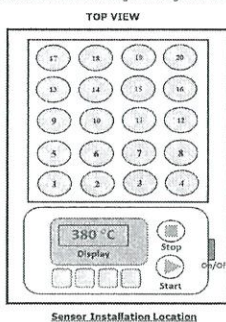
2008 ซ. 36, Anu Anom Road, Bang Yai Kruai Subdistr., Bang Phai Sanc., Bangkok 10700, Thailand
Tel: 0662 6432 6558 Fax: 0662 6432 6556



Verification Report

Certificate No.: 2304455-001-01
Equipment: Digestion Unit (Heating Block)
Model: DKL20 Serial No.: 213517
Resolution: 1 °C ID No.: UAE.WAS.005/2555
Manufacturer: VEP SCIENTIFICA
Date of Calibration: 28-29 August 2023 Page 4 of 4
Calibration point: 380 °C
Calibration result: Continued

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



Sensor Installation Location

----- End -----

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

DKSH Technology Limited, 2533 Sukhumvit Road, Bangkok 10260, Thailand
โทร: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientia-thailand
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Certificate of Calibration

Equipment: Autoclave
Model: CL-40L
Serial No. (or ID.): 810010
Manufacturer: ALP
Condition: In Condition
Certificate No.: C11230106
Issued Date: 11 June 2023
Job No.: KSPR2308770
Page: 1 of 4

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

Environment Condition: Temperature: 22 °C ± 0.8 °C
Humidity: 58 %RH ± 4.0 %RH
Voltage: 229 VAC ± 1.3 VAC

Calibration Place: United Analyst and Engineering Consultant Company Limited. (301 Room)
3 Soi Udomsuk 41 Sukhumvit Road,
Bangkok, Prakanong, Bangkok 10260 Thailand.

Calibration By: Mr. Amornthep Phumpha
Calibration Date: 09 June 2023
The Method used: In house method, CAL-WI-18, base on BS 2846 : Part 5
Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through Quality reborn Co., Ltd.
Certificate No. QR23-0086



Person in charge



Authorized signatory

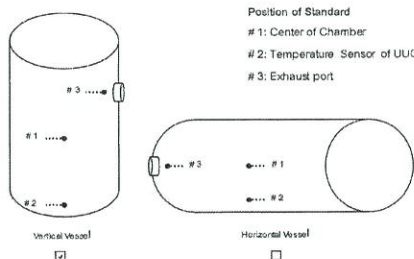
This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty which 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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Certificate No.: C11230106 Page: 2 of 4



Standard Installation Locations

Standard Locations (#1): Geometric center of the chamber
Standard Locations (#2): Distance from temperature sensor of UUC 2 (cm.)
Standard Locations (#3): Distance from the wall 5 (cm.)

Position of Std	#1	#2	#3
Channel of Logger	4	5	6

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.

Measured Temperature: The average reading of standards at any positions or location.

Measured Stability: The one-half of greatest maximum difference of measured temperatures at any one probe.

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CAL-FM-C11-15: 12 Sep 2022

Certificate No.: C11230106 Page: 3 of 4

Calibration Results: Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 115.0 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	115.34	0.34	0.35
#2	115.43	0.43	0.35
#3	115.43	0.43	0.35

Temperature Distribution

Temperature			Pressure	Measured Temperature at Spread Locations			Uncertainty (± °C)*
Desired (°C)	Setting (°C)	Indicating (°C)	Mpa	#1 (°C)	#2 (°C)	#3 (°C)	
115	115	115.0	0.08	115.34	115.43	115.43	0.35

Chamber Characterization

Indicating Temperature (°C)	Indicating Pressure Mpa	Measured Stability (± °C)
115.0	0.08	0.15

Note: * Maximum uncertainty of the each position

Record every 10 seconds after reaching steady state or after one achieved complete cycle.

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CAL-FM-C11-15: 12 Sep 2022

Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 121.0 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	121.34	0.34	0.35
#2	121.40	0.40	0.35
#3	121.26	0.26	0.35

Temperature Distribution

Temperature			Pressure	Measured Temperature at Spread Locations			Uncertainty
Desired (°C)	Setting (°C)	Indicating (°C)	Indicating Mpa	#1 (°C)	#2 (°C)	#3 (°C)	
121	121	121.0	0.12	121.34	121.40	121.26	0.35

Chamber Characterization

Indicating Temperature (°C)	Indicating Pressure Mpa	Measured Stability (± °C)
121.0	0.12	0.07

Note: * Maximum uncertainty of the each position

Record every 10 seconds after reaching steady state or after one achieved complete cycle.

The End of Certificate

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เอกสารไม่ควบคุม

CAL-FM-C11-10: 12 Sep 2022



Certificate of Calibration

Equipment: Cooled Incubator
Model: KB 400
Serial No.(or ID): 2022000022479
Manufacturer: Binder
Condition: New
Shelves(pc.): 5

Certificate No.: C31231678
Issued Date: 10 August 2023
Job No.: WO-00002652
Page: 1 of 3
Ventilation Valve: None

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

Environment Condition: Temperature: 25 °C ± 1.9 °C
Humidity: 49 %RH ± 5.3 %RH
Voltage: 232 VAC ± 1.2 VAC

Calibration Place: United Analyst and Engineering Consultant Company Limited. (Control Area)
3 Sol Udomsuk 41 Sukhumvit Road,
Bangkok, Prakanong, Bangkok 10260 Thailand.

Calibration By: Mr. Thanakrit Raksapol

Calibration Date: 07 August 2023

The Method used: In house method, CAL-WI-16, base on TLAS-G20

Traceability: This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Limited.
Certificate No. C10230019

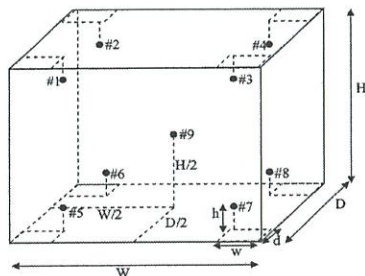
This certificate is issued in the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standards or other recognized national standard laboratories.
The measurement uncertainty stated is the expanded uncertainty 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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CAL-FM-C31-10: 12 Sep 2022



Standard Installation Locations

Volume (Calibration Zone)= 193 (Liters)

Inside chamber: W = 65 (cm) D = 49 (cm) H = 127 (cm)

Standard Locations (#1, #2, #3, #4): w = 7 (cm) d = 5 (cm) h = 15 (cm)

Standard Locations (#5, #6, #7, #8): w = 7 (cm) d = 5 (cm) h = 15 (cm)

#9: Geometric center of the chamber

Position of Std	#1	#2	#3	#4	#5	#6	#7	#8	#9
Channel of Logger	301	302	303	304	305	306	307	308	309

Definitions

Indicating Temperature: The average reading of indicating device which forms the integral part of the enclosure.**Measured Temperature:** The average reading of standards at any positions or location.**Measured Uniformity:** The maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time or at close observation time as possible to determine the temperature pattern or homogeneity with the chamber at steady-state. The reference probe is preferably located in the geometric center of the chamber.**Measured Stability:** The one-half of greatest maximum difference of measured temperatures at any one probe.**Overall Variation:** The difference of maximum and minimum measured temperatures throughout observation time.

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CAL-FM-C31-10: 12 Sep 2022

Calibration Results:

Without adjustment

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 35.0 °C

Locations	Measured Temperature (°C)	Correction of UUC (°C)	Uncertainty (± °C)
#1	36.11	0.11	0.23
#2	35.04	0.04	0.23
#3	35.03	0.03	0.23
#4	35.13	0.13	0.23
#5	35.02	0.02	0.23
#6	35.07	0.07	0.23
#7	34.97	-0.03	0.23
#8	34.97	-0.03	0.23
#9	35.10	0.10	0.23

Temperature Distribution

Desired		Setting	Indicating	Measured Temperature at Spread Locations (°C)									Uncertainty (± °C)*
(°C)	(°C)	(°C)	(°C)	#1	#2	#3	#4	#5	#6	#7	#8	#9	
35.0	35.0	35.0	35.0	35.11	35.04	35.03	35.13	35.02	35.07	34.97	34.97	35.10	0.23

Chamber Characterization

Indicating (°C)	Measured Uniformity (°C)	Measured Stability (± °C)	Overall Variation (°C)
35.0	0.16	0.04	0.22

Note: * Maximum uncertainty of the each position

The End of Certificate

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CAL-FM-C31-10: 12 Sep 2022

Statements of conformity:

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

The correction of indication determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, TLAS-G20. Therefore, those parameters have not been assessed separately.

Tolerance and Decision rules:

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

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

Without adjustment

Desired Temperature : 35.0 °C Tolerances : 0.5 °C

Measurement Temperature at Spread Locations, Indicating of Unit Under Calibration: 35.0 °C

Locations	Measured (°C)	Correction* (°C)	Guard band (W) (± °C)	Tolerance (± °C)	Conformity
#1	35.11	0.11	0.23	0.5	Pass
#2	35.04	0.04	0.23	0.5	Pass
#3	35.03	0.03	0.23	0.5	Pass
#4	35.13	0.13	0.23	0.5	Pass
#5	35.02	0.02	0.23	0.5	Pass
#6	35.07	0.07	0.23	0.5	Pass
#7	34.97	-0.03	0.23	0.5	Pass
#8	34.97	-0.03	0.23	0.5	Pass
#9	35.10	0.10	0.23	0.5	Pass

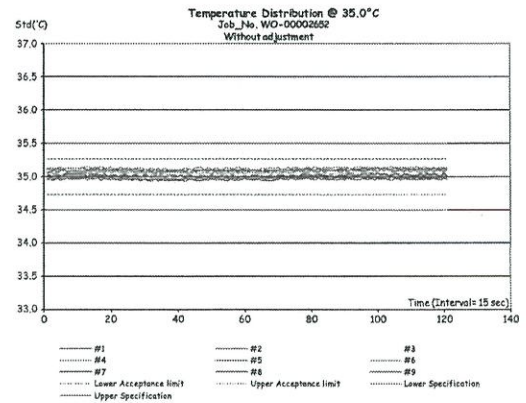
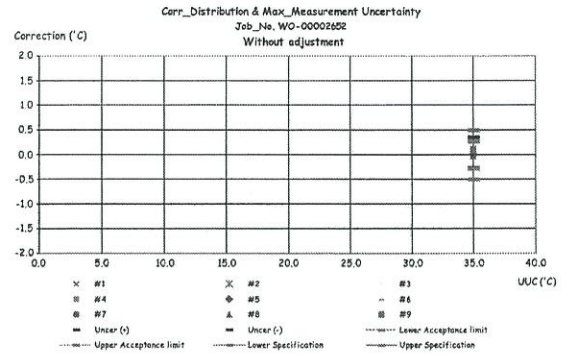
Correction* = Measured Temperature - Desired Temperature

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

The End of Statements of Conformity

DKSH Technology Limited
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เอกสารไม่ควบคุม
CAL-FM-C31-10-12 Sep 2022



เอกสารไม่ควบคุม

ใบตรวจสอบสภาพเครื่องควบคุมอุณหภูมิ

เลขที่ใบงาน: WO-00002652

ชนิดเครื่องมือ: Cooled Incubator รุ่น: KB 400

หมายเลขเครื่อง: 20220000022479.000

ตรวจสอบ (วัน)	รายการตรวจเช็ค	ตรวจสอบ (ส่ง)	หมายเหตุ
07 Aug 2023		07 Aug 2023	
ปกติ	ไม่ปกติ	ปกติ	ไม่ปกติ
	General		
<input checked="" type="checkbox"/>	<input type="checkbox"/> 1. สายไฟ	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 2. การทำงาน Main Switch	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 3. การทำงาน Selector Key	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 4. การแสดงผล Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 5. การทำงาน พัดลม	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 6. สภาพ Lever of Ventilation valve	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 7. สภาพ Lever door open / close	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 8. สภาพ Door seal	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 9. การทำงานของระบบ Safety	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 10. การทำงานของระบบทำความเย็น	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 11. การทำงานของระบบทำความร้อน	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 12. สภาพตู้เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>
<input checked="" type="checkbox"/>	<input type="checkbox"/> 13. สภาพแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>

ชื่อและตำแหน่ง:

Mr. Thanakrit Raksapol
Service Engineer

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Agilent CrossLab Compliance Services

Certificate of System Qualification
GC-OQ

System ID: UAE TOX.007_CN11021007
Organization Name: United Analyst and Engineering Consultant Co. Ltd.
Organization Location: 3 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260

Date: February 23, 2023 3:19:15 PM
EQP Name: AgilentRecommended
EQP Revision: GC.02.51
Overall Qualification Status: Pass

System Inspection and Basic Safety and Operation

Name: 7890

Setpoint Status: Pass

Overall System Inspection and Basic Safety and Operation Test Status

Pass

Inlet Pressure Decay

Name: 7890

Front SSL

Setpoint Status: Pass

Pressure: 25.0 psi

Pressure Change: -0.1 psi / 5 minutes

Agilent Recommended: >= -2.0 and <= 0.5

Overall Inlet Pressure Decay Test Status

Pass

Inlet Pressure Accuracy

Name: 7890

Front SSL

Date: February 23, 2023 3:19:15 PM
System ID: UAE TOX.007_CN11021007

เอกสารไม่ควบคุม

Setpoint Status:

Pass

Inlet Pressure: 25.0 psi Actual 25.0 psi
Accuracy: 0.0 psi
Agilent Recommended: <= 1.2

Overall Inlet Pressure Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890
Front UECD

Setpoint Status:

Pass

Flow Type: Makeup
Setpoint: 25.0 mL/min Measured Flow: 24.9 mL/min
Accuracy: 0.1 mL/min
Agilent Recommended: <= 10.0 % setpoint (2.5 mL/min)
Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

Detector Flow Accuracy

Name: 7890
Back FID

Setpoint Status:

Pass

Flow Type: Fuel
Setpoint: 30.0 mL/min Measured Flow: 30.2 mL/min
Accuracy: 0.2 mL/min
Agilent Recommended: <= 10.0 % setpoint (3.0 mL/min)
Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

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Setpoint Status:

Pass

Flow Type: Oxidizer
Setpoint: 400.0 mL/min Measured Flow: 389.6 mL/min
Accuracy: 10.4 mL/min
Agilent Recommended: <= 10.0 % setpoint (40.0 mL/min)
Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

Setpoint Status:

Pass

Flow Type: Makeup
Setpoint: 25.0 mL/min Measured Flow: 24.9 mL/min
Accuracy: 0.1 mL/min
Agilent Recommended: <= 10.0 % setpoint (2.5 mL/min)
Limit is percentage of setpoint or 0.5 mL/min, whichever is largest.

Overall Detector Flow Accuracy Test Status

Pass

GC Oven Temperature Accuracy

Name: 7890
Setpoint Status: Pass
Zone: Oven
Setpoint/Actual:
Temperature: 230.0 230.0 °C
Accuracy: 0.0 °C
Agilent Recommended: >= -1.0 % setpoint in K (-5.0 °C)
<= 1.0 % setpoint in K (5.0 °C)

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Setpoint Status:

Pass

Zone: Oven
Setpoint/Actual:
Temperature: 100.0 100.8 °C
Accuracy: 0.8 °C
Agilent Recommended: >= -1.0 % setpoint in K (-3.7 °C)
<= 1.0 % setpoint in K (3.7 °C)

Overall GC Oven Temperature Accuracy Test Status

Pass

GC Oven Temperature Stability

Name: 7890
Setpoint Status: Pass
Setpoint/Average:
Temperature: 100.0 100.7833 °C
Stability: 0.1 °C
Agilent Recommended: <= 0.5

Overall GC Oven Temperature Stability Test Status

Pass

Scouting Run

Tested Combination1 Front SSL / Front UECD
Injection Tower
Name: 7893B
Setpoint Status: Completed
Injection Volume on Column: 1.0 uL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination1 Front SSL / Front UECD

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Name: 7890
Setpoint Status: Pass
Base Signal: 212 Hz
ASTM Noise: 1.24 Hz
Drift: 13.32 Hz/hr
Agilent Recommended: <= 3.00 <= 15.00
Status: Pass Pass

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination1 Front SSL / Front UECD
Name: 7893B
Setpoint Status: Pass
Injection Volume on Column: 1.0 uL
Area RSD: 2.38 % Retention Time RSD: 0.03 %
Agilent Recommended: <= 3.00 <= 1.00

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination1 Front SSL / Front UECD
Injection Tower
Name: 7890
Setpoint Status: Pass
Signal to Noise: 4533
Agilent Recommended: >= 1500

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Overall Signal to Noise Test Status

Pass

Scouting Run

Tested Combination2 Front SSL / Back FID

Name: 7683B

Setpoint Status: Completed

Injection Volume on Column: 1.0 µL

Overall Scouting Run Status

Completed

Noise and Drift

Tested Combination2 Front SSL / Back FID

Name: 7890

Setpoint Status: Pass

Base Signal: 12.2 pA

	ASTM Noise pA	Drift pA/Hr
Agilent Recommended:	0.04	0.07
Status:	Pass	Pass

Overall Noise and Drift Test Status

Pass

Injection Precision

Tested Combination2 Front SSL / Back FID

Name: 7683B

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Setpoint Status: Pass

Injection Volume on Column: 1.0 µL

Area RSD: 0.57 % Retention Time RSD: 0.74 %

Agilent Recommended: <= 3.00 <= 1.00

Overall Injection Precision Test Status

Pass

Signal to Noise

Tested Combination2 Front SSL / Back FID

Name: 7890

Setpoint Status: Pass

Signal to Noise: 1173500

Agilent Recommended: >= 300000

Overall Signal to Noise Test Status

Pass

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Instrument Details

Purpose

This section describes the as found system configuration.

Details

System

System ID	UAE.TOX.007_CN11021007
Manufacturer	Agilent Technologies
Name	7890
Flow Data Input	Manual Data
Temperature Data Input	Manual Data or Other Data Logging

Tested Combination1	Injection Tower
Injection Technique	Front
Inlet	Front
Detector	Front
LTM Included?	No

Tested Combination2	Injection Tower
Injection Technique	Front
Inlet	Back
Detector	Back
LTM Included?	No

Sampler 1	Agilent Technologies
Manufacturer	Agilent Technologies
Type	Injection Tower
Name	7683B
Model Number	G2913A
Serial Number	CN28149436
Firmware Revision	A.11.02
Usage	Sample Injection
Location	Front
Syringe Volume (µL)	10

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Sampler 2

Manufacturer	Agilent Technologies
Type	Tray
Name	7683A
Model Number	G2614A
Serial Number	CN82248787
Firmware Revision	A.02.01

Mainframe 1

Manufacturer	Agilent Technologies
Name	7890
Model Number	G3440A
Serial Number	CN11021007
Firmware Revision	A.01.11
Oven Type	Standard

Inlet 1

Manufacturer	Agilent Technologies
Name	7890
Type	SSL
Location	Front
Carrier Gas	Helium
Control Type	Electronic Pressure Control (EPC)
Purged Inlet	Yes

Detector 1

Manufacturer	Agilent Technologies
Name	7890
Type	UECD
Serial Number	U16886
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Front
Makeup Gas	Nitrogen

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Detector 2

Manufacturer	Agilent Technologies
Name	7690
Type	FID
Adapter	Capillary
Control Type	Electronic Pressure Control (EPC)
Location	Back
Makeup Gas	Nitrogen

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Electronic Signature

Purpose

This signature page was created and published because the ACE sign-off action was executed, which is valid for the entire document, including attachments. The ACE sign-off is an electronic signature that requires two distinct identification components: unique username and personal password. The Agilent representative who has delivered this service understands the meaning and legal status of an electronic signature. As a trained official operator, the Agilent representative has a unique password and login to access ACE and electronically sign this document. (Other e-signatures can be applied to this document using a Document Content Management or other suitable method defined in your data access and control procedures.)

Details

Full Name of Signer: Saenguthai Tarak
Logged On User Name: ssenguthai.tarak@non.agilent.com
Signature Creation Date: February 23, 2023
Reason for Signature: Executed protocol and published this original version of document

Regulatory Disclaimer

This document provides a protocol to verify and record instrument configuration and evidence of proper operation. It has been prepared from our interpretation of applicable regulations as well as industry best practices. The document is designed to provide an important component of a complete compliance package. Validation depends upon many factors and use of this protocol alone does not assure compliance. Agilent Technologies makes no promises or representations as to its sufficiency for any specific regulatory program.

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User Name: saenguthai.tarak
Host Name: LAPTOP-GQ5SKOMV
System ID: UAE.TOX.007_CN11021007
Print Date: February 23, 2023 3:19:17 PM

UAE.TOX.007_CN11021007 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 23, 2023 9:16:11 AM	Audit	Session Created	Session	None
February 23, 2023 9:16:11 AM	Audit	Data	Session	Transaction Log file is either corrupted or deleted
February 23, 2023 9:16:11 AM	Start	Configuration	Session	None
February 23, 2023 9:16:11 AM	Audit	Entitlement	Licensing	Session identifier generated: 0800-0002-0000-17M5-HRS G
February 23, 2023 9:16:23 AM	Audit	Entitlement	Licensing	Successfully unlocked session identified by 0800-0002-0000-17M5-HRS G with unlock code 588VX65Q-05N3-8801-V08 40
February 23, 2023 9:26:56 AM	Audit	EqpLoaded	Session	EQP details for primary technique (GC): File path: [ProtocolPacks\GC\Configurations\GC_51\GC_51_51.eqp] EQP File Name: [GC_51_51.eqp] EQP Name: [AgilentRecommended]Protocol Revision: [GC_51_51]
February 23, 2023 9:26:00 AM	End	Configuration	Session	None
February 23, 2023 9:26:07 AM	Start	Qualification	Session	CO
February 23, 2023 9:26:07 AM	Start	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No setpoints associated	None

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User Name: saenguthai.tarak
Host Name: LAPTOP-GQ5SKOMV
System ID: UAE.TOX.007_CN11021007
Print Date: February 23, 2023 3:19:17 PM

UAE.TOX.007_CN11021007 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 23, 2023 9:26:24 AM	End	Execution	System Inspection and Basic Safety and Operation - 7890 - Qualitative Test - No setpoints associated	Run Count: 1
February 23, 2023 9:26:28 AM	Start	Execution	Inlet Pressure Decay - Front SBL - Pressure Controlled Inlet - S: 25.0 psi - L: <= -2.0 psi and <= 0.5 psi	None
February 23, 2023 9:26:37 AM	End	Execution	Inlet Pressure Decay - Front SBL - Pressure Controlled Inlet - S: 25.0 psi - L: <= -2.0 psi and <= 0.5 psi	Run Count: 1
February 23, 2023 9:26:39 AM	Start	Execution	Inlet Pressure Accuracy - Front SBL - Pressure Controlled Inlet - S: 25.0 psi - L: <= 1.2 psi	None
February 23, 2023 9:26:44 AM	End	Execution	Inlet Pressure Accuracy - Front SBL - Pressure Controlled Inlet - R: 25.0 psi - L: <= 1.2 psi	Run Count: 1
February 23, 2023 9:26:46 AM	Start	Execution	Detector Flow Accuracy - Front UECD - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	None
February 23, 2023 9:27:13 AM	Audit	Data	Detector Flow Accuracy - Front UECD - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Manual Data Entry
February 23, 2023 9:27:19 AM	End	Execution	Detector Flow Accuracy - Front UECD - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint	Run Count: 1
February 23, 2023 9:27:22 AM	Start	Execution	Detector Flow Accuracy - Back FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint	None

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Host Name: LAPTOP-GQ3SKOMV
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UAE.TOX.007_CN11021007 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 23, 2023 9:27:55 AM	Audit	Date	Detector Flow Accuracy - Back	Manual Data Entry FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint
February 23, 2023 9:27:57 AM	End	Execution	Detector Flow Accuracy - Back	Run Count: 1 FID - Type: Fuel - S: 30.0 mL/min - L: <= 10.0% setpoint
February 23, 2023 9:27:59 AM	Start	Execution	Detector Flow Accuracy - Back	None FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint
February 23, 2023 9:28:02 AM	Audit	Date	Detector Flow Accuracy - Back	Manual Data Entry FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint
February 23, 2023 9:28:08 AM	End	Execution	Detector Flow Accuracy - Back	Run Count: 1 FID - Type: Oxidizer - S: 400.0 mL/min - L: <= 10.0% setpoint
February 23, 2023 9:28:29 AM	Start	Execution	Detector Flow Accuracy - Back	None FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint
February 23, 2023 9:28:03 AM	Audit	Date	Detector Flow Accuracy - Back	Manual Data Entry FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint
February 23, 2023 9:28:08 AM	End	Execution	Detector Flow Accuracy - Back	Run Count: 1 FID - Type: Makeup - S: 25.0 mL/min - L: <= 10.0% setpoint
February 23, 2023 9:28:08 AM	Start	Execution	GC Oven Temperature	None Accuracy - 7890 - Temperature Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K
February 23, 2023 9:30:02 AM	Audit	Date	GC Oven Temperature	Manual Data Entry Accuracy - 7890 - Temperature Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K

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User Name: saenguthai.tarak
Host Name: LAPTOP-GQ3SKOMV
System ID: UAE.TOX.007_CN11021007
Print Date: February 23, 2023 3:19:17 PM

UAE.TOX.007_CN11021007 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 23, 2023 9:30:04 AM	End	Execution	GC Oven Temperature	Run Count: 1 Accuracy - 7890 - Temperature Oven - S: 230.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K
February 23, 2023 9:30:06 AM	Start	Execution	GC Oven Temperature	None Accuracy - 7890 - Temperature Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K
February 23, 2023 9:30:40 AM	Audit	Date	GC Oven Temperature	Manual Data Entry Accuracy - 7890 - Temperature Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K
February 23, 2023 9:30:43 AM	End	Execution	GC Oven Temperature	Run Count: 1 Accuracy - 7890 - Temperature Oven - S: 100.0°C - L: >= -1.0 AND <= 1.0 % setpoint in K
February 23, 2023 9:30:45 AM	Start	Execution	GC Oven Temperature Stability	None - 7890 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C
February 23, 2023 9:31:45 AM	Audit	Date	GC Oven Temperature Stability	Manual Data Entry - 7890 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C
February 23, 2023 9:31:48 AM	End	Execution	GC Oven Temperature Stability	Run Count: 1 - 7890 - Temperature - Oven - S: 100.0°C - L: <= 0.5°C
February 23, 2023 9:31:53 AM	Start	Execution	GC Scouting Run - Injection	None Tower, Front SSL, Front UECD - Part of System Preparation - No limits associated
February 23, 2023 9:40:21 PM	Start	Execution	GC Scouting Run - Injection	None Tower, Front SSL, Front UECD - Part of System Preparation - No limits associated

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Host Name: LAPTOP-GQ3SKOMV
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UAE.TOX.007_CN11021007 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 23, 2023 2:42:56 PM	Start	Execution	GC Scouting Run - Injection	None Tower, Front SSL, Front UECD - Part of System Preparation - No limits associated
February 23, 2023 2:42:19 PM	Audit	Date	GC Scouting Run - Injection	Data file Path: E:\UAE 2023020203_ECD - Part of System Preparation - No limits associated 14-10-450Q_GCT890_uEC D_Sc10.D\ECD1A.ch
February 23, 2023 2:43:14 PM	End	Execution	GC Scouting Run - Injection	Run Count: 1 Tower, Front SSL, Front UECD - Part of System Preparation - No limits associated
February 23, 2023 2:43:17 PM	Start	Execution	Noise and Offset - Front UECD -	None Detector UECD - L (Noise): <= 3.00 Hz - L (Drift): <= 15.00 Hz/hour
February 23, 2023 2:43:54 PM	Audit	Date	Noise and Offset - Front UECD -	Data file Path: E:\UAE 20230203_ECD_NO_03.D\ECD1A.ch 3.00 Hz - L (Drift): <= 15.00 Hz/hour
February 23, 2023 2:44:11 PM	End	Execution	Noise and Offset - Front UECD -	Run Count: 1 Detector UECD - L (Noise): <= 3.00 Hz - L (Drift): <= 15.00 Hz/hour
February 23, 2023 2:44:14 PM	Start	Execution	Injection Precision - Injection	None Tower, Front SSL, Front UECD - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%
February 23, 2023 2:44:45 PM	Start	Execution	Injection Precision - Injection	None Tower, Front SSL, Front UECD - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%

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Print Date: February 23, 2023 3:19:17 PM

UAE.TOX.007_CN11021007 Transaction log:

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 23, 2023 2:46:43 PM	Audit	Date	Injection Precision - Injection	Data file Path: E:\UAE 2023020203_ECD GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% 14-10-450Q_GCT890_uEC D_Ph01-020F.D\ECD1A.ch
February 23, 2023 2:46:43 PM	Audit	Date	Injection Precision - Injection	Data file Path: E:\UAE 2023020203_ECD GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% 14-10-450Q_GCT890_uEC D_Ph01-021F.D\ECD1A.ch
February 23, 2023 2:46:43 PM	Audit	Date	Injection Precision - Injection	Data file Path: E:\UAE 2023020203_ECD GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% 14-10-450Q_GCT890_uEC D_Ph01-022F.D\ECD1A.ch
February 23, 2023 2:46:52 PM	Audit	Date	Injection Precision - Injection	Data file Path: E:\UAE 2023020203_ECD GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% 14-10-450Q_GCT890_uEC D_Ph01-024F.D\ECD1A.ch
February 23, 2023 2:46:52 PM	Audit	Date	Injection Precision - Injection	Data file Path: E:\UAE 2023020203_ECD GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00% 14-10-450Q_GCT890_uEC D_Ph01-025F.D\ECD1A.ch
February 23, 2023 2:47:57 PM	End	Execution	Injection Precision - Injection	Run Count: 1 Tower, Front SSL, Front UECD - GC - L (Area): <= 3.00% - L (Ret. Time): <= 1.00%

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User Name: saenguthai.torak System Id: UAE.TOX.007_CN11021001
 Hostname: LAPTOP-CQ3SKOMV Print Date: February 23, 2023 3:10:17 PM

UAE.TOX.007_CN11021007 Transaction log :

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 23, 2023 2:50:23 PM	Start	Execution	Noise and DfHr - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (DfHr) <= 2.50 pAHour	None
February 23, 2023 2:55:53 PM	Audit	Data	Noise and DfHr - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (DfHr) <= 2.50 pAHour	Data File Path : E:\UAE\202302\GC7890_FID_N_1.D\FID23h.ch
February 23, 2023 2:54:10 PM	End	Execution	Noise and DfHr - Back FID - Detector FID - L (Noise) <= 0.10 pA - L (DfHr) <= 2.50 pAHour	Run Count : 1
February 23, 2023 2:54:13 PM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
February 23, 2023 2:57:04 PM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
February 23, 2023 2:57:37 PM	Start	Execution	Injection Precision - Injection Tower, Front SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	None
February 23, 2023 2:58:21 PM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : E:\UAE\202302\GC7890_FID_N_1.D\FID23h.ch
February 23, 2023 2:59:21 PM	Audit	Data	Injection Precision - Injection Tower, Front SSL, Back FID - GC - L (Area) <= 3.00% - L (Ret. Time) <= 1.00%	Data File Path : E:\UAE\202302\GC7890_FID_N_1.D\FID23h.ch

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Date: February 23, 2023 3:19:15 PM
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User Name : saenguthai.tarak System Id : UAE.TOX.007_CN11021007
Hostname : LAPTOP-CQ3SKOMV Print Date : February 23, 2023 3:19:17 PM

UAE_TOX.007 CN11921007 Transaction log 1

Time	Transaction State	Activity Performed	Type of Transaction	Optional Information
February 23, 2023 3:03:51 PM	End	Execution	Signal to Nuke - Injection Tower Front SQL, Stack FID - Detector FID - L, ** 300000	Run Count : 1
February 23, 2023 3:04:00 PM	End	Qualification	Session	OQ
February 23, 2023 3:04:00 PM	Start	Reporting	Session	None
February 23, 2023 3:18:15 PM	Audit	Reporting	Session	Report Generated : Certificate

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Agilent CrossLab Start Up Services Agilent 7890 Gas Chromatograph Preventive Maintenance Checklist

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

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides 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 preventive maintenance activities.

Agilent 7890 GC Preventive Maintenance Checklist

Introduction

Customer Information

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

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>
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>.
- 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** <http://www.agilent.com/search/support>
- Videos** about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube** channel at <https://www.youtube.com/user/agilent>.
- 7890B Manuals** are also available on Agilent.com:
 - Safety**
https://www.agilent.com/cs/library/usermanuals/public/7890B_Safety.pdf
 - Installation and First Startup**
https://www.agilent.com/cs/library/usermanuals/public/7890B_Installation.pdf
 - Operation Manual**
https://www.agilent.com/cs/library/usermanuals/public/7890B_Operation.pdf
 - Maintaining Your GC**
https://www.agilent.com/cs/library/usermanuals/public/G3430-60052%207890B_Maintaining%20Guide.pdf

Agilent 7890 GC Preventive Maintenance Checklist

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "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.

Additional Instruction Notes

- Check for any active service notes for this unit. If there are any applicable "Safety" or "Modification Recommended" Service notes, plan to implement the changes on this unit before doing any qualification service.
- Do not implement firmware updates, unless you get approval from the customer and are sure that they are compatible with the instrument control software.

System Information

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

Instrument System Name and ID

VAE.TOX.007

CN 11201007

Instrument System Site and Location

VAE

Analytical Laboratory

List System Component Product Numbers

1. 039440A
2. 02917A
3. 02614A
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.

List the Serial Numbers of each Component

CN 11201007
CN 82149496
CN 82248797

Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components, settings as defined by current Service Notes.
- ☒ Check for required firmware updates and verify with customers if they would like them installed.
- ☒ Before starting the following procedures, record the Detector Signal Output(s) in the results table. If the GC is turned OFF or in a service mode, comparing the detector outputs before and after the service is not possible.

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Preventive Maintenance Procedure

Clean and inspect GC

- ☒ Unplug power cord from the power source.
- ☒ Open GC covers and vacuum/remove any dust/debris. Pay particular attention to cooling fans.
- ☒ Inspect internal connectors for proper contact and placement.
- ☒ Reconnect Power to the GC. Power the GC on and verify the power on self-test passed.
- ☒ Verify oven motor spins freely and turns on with the oven door closed, off when the door is opened.
- ☒ Verify operation of all other fans - the inlet and EPC cooling fans.
- ☒ Verify oven intake/outlet flap assembly is operating smoothly while heating and cooling the oven.

Inlet and detector consumable replacement

- ☒ For the inlets installed, perform inlet maintenance as defined in the 7890 manual - "Maintaining Your GC" - for the inlet(s) installed.
- ☒ Replace the split vent trap cartridge filter on units with these inlets: Split/Splitless Capillary (SSL), Multi-Mode Inlet (MMI), Programmed Temperature Vaporizer (PTV), Volatiles Interface (VI).
- ☒ If the inlet system is used in Split Mode with viscous samples, inspect and clean the split vent tube on the inlet and flush or replace the tubing between the inlet and the split vent trap.
- ☒ If the GC includes a Flame Ionization Detector (FID), replace the jet. If the ignitor shows any buildup of sample or corrosion, replace the ignitor. Examine the FID collector and castle assemblies for contamination - clean as necessary.

Zero Sensors and Leak test

- ☒ Zero all pressure sensors per the procedure in the 7890 "Advanced User Guide".
- ☒ Perform inlet pressure decay test(s) as defined in the 7890 "Troubleshooting Manual". If the PM is done in preparation for an Operational Qualification, then the pressure decay test defined within that protocol can be used for the PM.
- ☒ Record if test passed or failed in the results table.

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ALS Maintenance

- ☐ Section NOT applicable
- ☒ Check all cabling and configuration settings between GC, tray, and injectors.
- ☒ Vacuum or remove any dust, especially around fans.
- ☒ Check operation of all fans.
- ☒ Check syringe for smooth plunger operation.
- ☒ Check for smooth operation of the needle support - clean if necessary

Restore Instrument

- ☒ Restore the normal operating conditions or customer method using the Data System.
- ☒ Purge the system with carrier flow for 15 minutes
- ☒ Bake out the system, then restore the normal operating conditions
- ☒ After equilibration, check and record the post PM detector signal output values. Results should be similar or lower than the detector outputs recorded prior to PM.
- ☒ Perform a chemical checkout. If this is a routine PM, inject the customer's sample using the ALS if applicable. This will act as a final checkout of both the ALS and the GC.

Note: 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 with the customer this service, parts replaced, and test results obtained.
- ☐ 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.
- ☐ Supply the customer with a copy of the Smart Alerts flyer.
- ☐ Describe Smart Alerts to the customer.
- ☐ Install Smart Alerts if requested.

7890 GC Test Results Table

Detector Signal Outputs
Front detector output
Back detector output
AUX detector output
Pressure decay test
Front inlet pressure decay test
Back inlet pressure decay test

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7890 Parts List Table

The following kits are recommended for capillary and purged packed inlets. If this is a general PM and the customer has a preferred set of consumables, you may use the customer's consumables.

Part description	Part number	Product or model where used	Quantity consumed
SSL Capillary Inlet PM kit, Splitless	5188-6497	7890A/B	1
SSL Capillary Inlet PM kit, split	5188-6496	7890A/B	N/A
SSL Capillary Ultra Inert Inlet Gold Seal with Washer	5190-6144	7890A/B	N/A
SSL Capillary Ultra Inert Inlet Splitless Liner - Single taper with Glass Wool	5190-2293	7890A/B	N/A
SSL Capillary Ultra Inert Inlet Low Pressure Drop Split Liner - with Glass Wool	5190-2295	7890A/B	N/A
PP Inlet PM kit	5188-6498	7890A/B	N/A
Split vent trap PM kit, single cartridge (for MML, PTV & VE)	5188-6495	7890A/B	N/A
MML Cleaning Kit	G3510-60820	7890A/B	N/A
PTV Septumless Head Rebuild Kit	5182-9747	7890A/B	N/A
PTV Septumless Head Teflon Guide	5182-9748	7890A/B	N/A
Ignitor (glow plug) assembly with O-ring	19231-60680	7890A/B	1
FID Collector Rebuild/Cleaning Kit	G1531-67000	7890A/B	N/A
Standard .011-inch FID Jet for capillary FID base	G1531-80560	7890A/B	1
High Temperature .018-inch FID Jet for capillary FID base	G1531-80620	7890A/B	N/A
Standard .018-inch FID Jet for packed column with packed FID base	18710-20119	7890A/B	N/A
Standard .011-inch FID Jet for capillary column with packed/adaptable FID base	19244-80550	7890A/B	N/A
High Temperature .018-inch FID Jet for capillary column with packed/adaptable FID base	19244-80620	7890A/B	N/A
NPD Jet, universal fit, .011-inch ID	G1534-80580	7890A/B	N/A
NPD Jet, universal fit, .011-inch ID Extended tip	G1534-80590	7890A/B	N/A
SSL Capillary Ultra Inert Inlet Gold Seal with Washer	5190-6144	7890A/B	N/A
SSL Capillary Ultra Inert Inlet Splitless Liner - Single taper with Glass Wool	5190-2293	7890A/B	N/A
**FID Collector Replacement Kit, if needed	G1531-67001	7890A/B	N/A

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Service Engineer Comments

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

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Document Control Logs

Revision Log

Revision	Date	Author	Reason for update
Revision of document	Date of issuance	Author of document	Author to describe main features/changes made for this specific revision
1.0 Draft	4-Mar-2011	Dave Park	Migrated the content of revision A.01.05 to the new Agilent template. Reviewed by subject matter expert, Dave Park.
1.1 Draft	20-Jan-2015	Dave Park	Added Split Vent trap to MML, PTV and VE - also PTV and FID PM Parts
1.2 Draft	31-March-2015	Dave Park	Added Ultra Inert Gold Seal and Liner to SS Consumables
A.01.11	10-Dec-2015	Dave Park	Added step to perform maintenance on the Split Vent Tube and .018" FID Jet part numbers - Fixed broken web links
2.00	30-Dec-2020	Gary Boardman	Updated New Template and terminology change: Familiarization to Introduction. Create New Agile Document Number: D0007063

Approval Log

Revision	Approver	Title of approver
Add revision number	Add approver name here	Add approver's function or title here
A.01.06	Don Gage	Product support manager
A.01.09	Kai Meng	Product support manager
A.01.10	Suneetha Tippireddy	Product support manager
A.01.11	Suneetha Tippireddy	Product support manager
2.00	Josh Roark	GC Product Support Manager

Designated Evaluation Log

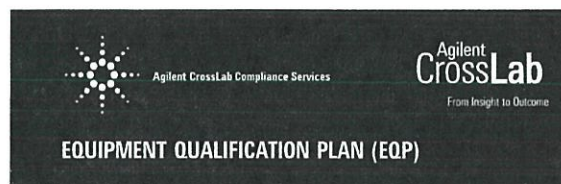
Revision	Designated Evaluator (DE)	Title of DE	DE Number
Add revision number	Add name	Add function or title	Add DE number here
2.00	Michael Zumwalt	CrossLab Start Up Services Application Consulting Lead	44166.759722222

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EQP Name: AgilentRecommended

Service Type: OQ

Company Name: United Analyt and Engineering Consultant Co., Ltd.

Customer Name/Title: Min Penjawan Nityakulchai / Laboratory Manager

EQP Filename: GC 02 51 eqp

EQP Release Date: November 2020

Print Date: November 2, 2020 8:00:29 PM

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Scope and Purpose

Overview

The Equipment Qualification Plan (EQP) documents the activity program that is performed during the qualification services for the applicable systems. A complete description of the test specifications is provided for the supported services, including setpoints and acceptance criteria (or limits) for each test. The test specification section of this document is created directly from the EQP file name listed on the cover. This document is an abstraction of the EQP file used to perform the service and is generated directly from the electronic Agilent Equipment Qualification Plan (eEQP) Editor. The purpose of this document is to allow the user to review and record approval of the EQP that guides the delivery of compliance services provided by the Agilent Automated Compliance Engine.

CDS Software Pre-requisite for Hardware Qualifications

(Applies to hardware qualifications only) Agilent recommends that the customer data system (CDS) software used during the qualification has been qualified within the qualification period specified by the customer's software qualification SOP.

Statement of Intent

Unless otherwise requested, the qualification is delivered according to the standard test program described in the Agilent Recommended EQP. Agilent defines variances as changes to the default recommended values (as stated in the Agilent Recommended EQP) that fall within a well-defined range. These changes are considered to be within the intended use range of the system under test.

Customizations are values that (a) subject the system to limits that exceed the typical operational range or (b) additional tests that are not considered part of the core program required for completion of the selected service. Because custom setpoints and limits may exceed the operational envelope of the equipment, Agilent reserves the right to warrant conformance only to the closest variance value. The user is notified of this stipulation at EQP setup time and the qualification report (EQR) will reflect this situation.

A set of ink signature fields, as determined by the creator of this document, can be included at the end of this document. All fields should be completed or a single set of fields, initiated by an appropriate approver, run through any signature fields that are not to be used. This is an optional process that allows a paper record of signoff by the appropriate reviewers where a hybrid (electronic/ink) signature SOP is followed. If this document will be saved electronically and digitally signed in a document management system, it should be generated without ink signature fields. The customer must sign the EQP review documents and return an electronic copy to Agilent prior to qualification delivery. The delivery of the services is done according to the terms and conditions stated in the corresponding service exhibit. It is recommended that after approval, this EQP be archived with the electronic EQP file.

Understanding the Test Specification Section in Tabular Review Documents

(Applies to hardware qualifications only) For Agilent recommended setpoints and limits, the range of allowable values (L for low, H for high) is included. As applicable, variances, customizations, and additional setpoints are listed beneath the Agilent recommended values and marked W (within range) or O (outside of range) in the left margin; values for added setpoints are also marked W or O and displayed after all configurations values. Dual limits are marked DW or DO. Agilent is NOT responsible for test failures for out of range setpoints and limits. Optional tests that are enabled are included and marked as such; required tests that are disabled by the customer are included and marked as such.

NOTE: Limit ranges must be more tightly managed than setpoint ranges because they often reflect physical measurement limits and are directly linked to the testing method. Therefore "within range" user limits are subject to best effort repairs if they cannot be met. In particular, Agilent will not be responsible for test failures for limits tighter (more demanding or challenging) than the recommended values.

Customer Responsibilities

If Agilent representatives use a customer CDS account to acquire test data, they log off from the CDS account at the end of test acquisition. Agilent Technologies has no responsibility for those account credentials. It is up to the customer to protect the CDS from misuse.

- o (As applicable) Disable the account used by the Agilent representative to acquire CDS data.
- o Safely store and archive this EQP
- o Maintain change control and revision history
- o Review and optionally sign the EQP, making sure the service delivery is what was approved
- o Review and approve any of the following variances from the Agilent recommended:
 - Within Variance Range: changes to the Agilent recommended that are identified by Agilent as within the operation ranges determined in our test development
 - Outside of Variance Range: changes to the Agilent recommended that Agilent identifies as outside of the operational ranges determined in our test development. Agilent is not under any obligation to make the instrument pass the more stringent limits that fall in this range and this detail is called out in the EQP Test Specification
 - Optional Tests: additional tests that are available but not part of the core testing suite and cost extra
 - Disabled Tests: test for which all possible configurations have been disabled (tests are flagged in the test specification)

Agilent Responsibilities

- o Deliver the services following the test programs described in the customer EQP
- o Provide a locked and e-signed Qualification Report (EQR) upon completion of the service
- o If requested, provide an optional ink-signed EQR CD to the customer

General Statements on the Testing Program

The recommended set of hardware OQ tests described in this EQP derives from Agilent's interpretation of authoritative expert literature issued by the FDA, USP, GAMP, ASTM 2500, and others. The OQ test design incorporates both modular and holistic testing, which is a proven approach, acceptable to regulators. As prescribed by the 4Q qualification methodology for Analytical Instrumentation Qualification (AIQ), the OQ step is separated from the PQ as recommended by the regulatory guidelines.

Agilent CrossLab Compliance uses a balanced selection of metrology and chemical tests to directly determine the performance of the systems without unnecessary reliance on inferred or derived results. For example, direct metrology is used to test pump flow rates and thermal-controlled column compartment and autosampler modules. Holistic chemical testing is used for the evaluation of the following critical instrument characteristics: linearity, precision, signal to noise, and carry over.



Agilent CrossLab Compliance Services

Agilent CrossLab is designed to fit traditional quality systems used by firms and recognized by regulatory agencies worldwide. Note: Enterprise Edition has been renamed Agilent CrossLab Compliance; all functionality remains the same.

How Agilent CrossLab aligns with a traditional, paper-based methodology:

- Policy documents dictate the need for validation and qualification of GMP/GLP systems and usually mention the DD/DO/PO model. The precise procedures for IQ and OQ for each type of equipment are prescribed in an approved SOP, perhaps called SOP #123. Qualification of HPLC Systems. In Agilent CrossLab, the equipment qualification plan (EQP) has the same role as the traditional qualification SOP.
- The traditional SOP provides lists of tests and limits for the range of system configurations found in the laboratory. The EQP follows this concept. The inventory of systems covered by an EQP or EDP changes over time, so this is kept as a separate record.
- The traditional qualification SOP typically has blank results forms as attachments to be photocopied for each IQ or OQ event—the results recorded in ink with manual calculations. In Agilent CrossLab, this execution process is streamlined and automated by use of Adobe forms and the Agilent Compliance Engine (ACE) delivery tool. It provides reports with no handwriting errors, validated calculations, automated pass/fail report, traceability to raw data and the number of times a test was run. This automation provides efficiency and enforces compliance to procedure.
- The traditional qualification SOP is approved and released only once—replacing the need to author individual protocols for each chromatography system. This is the same concept for the EQP. The appropriate tests for each individual configuration are automatically selected by ACE from the list in the approved EQP—at time of delivery. The final reports are unique for each system and each qualification event—but the single approved EQP can cover a lab, department, or as wide a scope as desired.
- In the traditional qualification methodology, there is no convenient provision to record the actual workflow of the tests execution and results. In the event that a test is repeated during the Agilent CrossLab delivery, ACE maintains a counter per test which is automatically incremented for GxP compliant work, and the engineer generates a deviation note within the ACE report.



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Design Qualification (DQ)

DQ for commercial lab instruments is recommended by some, but not all, guidelines and procedures. Definitions of DQ found in guidelines and literature vary widely around the world. Some firms require nothing more than a record (such as certificate) from the instrument manufacturer demonstrating that the lab system has been designed for purpose and manufactured to a quality standard. Others treat DQ as the development of a user requirement specification document (URS) which can be matched to the IQ and OQ specification and for a manufacturer. Other firms consider DQ as including the vendor selection activities.

USP Chapter literature definition of DQ:

Design qualification (DQ) is the documented collection of activities that define the functional and operational specifications of the instrument and criteria for selection of the vendor, based on the intended purpose of the instrument. Design qualification (DQ) may be performed not only by the instrument developer or manufacturer but also may be performed by the user. The manufacturer is generally responsible for design and maintaining information describing how the analytical instrument is manufactured (design specifications, functional requirements, etc.) and tested before shipment to users. Nonetheless, the user should ensure that commercial off-the-shelf (COTS) instruments are suitable for their intended application and that the manufacturer has adopted a quality system that provides for reliable equipment. Users should also determine capability of the manufacturer for support installation, services, and training.

For your reference, Agilent provides the following statements for DQ purposes.

- All Agilent hardware and software laboratory products including the ACE software used to deliver qualification services, are designed, manufactured, and tested according to Agilent Internal Quality Life Cycle Development Procedures.
- Certificates of Agilent testing, validation, and conformance to standards are provided with new Agilent instruments and similar certification is provided for ACE software. These documents are checked and recorded in Agilent CrossLab Compliance Services IQ.
- Agilent maintains information describing how products are manufactured and maintains a problem and log reporting program as required by international software quality guidelines.
- The DQ specifications in this EQP can be used, as appropriate, by the user to prepare URS. The DQ specifications in this EQP represent the levels of performance acceptable to regulatory agencies for the technique, conform to typical specifications found in validation literature, are equally suitable for OQ at installation and on-going OQ throughout operational lifetime, are equivalent to the DQ specifications published in the legacy Agilent Classic GxP protocols, and are suitable for most user requirements.
- Agilent Technologies is capable of installation, support, preventive maintenance, on-going qualification, and re-qualification on after repair and user training worldwide.

Installation Qualification (IQ)

IQ checks and tests for Agilent hardware and software products include the following:

- Purchase Order Details: Allows the customer to verify that the instrument being qualified matches their design requirements (if available) and purchase order.
- Preparation and Installation Details: Gather and records information about preparation and installation documents.
- Documentation: Gather and records information about reference and user manuals for initial installations.
- Product Quality Assurance Details: Collects and records certificates and other forms that verify that the vendor has developed and built the product according to internal standards.
- Startup: Verifies that all modules start up properly.
- Instrument Check (hardware only): Demonstrates that all modules of the instrument are correctly installed and connected. It does not test instrument performance as fully as OQ. This test is not necessary and therefore skipped if an OQ is to be performed by Agilent operator after installation.
- Installation Verification (software only): Verifies the correctness of all installation-related files.

Operational Qualification (OQ)

Refer to the appropriate Test Guidelines document for a detailed description of the testing program, setpoints, and acceptance limits for each system technique, category, and instrument configuration.

Dual-Acceptance Limits

(Applies to hardware qualification only)

Within the EQP of Agilent CrossLab, each of the tests final result can be compared against two different limits if required. This allows customer-configured OQ to report against a User Limit (Limit 1) and the Agilent Recommended Limit (Limit 2) simultaneously.

In the standard EQP documents, Limit 1 and 2 values are the same—effectively deactivating this feature. Custom EQPs can also be prepared on request, making effective use of the two-limit feature of the Agilent Compliance Engine (ACE). In those cases, Limit 2 will always be the Agilent Recommended limit, and Limit 1 will be the limit requested by the user.

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Agilent will not be under any obligation regarding the OQ testing results against user-requested limits that are more stringent than the Agilent Recommended ones.

Re-qualification after Repair (RQ) Hardware

(Applies to hardware qualifications only)

In the event of a hardware breakdown followed by an engineering repair of a qualified instrument, it is necessary to re-qualify the system to an appropriate level before release back into operational use.

For some of the instrument techniques, Agilent offers a service contract to repair and re-qualify an instrument during the period between scheduled annual OQs.

The level of re-testing is prescribed in the RQ section of ACE: a form is displayed for the operator showing all types of repair possible and the re-testing required. Part of an example form is shown below.

Re-qualification After Repair			
Pump Strategies	Modules	Any pump	OQ/PV Testing
Repair/Replace Strategy			Flow Accuracy & Precision
Internal pump head parts, valve inlet valve for AIV cartridge, (parts all check valves, reference valves, inlet manifold or pump drive, or taking pump head apart to clean (versus repair)		Any pump	Flow Accuracy & Precision
Pulse damper, pressure transducer		Any pump	Flow Accuracy & Precision
Multi-channel gradient valve		Quaternary	Gradient Composition

The full list of repair and re-test guidance is available for review by customers of the RQ service.

The RQ form in ACE prescribes which tests the operator must perform for each repair circumstance. The test procedure, setpoints, and limits will be an exact repeat of the previous OQ test (a regression testing strategy).

Updated: November 2019

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Overview

Agilent CrossLab qualification services offer flexible options for the delivery method as desired below. The desired service delivery method is chosen according to the laboratory data integrity and general procedural requirements. To ensure complete data traceability, Agilent has devised two delivery methods that access data directly (default method). An alternative method is also available that accesses data indirectly through a transfer location. If neither of the default methods is chosen, the document captures customer approval of the alternative delivery method.

Available Methods

Method	Definition
Preferred 1	Network-distributed ACE (NDA), where the ACE software is installed on a network node within the laboratory LAN infrastructure. Requires collaboration with the customer to load ACE behind the customer firewall. Raw data locations are always captured in the equipment qualification report (EQR), which provides end-to-end traceability and a fully characterized data workflow in the delivery.
Preferred 2	Dedicated spinning USB drive, where the ACE software resides on an independent drive that can be driven from the system controller, where the CDS resides. Because the USB spinning drive is connected to the CDS, the validity of this method is equivalent to the preferred 1 method. Raw data is imported directly into ACE by the Data Manager tool, with the data paths always captured in the report, which provides data traceability assurance. This is the most commonly used method.
Alternative	The ACE software is installed on and run from a PC not directly connected to the customer data system (CDS), such as the FSE's laptop. System data files are transferred indirectly from the CDS to the laptop instead of directly like preferred 1 and 2 methods. Requires customer pre-approval to remove later questions on data integrity. NOTE: The FSE's CDS used in this method is qualified for data collection purposes.

EQR Storage

Select the checkbox below to authorize Agilent to store a copy of the Equipment Qualification Reports (EQRs) generated by Agilent Compliance Engine for internal assessments. The intention of the assessment is to evaluate the delivery of the qualification service, with a focus to improve delivery and assess the appropriateness of data integrity measures. The storage is exclusively for the internal assessment by Agilent and will not be shared with other organizations. It is not to be considered a backup for the EQR provided at qualification delivery.

Customer Approval of Alternative Method and EQR Storage

Authorize Agilent to use the alternative method (check for approval):

Authorize Agilent to store EQRs for their internal assessment (check for approval):

Approved by title: *Jonathan Nitigulchai / Laboratory Manager*

Comments:

Updated: September 2020

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Introduction

With heightened scrutiny of data integrity, Agilent's ACE (Automated Compliance Engine) software must be able to access instrument-generated raw data files one of two ways: (1) directly, using the connection between network nodes or with the server; (2) indirectly, through temporary storage in a transfer location. (In this document, data integrity refers to the who, what, and where of data used in generating an ACE equipment qualification report, or EQR.)

ACE includes three main service delivery use cases that address data integrity requirements; the rest of this document provides details to determine which one best fits a customer's needs.

Regardless of the delivery method, ACE features and delivery procedures are compatible.

Preferred Method 1: Network-distributed ACE (NDA)

Preferred Method 2: Dedicated spinning USB drive (most commonly used method)

Alternative: Service portable laptop or other PC not directly connected to customer data system (CDS)

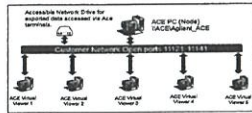
Preferred Method 1: Network-Distributed ACE (NDA)

Overview



ACE software is installed on a network node within the laboratory LAN infrastructure, which requires collaboration with the customer to load ACE behind their firewall. Raw data locations are always captured in the EQR, which provides end-to-end traceability and a fully characterized data workflow in the delivery.

Details



Installing ACE in a separate node (i.e., the host PC) on the same network as the system controller offers data traceability that is equivalent to an installation on the system controller itself. The system controller (where the CDS resides) and the ACE host PC are identified and seen by the server and subject to the customer's data access controls and general IT policies. The CDS's audit trail records data movements between nodes or between the client and server, and ACE's data traceability feature identifies the original data directory and therefore ensures end-to-end data traceability.

The ACE host PC has a separate/partitioned drive for ACE software. During ACE's installation, two services are set up on the operating system (OS): one for security and the other as a watchdog. Because the ACE host PC sits on the network as a shared drive, engineers access ACE through the networked drive. ACE is not installed on ACE Virtual Viewer PCs.

Requirements

Installation

- Install on a host PC with a separate drive (different from that of the OS)
- Attach to a network that clients can access
- 500 GB
- NTFS format
- User has local administration rights

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Operational

- User has an ACE node login with a minimum of power user rights permissions; user also has a personal ACE account and password added through the ACE licensing tool
- Up to 5 users with 3 open sessions each can access the NDA simultaneously
- Exception to ports 11121-11141 on ACE node, clients, and switch/s/Smart Hubs to be open on the network

Preferred Method 2: Dedicated Spinning USB Drive

Overview



ACE software resides on an independent drive that can be driven from the system controller, where the CDS resides. Because the drive is connected to the CDS, this method's data integrity is equivalent to preferred method 1. Raw data is imported directly into ACE by ACE's Data Manager tool, and data paths are captured in reports to provide data traceability.

Details

A dedicated spinning USB drive can run ACE software without leaving a footprint on the host PC. Therefore, it can be connected directly to the system controller (where the CDS resides) without altering the system's qualification status. For additional protection, the drive can be driven by another host PC on the same network; also, the USB drive can remain on site with the customer for use by the Agilent FSE during service deliveries only.

Alternative Method

The ACE software is installed on and run from a PC not directly connected to the customer data system (CDS), such as the FSE's laptop. System data files are transferred indirectly from the CDS to the laptop instead of directly preferred 1 and 2 methods.

Requires customer pre-approval to remove later questions on data integrity.

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Standard OQ Test Suite

This document describes the test program for qualifying GC systems, and the following table lists all OQ tests.

Note: Headspace tests apply only if a headspace sampler is an integral part of the system: *Injection Carry Over* is included in the standard OQ for GCs with headspace configurations but not for liquid sampler configurations (it can be ordered as EXTRA COST TEST). *Inlet Pressure Decay* is not included for GCs configured with mass spectrometer detectors.

Key: Fixed setpoints/limits Variances allowed

Test	Setpoints and Parameters	Limits
System Inspection and Basic Safety and Operation	N/A	Gases, chassis electric grounding, interlocks, hydrogen shutdown, and so on all correct
GC Oven Temperature Accuracy and Stability (Agilent Intuvo 9000)	Column connector = 250.0°C Oven 1 = 250.0°C Oven 2 = 100.0°C Stability measured at oven 2	Accuracy ≥ -0.8°C and ≤ 0.5°C of setpoint in K (oven) Accuracy ≥ -1.8°C and ≤ 2.0°C of setpoint in K (column connector) Stability ≤ 0.5°C
GC Oven Temperature Accuracy and Stability	Temperature 1 = 250.0°C Temperature 2 = 100.0°C Stability measured at temperature 2	Accuracy ≥ -1.0°C and ≤ 1.5°C of setpoint in K Stability ≤ 0.8°C (Agilent) Stability ≤ 1.0°C (Others)
Headspace Leak (7897A only)	N/A	Valve functions properly and HSS is leak tight
Headspace Vent and Pressurization Valve Integrity (8188A and older)	N/A	Valve functions properly
Headspace Heated Zones Temperature Accuracy	Time: 115.0°C Sample Loop: 110.0°C Syngas Heater: 110.0°C Oven: 100.0°C Agilator: 100.0°C (Applicable zones vary by model): • TurboMatrix 40, TurboMatrix 16, TurboMatrix 116, H104CL, H111, H1110L models only Time is transfer time.	Time accuracy ≥ -1.8 and ≤ 0.2% of setpoint (7897A, 7897A w/tray) Time accuracy ≥ -4.0 and ≤ 0.3% of setpoint (Others) Sample loop accuracy ≥ -0.6°C and ≤ 0.8°C (8188A, 7897A, 7897A w/tray) Sample loop accuracy ≥ -0.6°C and ≤ 0.8°C (Others) Syngas heater accuracy ≥ -2.0°C and ≤ 2.0°C (CTC) Oven heater accuracy ≥ -0.5°C and ≤ 0.5°C (Others) Oven accuracy ≥ -0.5°C and ≤ 0.5°C (PerkinElmer) Oven accuracy ≥ -0.5°C and ≤ 0.5°C (7897A, 7897A w/tray) Oven accuracy ≥ -0.5°C and ≤ 0.5°C (Others) Agilator accuracy ≥ -2.0°C and ≤ 2.0°C (CTC) Diff. from setpoint ≥ -2.0°C, ≤ 2.0°C
Vial Heater Temperature Accuracy	Temperature: 60.0°C	Pressure change / 5 minutes ≥ -2.0 psi and ≤ 0.5 psi
Inlet Pressure Decay (non-MS) (EPC or manual control only)	Inlet gas flow control	Accuracy ≤ 1.2 psi
Inlet Pressure Accuracy (EPC or manual control only)	Inlet pressure: 25.0 psi	Accuracy ≤ 10.0%
Inlet Flow Stability (EPC control only)	Inlet flow: 4.0 ml/minute	Precision ≤ 0.0%

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Test	Setpoints and Parameters	Limits
Detector Flow Accuracy	Flow rate varies by detector type (N/A for NPD)	Accuracy ≤ 10.0% of setpoint (or 0.5 ml/minute, whichever is larger)
Noise and Drift (FID)	Detector signal	Noise ≤ 0.19 pA Drift ≤ 2.50 pA/hour
Noise and Drift (TCD)	Detector signal	Noise ≤ 0.15 DU (He or H ₂ carrier and makeup (or no makeup)) Noise ≤ 0.25 DU (N ₂ carrier and makeup (or no makeup)) Drift ≤ 2.20 DU/hour
Noise and Drift (RPD)	Detector signal (N/A for 5890)	Noise ≤ 0.15 pA Drift ≤ 3.00 pA/hour
Noise and Drift (ECD)	Detector signal (N/A for 5890)	Noise ≤ 0.15 DU Drift ≤ 1.00 DU/hour
Noise and Drift (uECD)	Detector signal	Noise ≤ 3.00 DU Drift ≤ 15.00 DU/hour
Noise and Drift (FPD new style)	Detector signal, sulfur (N/A for 5890)	Noise ≤ 5.00 DU Drift ≤ 5.00 DU/hour
Noise and Drift (FPD+)	Detector signal, sulfur (N/A for 5890)	Noise ≤ 4.00 DU Drift ≤ 5.00 DU/hour
Noise and Drift (FPD new style)	Detector signal, phosphorous (N/A for 5890)	Noise ≤ 5.00 DU Drift ≤ 5.00 DU/hour
Noise and Drift (FPD+)	Detector signal, phosphorous (N/A for 5890)	Noise ≤ 2.00 DU Drift ≤ 1.50 DU/hour
Noise and Drift (FVCD, SCD)	Detector signal	Noise ≤ 5.00 pA Drift ≤ 50.00 pA/hour
Scouting Run	Injection volume on column; varies by configuration	N/A
Signal to Noise (FID/SS/MMI/ALS)	Signal height divided by ASTA baseline noise for known concentration and conditions.	S/N ≥ 300,000 (N ₂ makeup gas) S/N ≥ 240,000 (He makeup gas)
Signal to Noise (FID/SS/MMI/HSS)		S/N ≥ 5,000 (N ₂ makeup gas) S/N ≥ 4,000 (He makeup gas)
Signal to Noise (FID/NI/HSS)		S/N ≥ 2,000 (N ₂ makeup gas) S/N ≥ 3,200 (He makeup gas)
Signal to Noise (FID/non-SS/using 1510-69170)		S/N ≥ 800 (N ₂ makeup gas) S/N ≥ 600 (He makeup gas)
Signal to Noise (FID/non-SS/using 5168-5372)		S/N ≥ 200 (N ₂ makeup gas) S/N ≥ 100 (He makeup gas)
Signal to Noise (NPD)		S/N ≥ 300
Signal to Noise (TCD/SS/MMI)		S/N ≥ 750 (N ₂ makeup gas) S/N ≥ 5,000 (He or H ₂ makeup gas)
Signal to Noise (TCD/non-SS/MMI)		S/N ≥ 4 (N ₂ makeup gas) S/N ≥ 100 (He or H ₂ makeup gas)
Signal to Noise (uECD)		S/N ≥ 1,500
Signal to Noise (FPD new style)		S/N ≥ 700 (sulfur) S/N ≥ 1,000 (phosphorous)
Signal to Noise (FPD+)		S/N ≥ 1,400 (sulfur) S/N ≥ 2,400 (phosphorous)
Signal to Noise (NCD)		S/N ≥ 600 (NCD)
Signal to Noise (SCD)		S/N ≥ 500 (SCD) S/N ≥ 25 (SCD on FID base)
Injection Precision (Split/Splitless)	Injection volume on column: 1.0/1000/200 µl (ALS/Agilent HSS/CTC HSS with split/splitless FID) Injection time: 0.2 minutes (pressure-balanced HSS only)	Retention time RSD ≤ 1.00% Area RSD ≤ 3.00% (ALS, Agilent HSS) Area RSD ≤ 4.00% (CTC HSS) Area RSD ≤ 0.00% (NCD, SCD, ALS only)

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Test	Test points and Parameters	Limits
Injection Precision (Purged/Packed)	ALS with purged/packed injection port, without HSS	Retention time RSD $\leq 1.00\%$ Area RSD $\leq 0.00\%$ (FID, TCD) Area RSD $\leq 0.00\%$ (other detectors) Area carry over $\leq 1.00\%$
Injection Carry Over (HSS only)	Same as Injection Precision	

Test Design and Rationale

Overview

Many GMP/GLP enforcement agency inspectors now ask firms to provide a risk assessment of their equipment and computer systems plus a science-based rationale for subsequent validation and qualification testing.

GENERAL RISK STATEMENT: Any laboratory chemical system used for raw material testing or final drug product / medical device testing in GMP or used in formal GLP studies will likely fall into a HIGH RISK category. This risk assessment will imply the need for IQ & OQ & on-going qualification. ANY USER SPECIFIC RISK ANALYSIS SUPERCEDES THIS GENERAL RISK STATEMENT.

This rest of this section outlines the science-based rationale for each test in the Agilent hardware OQ plus a brief test design and procedure description.

The recommended set of hardware OQ tests described in this EQP derives from Agilent's interpretation of FDA, USP, and GAMP guidelines and other authoritative expert literature.

OQ test design incorporates both modular and holistic testing, which is a proven and regulatory acceptable approach. When applicable, direct methodology is used to test pump flow rates and thermal-controlled column compartments, for example. Holistic chemical testing is used to evaluate critical instrument characteristics.

When applicable, certified reference standards and calibrated equipment are used.

Considering the number of setpoints, parameters, and conditions of each recommended OQ test, the proven concepts of worst case, range, and representative have been applied. If a property or characteristic is known to have its worst performance at one end of a range of use, this is the setpoint that should be tested and other setpoints are not required. If a property or characteristic has no known worst case, testing at the high and low points of the range of use is required. If there are too many possible use cases and conditions to realistically test (and none is a worst case), a representative sample for test is the best approach.

System Inspection and Basic Safety and Operation

Description: System must be in safe and operational condition before starting the OQ tests.

Procedure: The instrument is given a general inspection and its basic safety features are challenged to ensure proper operation.

GC Oven Temperature Accuracy and Stability

Description: Oven temperature accuracy is important for comparability between systems and transferring methods. Oven temperature stability is critical for qualitative and quantitative analysis.

Procedure: At two different temperatures, accuracy is measured using an external calibrated thermometer and expressed as the difference between found and setpoint values. At one of these, a statistically significant number of additional readings are taken during the total duration of the test and stability is expressed as the delta between the highest and lowest temperatures.

Headspace Leak

Description: Proper operation of the valves is critical for repeatable peak areas and carry over.

Procedure: This test verifies that the valves operate properly with no excessive leaks or restricted internal flow paths.

Headspace Vent and Pressurization Valve Integrity

Description: Proper operation of the valves is critical for repeatable peak areas and carry over.

Procedure: This test verifies that the valves operate properly with no excessive leaks or restricted internal flow paths.

Headspace Heated Zones Temperature Accuracy

Description: Temperature accuracy of the heated zones is important for comparing systems and transferring methods. Oven accuracy is critical to quantitative headspace methods.

Procedure: The temperature is measured using an external calibrated thermometer with appropriate probe design. Accuracy is determined as the difference between found and setpoint values.

Vial Heater Temperature Accuracy

Description: The 7683A vial heater option can be used during sample preparation. This test verifies that it heats accurately. Procedure: The heater temperature is measured with an external thermometer and accuracy is calculated as the difference between the measured value and setpoint.

Inlet Pressure Decay

Description: Inlet pressure integrity is critical for repeatable injection and retention times. The pressure decay and pressure accuracy tests combine to demonstrate pressure integrity. NOTE: If there is too much air in the system, the MS system's Tune test indicates a leaking detector, so pressure decay is not necessary for MS-only systems.

Procedure: The inlet is capped, a pressure applied, and inlet flow turned off. The pressure decay is recorded over a specified time range.

Inlet Pressure Accuracy

Description: Inlet pressure integrity is critical for repeatable injection and retention times. The pressure decay and pressure accuracy tests combine to demonstrate pressure integrity. This test checks for accurate pressure to the head of the column. Column flow is achieved by maintaining a constant pressure against a known restriction. Because the restriction is a function of the column geometry, measuring pressure in the inlet is the most accurate way to determine flow.

Procedure: The inlet is capped, a pressure is applied, and the inlet pressure is recorded using an external calibrated manometer connected to the inlet.

Inlet Flow Stability

Description: Inlet flow stability is critical for repeatable injection and retention times. Inlet flow accuracy and precision tests combine to demonstrate inlet flow stability.

Procedure: Column flow setpoint is achieved, all detector flows are turned off, and calculations are made: flow accuracy as the absolute % difference of the mean of the ten flow readings and the setpoint; flow precision as the % RSD of ten flow readings.

Detector Flow Accuracy

Description: Detector flow accuracy is critical for a stable detector signal. Incorrect flows may have an impact on detector performance.

Procedure: Flow accuracy is determined by measuring the flows with a calibrated mass flowmeter and then comparing the results to the test setpoints and the values displayed by the GC.

Noise and Drift

Description: This test gives an indication of detector sensitivity and stability.

Procedure: The signal is monitored at specified conditions appropriate to the type of detector over a twenty-minute period. The signal noise is calculated based on ASTM E594-99 as the average peak-to-peak noise in a number of signal segments. The drift is calculated as the slope of the linear regression for the signal. Detector type and the gases used all contribute to different performance and therefore different limits for each configuration.

Scouting Run

Description: This test is used to determine the chromatogram for presence of expected peaks, sufficient run time, and proper integration events prior to the start of the actual qualification runs.

Signal to Noise

Description: Sensitivity of GC detection is a critical performance feature in quantitative and qualitative analysis. A signal-to-noise value of a representative compound at known concentration provides sensitivity statistics.

Procedure: A traceable standard is injected and signal to noise is calculated.

Injection Precision

Description: System precision is critical for quantitative analysis.

Procedure: An initial stabilizing injection is made, followed by six repeat injections of a traceable standard followed by a final blank injection. The % RSD of the six injections is calculated to provide precision statistics. There are separate dedicated instrument parameters and reference standards applicable to each inlet/detector combination. This test is performed with liquid and headspace sampler configurations.

Injection Carry Over

Description: Low carry over from a previous injection is critical for accuracy of quantitative and reliability of qualitative analysis. For headspace samplers, the engineering condition contributes to carry over performance, so this is a core OQ test for these samplers.

For liquid samplers, carry over performance is contingent on many variable factors independent of the engineering condition of the GC system. Many different syringe wash programs are available that can eliminate carry over. These are user selectable and may be application specific. The condition of the injection syringe is the only controllable engineering factor. The injection syringe is typically replaced for new during PM before OQ. Therefore, the carry over test for liquid samplers is offered only as an optional extra fee test in a customer-configured EQP.

Procedure: The blank injection after the six repeat injections of the precision test is evaluated for carry over, and the result is expressed as a percentage.

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Report and Delivery Options

(For hyphenated system types only) If different options are chosen for the primary and supported system types, the primary system options are used for both techniques in the EQR.

- Show chromatograms
- Show header and footer on cover
- Include repeated run logs
- Include Transaction logs

Selected Signature Options

Status: EQP is not signed

- Reporting variance is allowed in this EQP

Customer Approval

Name: Miss Panjawan Viriyothai
 Title: Laboratory Manager
 Date: Feb 2, 2021
 Signature: 

Name: _____
 Title: _____
 Date: _____
 Signature: _____

Name: _____
 Title: _____
 Date: _____
 Signature: _____

Name: _____
 Title: _____
 Date: _____
 Signature: _____

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Protocol Details

Protocol Revision Used for this Document
 GC.02.51

Protocol Revision Release Date
 November 2020

NOTE: The Revision History - EQP Editor document includes details for above and other available revisions.

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Hanna Instruments (Thailand) Ltd.

410/67-68 Soi Ratchadapisek 24, Ratchadapisek Rd., Samson-nok,
 Huaykwang, Bangkok 10310 Tel: 0-2541-4199 Fax: 0-2541-4198



Certificate No.: HIT-2312-0342

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CERTIFICATE OF CALIBRATION

Equipment :	COD Test Tube Heater	
Meter Model :	HI839800-02	Serial No. : H018500I
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	

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

Approved

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

Figure: Shows the location of the temperature source.

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

Remark: The Acceptance criteria is the error value plus or minus the Measurement Uncertainty, and then Not Move 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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CERT.No.: HS-U012C

Calibration Date : 1 Mar 23

Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Road, Bangkok,
Phrakhanong, Bangkok.(Head office)

Avg Room Temp : 20 °C

Avg Water Temp : 20 °C

Air Pressure : 759.00 mmHg

Salinity : 0 ppt

Model : YSI 5100

S/N : 11B101863

Probe : YSI 5010

S/N : 23B100125

ID NO. : -

Air Temp ref : S/N. E00522

Barometric ref : S/N. E00522

Water Temp ref : S/N 11451

Technician : Kittipong M.

Calibration Details

Calibration Point	100% air sat. (@20 °C, DO = 9.09 mg/l)	(status)	(status)
Measurement 1 (mg/l)	9.09	(PASS)	-
Measurement 2 (mg/l)	9.09	(PASS)	-
Measurement 3 (mg/l)	9.09	(PASS)	-
Measurement 4 (mg/l)	9.09	(PASS)	-
Measurement 5 (mg/l)	9.09	(PASS)	-
Measurement 6 (mg/l)	9.09	(PASS)	-
Measurement 7 (mg/l)	9.09	(PASS)	-
Measurement 8 (mg/l)	9.09	(PASS)	-
Measurement 9 (mg/l)	9.09	(PASS)	-
Measurement 10 (mg/l)	9.09	(PASS)	-

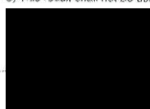
Mean Measurement	9.09	mg/l	-	-
Inaccuracy	0.00	mg/l	-	-

Overall Status (PASS)

Manufacturer Specification

Accuracy = +/- 0.02 mg/l

- This certificate is issued based on the result that are found as shown on date and place of test only.
- The calibration procedure followed in accordance with Harikul Science Co., Ltd.
- This result shall not be used for advertising purpose.



(Kittipong Meekwong)

เอกสาร



Request No. 25-66 / 0323

MTC. ACLNo. 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-ME8706640
SUBMITTED BY : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk41, Sukhumvit Road, Bangkok, Prakanong, Bangkok 10260

CALIBRATION PROCEDURE : 1. Performance Verification of Atomic Absorption Spectrophotometer (W-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 "Carto Erba", "PanReac AppliChem"

Cadmium Lot No. 1152457, Chromium Lot No. 1793249, Copper Batch No. T117098A, Iron Batch No. T126067A, Lead Lot No. 1227873, Manganese Batch No. T109228A, Nickel Batch No. T270176A, 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 Laboratory.

Calibrated by

Approved by

Acting

Issued Date : 13 February 2023

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

Advertising the Report/Certificate and publicity of the result except in full are prohibited unless written permission is obtained from the governor of TISTR.

FMEL/MTC.002 Rev.4

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Request No. 25-66 / 0323

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MTC. ACL No. 387 / 66

CALIBRATION DATA

1. Noise Level

Element	Cd	Cr	Cu	Fe	Pb	Mn	Ni	Zn
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	0.0006	-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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INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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TISTR

Request No. 25-66 / 0323

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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	0.0109	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	0.0115	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	0.0996	0.0998	0.1007	0.1000	0.1013	0.0999	0.100	0.099	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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TISTR

Request No. 25-66 / 0323

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MTC. ACL. No. 387 / 66

3. Trueness

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

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

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

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

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

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

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TISTR

Request No. 25-66 / 0323

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MTC. ACL. No. 387 / 66

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

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

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

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

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

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

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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

Issued Date : 15 February 2023

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

End of Certificate

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Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES Preventive Maintenance

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

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

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

Introduction

Customer Information

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

Important Customer Web Links

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

Service Engineer's Responsibilities

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

Instrument Maintenance

System Information

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

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

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 3015 R	114 15030001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

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

Preparation

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

Preventive Maintenance Procedures

Record Pre-PM instrument performance

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

Clean and inspect ICP-OES system

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

Agilent Water Recirculator

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

SPS 3 Auto Sampler

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

SPS 4 Auto sampler

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

AVS 4, 6, 7 Advanced Valve System

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

ICP-OES adjustment

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

Record Post-PM instrument performance

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

- ☒ Record the result in the Instrument Test Results Table

Restore Instrument

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

Service Review

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

Test Results

Instrument Performance Test Results Table

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

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial*	Radial	Axial*
Zn 213.857 nm SBR	4190.5	6449.9	4700.8	7564.2
Mn 257.610 nm SBR	15681.0	27295.3	14569.1	29992.5
Al 396.152 nm SBR	12.1	14.6	11.9	15.6
K 765.491 nm SBR	8.0	31.2	7.4	39.7

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

Instrument Test Results Table

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

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

ICP-OES Status Results Table

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

Measurement	Standby Mode	Plasma On
Mains Voltage	225.153 VAC	220.613 VAC
Mains Current	0.090 A	0.219 A
Instrument Temperature	24.0 °C	25.1 °C
RF Air Flow (sensor speed)	15.0 Hz	19.0 Hz
Plasma Exhaust Temperature	No measurement	39.2 °C
Water Flow Oscillator	No measurement	1.37 L/min
Water Flow Detector	0.54 L/min	0.81 L/min
Water Inlet Temperature	17.3 °C	17.8 °C
Polychromator Temperature	35.0 °C	35.0 °C
CCD Temperature	-39.8 °C	-39.8 °C
Thermal Stabilizer	35.0 °C	35.0 °C
Argon Supply Pressure	659.52 kPa	608.63 kPa
Purge Gas Supply Pressure*1	656.41 kPa	627.71 kPa
Option Gas Supply Pressure*1	- kPa	- kPa
Nebulizer Flow	No measurement	0.70 L/min
Nebulizer Back Pressure	No measurement	166.30 kPa
Plasma Gas Flow	No measurement	11.98 L/min
Auxiliary Gas Flow	No measurement	1.00 L/min
RF Power	No measurement	1199.5 W
RF Supply Current	No measurement	8.223 A
RF Supply Voltage	No measurement	194.481 V

*1 If option installed

Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Agilent Cool Clear Coolant Fluid	5799-0037	Agilent Water Recirculator	-
Purge Gas Filter	G8010-60136	All	1
Air Inlet Filter	G8010-60002	All	1
High Capacity Air Filter	G8010-60169	Optional	-
Rotor seal for 6-7 port valve for AVS6/7	G8494-60007	G8494A/G8495	-
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	-
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	-
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	-
PVC waste tubing, 8mm od x 5mm id, 2m	G8410-80122	SPS 4	-
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047500	SPS 3	-
Z axis drive belt	5410047400	SPS 3	-
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	-

Consumed Parts Reference
(Purchased by customer, not included as part of PM)☐ Section Not Applicable

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

Signature Page

Service Engineer Comments (optional)

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

Service Verification

Service Request Number:
6006331120Service Engineer Name:
Kanyakorn S.Service Engineer Signature:
Kanyakorn S.Total number of pages in this document:
14

Date Service Completed:

15 Nov 2023

Customer Name:

Aphorn Onkong

Customer Signature:

Aphorn Onkong

Report Summary

Instrument Model: Agilent 5100/5110 VDV ICP-OES
Instrument ID: G8011A/G8015A
Instrument Serial Number: MY18030001
Software Version: 7.3.1.9507
Firmware Version: 3442
Tested By: Kanyakorn S.
Test Completed On: 11/13/2023 9:18:24 AM

Result Summary

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

Resolution Test

Pass

Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	6.92
As (188.980 nm)	≤ 8.20	6.12
C (193.027 nm)	≤ 11.50	8.31
Mo (202.032 nm)	≤ 8.20	6.35
Cr (206.158 nm)	≤ 13.40	8.99
Zn (213.857 nm)	≤ 8.70	6.64
Pb (220.353 nm)	≤ 9.50	7.06
Co (228.615 nm)	≤ 17.20	11.68
Ba (230.424 nm)	≤ 9.40	7.27
Mn (257.610 nm)	≤ 13.30	9.46
Mn (260.568 nm)	≤ 20.30	14.18
Cr (267.716 nm)	≤ 11.00	8.01
Cu (324.754 nm)	≤ 25.00	18.89
Cu (327.395 nm)	≤ 14.20	11.29
Sr (338.071 nm)	≤ 33.50	24.46
Ba (455.403 nm)	≤ 44.00	33.62
Sr (460.733 nm)	≤ 36.00	17.37
Ba (493.408 nm)	≤ 36.00	25.47
Ba (514.171 nm)	≤ 42.00	25.43
Ar (575.283 nm)	≤ 74.00	60.50
K (766.481 nm)	≤ 80.00	65.33

Sensitivity Test			Fail		
Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	142.0	958.5	41.7
Se (196.026 nm)	≥ 41.0	SRBR	105.9	937.4	67.5
Zn (213.857 nm)	≥ 1421.0	SRBR	4190.3	44372.5	111.6
Pb (220.353 nm)	≥ 46.0	SRBR	213.9	2521.3	125.4
Mn (257.610 nm)	≥ 3518.0	SRBR	13681.0	279651.7	416.6
Al (396.152 nm)	≥ 3.4	SBR	12.1	52269.7	3994.3
Ba (493.408 nm)	≥ 34.0	SBR	185.8	2294372.8	12280.0
K (766.491 nm)	≥ 1.8	SBR	8.0	107401.4	11878.7
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	189.4	2285.0	129.5
Se (196.026 nm)	≥ 159.0	SRBR	168.7	2813.7	233.8
Zn (208.200 nm)	≥ 234.0	SRBR	905.0	10158.4	123.0
Zn (213.857 nm)	≥ 1743.0	SRBR	6849.9	135760.6	390.5
Cd (214.439 nm)	≥ 4227.0	SRBR	5597.6	92921.3	273.9
Pb (220.353 nm)	≥ 320.0	SRBR	454.8	10111.2	451.1
Mn (257.610 nm)	≥ 10625.0	SRBR	27295.3	1126118.1	1697.0
Cr (267.716 nm)	≥ 1048.0	SRBR	3948.2	144675.3	1322.0
Cu (324.754 nm)	≥ 19.0	SBR	49.2	341489.7	6798.2
Al (396.152 nm)	≥ 6.0	SBR	14.6	235321.6	15043.9
Ba (493.408 nm)	≥ 60.0	SBR	183.3	8393101.3	45538.3
K (766.491 nm)	≥ 24.0	SBR	31.2	1447045.2	44917.1

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เอกสารไม่ควบคุม

Precision Test			Pass
Radial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 2.60	1.22	
Se (196.026 nm)	≤ 2.60	0.76	
Zn (213.857 nm)	≤ 1.50	0.33	
Pb (220.353 nm)	≤ 2.60	0.86	
Mn (257.610 nm)	≤ 1.50	0.45	
Al (396.152 nm)	≤ 1.50	0.37	
Ba (493.408 nm)	≤ 1.50	0.68	
K (766.491 nm)	≤ 1.50	0.33	
Axial			
Element Wavelength	Specification	Measured Value % RSD	
As (188.980 nm)	≤ 1.50	0.63	
Se (196.026 nm)	≤ 1.50	0.87	
Zn (208.200 nm)	≤ 1.50	0.59	
Zn (213.857 nm)	≤ 1.50	0.46	
Cd (214.439 nm)	≤ 1.50	0.70	
Pb (220.353 nm)	≤ 1.50	0.36	
Mn (257.610 nm)	≤ 1.50	0.95	
Cr (267.716 nm)	≤ 1.50	0.56	
Cu (324.754 nm)	≤ 1.50	0.69	
Al (396.152 nm)	≤ 1.50	0.63	
Ba (493.408 nm)	≤ 1.50	0.86	
K (766.491 nm)	≤ 1.50	1.13	

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เอกสารไม่ควบคุม

Report Summary	
Instrument Model	Agilent 5100/5110 VDV ICP-OES
Instrument ID	G8011A/G8015A
Instrument Serial Number	MY18030001
Software Version	7.3.1.9507
Firmware Version	3442
Tested By	Kanyakorn S.
Test Completed On	11/13/2023 11:10:02 AM
Result Summary	
Subsystem Communications Test	Pass
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Pass
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass
Subsystem Communications Test	Pass
Optics Test	
Radial	Axial
Intensity 3522064	4003312
Wavelength 737.212	737.212

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เอกสารไม่ควบคุม

Resolution Test			Pass	
Element Wavelength	Specification	Width		
N (174.213 nm)	≤ 9.40	6.92		
As (188.980 nm)	≤ 8.20	6.08		
C (193.027 nm)	≤ 11.50	8.33		
Mo (202.032 nm)	≤ 8.20	6.31		
Cr (206.158 nm)	≤ 13.40	8.98		
Zn (213.857 nm)	≤ 8.70	6.73		
Pb (220.353 nm)	≤ 9.50	7.02		
Co (228.615 nm)	≤ 17.20	11.65		
Ba (230.424 nm)	≤ 9.40	7.38		
Mn (257.610 nm)	≤ 13.30	9.46		
Mn (260.568 nm)	≤ 20.30	14.05		
Cr (267.716 nm)	≤ 11.00	7.92		
Cu (324.754 nm)	≤ 25.00	18.84		
Cu (327.395 nm)	≤ 14.20	11.31		
Sr (338.071 nm)	≤ 33.50	24.18		
Ba (455.403 nm)	≤ 44.00	33.28		
Sr (460.733 nm)	≤ 36.00	17.41		
Ba (493.408 nm)	≤ 36.00	25.43		
Ba (514.171 nm)	≤ 42.00	25.27		
Ar (575.283 nm)	≤ 74.00	56.87		
K (766.491 nm)	≤ 80.00	65.88		

Page 2 of 4

เอกสารไม่ควบคุม

Sensitivity Test						Pass					
Radial											
Element Wavelength	Specification	Method	Ratio	Standard	Blank						
As (188.980 nm)	≥ 46.0	SRBR	168.6	1284.6	53.3						
Se (196.026 nm)	≥ 41.0	SRBR	122.4	1256.0	90.7						
Zn (213.857 nm)	≥ 1421.0	SRBR	4700.8	53870.1	130.7						
Pb (220.353 nm)	≥ 46.0	SRBR	236.0	3100.6	155.7						
Mn (257.610 nm)	≥ 3518.0	SRBR	14569.1	318398.1	476.2						
Al (396.152 nm)	≥ 3.4	SBR	11.5	59510.5	4761.6						
Ba (493.408 nm)	≥ 34.0	SBR	170.6	2490835.6	14514.2						
K (766.491 nm)	≥ 1.8	SBR	7.4	117898.7	14024.1						
Axial											
Element Wavelength	Specification	Method	Ratio	Standard	Blank						
As (188.980 nm)	≥ 208.0	SRBR	214.5	2706.2	142.8						
Se (196.026 nm)	≥ 159.0	SRBR	188.0	3262.8	255.9						
Zn (206.200 nm)	≥ 234.0	SRBR	1088.2	12794.8	135.3						
Zn (213.857 nm)	≥ 1743.0	SRBR	7564.2	156883.9	427.8						
Cd (214.439 nm)	≥ 4227.0	SRBR	6647.3	116281.7	304.4						
Pb (220.353 nm)	≥ 320.0	SRBR	519.3	12490.2	530.3						
Mn (257.610 nm)	≥ 10625.0	SRBR	29992.5	1305852.5	1890.2						
Cr (267.716 nm)	≥ 1048.0	SRBR	4366.6	173343.4	1547.9						
Cu (324.754 nm)	≥ 19.0	SBR	46.8	361093.0	7560.5						
Al (396.152 nm)	≥ 6.0	SBR	15.6	274029.5	16498.6						
Ba (493.408 nm)	≥ 60.0	SBR	203.6	9028914.5	44122.1						
K (766.491 nm)	≥ 24.0	SBR	39.7	1701521.4	41771.8						

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เอกสารไม่ควบคุม

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

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เอกสารไม่ควบคุม

Report Summary		
Instrument Model	Agilent 5100/5110 VDV ICP-OES	
Instrument ID	G8011A/G8015A	
Instrument Serial Number	MY18030001	
Software Version	7.3.1.9507	
Firmware Version	3442	
Tested By	Kanyakorn S.	
Test Completed On	11/13/2023 11:15:43 AM	
Result Summary		
Subsystem Communications Test	Pass	
Air Flow Test	Pass	
Water Flow Test	Pass	
Gas Flows Test	Pass	
RF Generator Test	Pass	
Camera Test	Pass	
Optics Test	Skipped	
Advanced Valve System Test	Skipped	
Resolution Test	Skipped	
Sensitivity Test	Skipped	
Precision Test	Skipped	
Subsystem Communications Test	Pass	
Air Flow Test	Pass	
30% Air Flow (relative speed)	75% Air Flow (relative speed)	
14.00	20.00	
Water Flow Test	Pass	
RF Water Flow(L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.27	0.81	20.37

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เอกสารไม่ควบคุม

Gas Flows Test						Pass	
Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure		
0.70	0.70	271.62	2.00	2.00	111.13		
Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure		
2.00	2.00	116.00	18.00	17.94	23.11		
RF Generator Test						Pass	
RF Power Supply Test		Passed					
RF Power Supply (V)		147.380					
RF Oscillator Test		Passed					
RF Oscillator Frequency (MHz)		25.843					
Work Coil Current (A)		44.410					
RF Power Supply Current (A)		1.999					
Camera Test						Pass	
		Integration Time (ms)	Standard Deviation	Status			
Electronic Offset Test		1000	5.361	Passed			
Dark Current Test		6000	0.779	Passed			
Array Test		5	0.025	Passed			
Linearity Test			0.118	Passed			

Page 2 of 2

เอกสารไม่ควบคุม

UNITED ANALYST AND ENGINEERING CONSULTANT COMPANY Ltd.

Automatic Mercury Analyzer

Model RA-4500

Preventive Maintenance Report

Serial No. : 17780278

Soft v

ROM

Date

PM b

Appro



Coax Group Corporation Ltd.

1131/62,64,325-331 Nakornchaisri road,

Kwang ThanonNakornchaisri, Dusit, Bangkok 10300 Thailand

Tel. 02-2435263, 02-6682436 Fax. 02-2437386

เอกสารไม่ควบคุม

Inspection result

ITEM	STANDARD	RESULT	JUDGE
1. Self Check			
1.1 Heating		PASS	OK
1.2 Cooling		PASS	OK
1.3 Leak		PASS	OK
1.4 Optical system		PASS	OK
1.5 Drift		PASS	OK

2. Analytical curve inspection(AREA)

2.1 No Pretreatment (Low Conc.)	Correlation coefficient	1.0000	OK
	(r) ≥ 0.9990		

3. Repeatability(AREA)

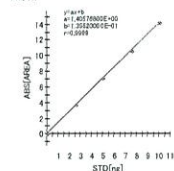
3.1 No Pretreatment 100ppb, n=5			
	1.	99.12	ppb
	2.	101.48	ppb
	3.	101.24	ppb
	4.	102.34	ppb
	5.	101.92	ppb
	C.V. ≤ 5%	1.23%	OK

4. Blank	Below 1.0 (AREA)	0.2062	OK
----------	------------------	--------	----

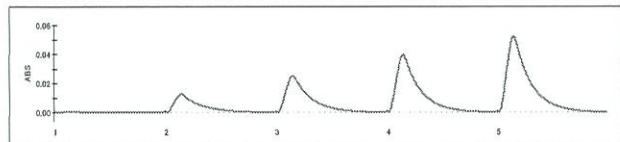
เอกสารไม่ควบคุม

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

Calib



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



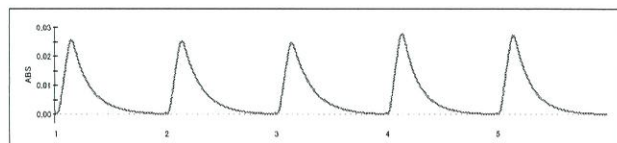
No.	NAME	SVOL (mL)	CVOL (mL)	DVOL (mL)	AREA (ON)	MEAS (ng)	CONC (ug/L)	Note
1	hg 100 ppb	0.050	5.000	5.000	7.1027	4.9561	99.122	
2	hg 100 ppb	0.050	5.000	5.000	7.2687	5.0742	101.484	
3	hg 100 ppb	0.050	5.000	5.000	7.2514	5.0619	101.238	
4	hg 100 ppb	0.050	5.000	5.000	7.3285	5.1168	102.336	
5	hg 100 ppb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

Statistics

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

เอกสารไม่ควบคุม

NIPPON INSTRUMENTS CORPORATION



Self Check

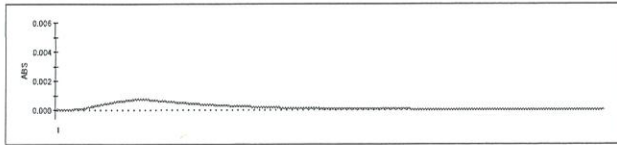
Heat check: PASS!! (24.9degC[05:00] -> 28.9degC[02:31])
Sensor check: PASS!! (78- 18= 60)
Leak check: PASS!! (0.17L/min)
Sig/Ref check: PASS!! (Sig:3.73V, Ref:3.94V)
Drift check: PASS!! (-0.0027882 - -0.0032876 = 0.0004993)

เอกสารไม่ควบคุม

NIPPON INSTRUMENTS CORPORATION

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

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



เอกสารไม่ควบคุม

NIC NIPPON INSTRUMENTS CORPORATION



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, Bangkok, 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 :

พิชญ์

(Mr. Thanawat Pittadach)

Technical Manager

Approved by :

ชลธิชา

(Ms. Chonlitha Sangnorn)

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 in the corresponding national standard laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the DQE Services Co., Ltd.

FM-706-02 R01 1/11/2021

เอกสารไม่ควบคุม



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 Starna Scientific Limited

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min.

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

FM-706-02 R01 1/11/2021

เอกสารไม่ควบคุม



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

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

REPORT OF CALIBRATION

Certificate No. : SP23-021 Page 5 of 5

Wavelength Accuracy :

CRMs Values (nm.)	UUC Reading (nm.)	Correction (nm.)	Uncertainty (nm.)	Coverage factor k
241.72	242.0	-0.28	0.18	2.00
279.45	279.5	-0.05	0.18	2.00
287.81	287.5	0.31	0.18	2.00
334.06	335.5	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%

- * Indicator non TISI accredited

- End of Certificate -

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Agilent 55 240 280 Series Atomic Absorption Spectroscopy Systems

Preventive Maintenance Checklist

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

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

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

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

Introduction

Customer Information

- 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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Instrument Preventive Maintenance Checklist

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 by 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: 8445A / PM15150003
Instrument System Site and Location: UNITED ANALYST AND ENGINEERING CONSULTANT

List System Component Product Numbers	List the Serial Numbers of each Component
1. 4445A	PM15150003
2. PS0120	PM1515140001
3. 4445A	PM1515140001
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. *N/A*
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components, settings as defined by current Service Notes
- ☒ Check for required firmware updates and verify with customers if they would like them installed.
- ☒ Use SVD to perform a Full Wavelength Scan for Cu HCL - "As found test_1"
- ☒ Perform a Basic Cu ABS test - "As found test_2"
- ☒ Print the Details page or screen captures of the test results and attach to the end of this checklist.

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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 %	✓
Flame performance test with 5 ppm copper sample		
Air/acetylene, mixing paddle removed	Abs value > 0.5	✓
Air/acetylene, mixing paddle installed 10 replicates	%RSD < 1.0	✓
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 (324.8 nm)		
Precision %RSD	≤ 4.0%	0.5
Abs value	≥ 0.10	0.1597
MSR%	≥ 70 %	92.152

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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 Hvac 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)

Service Completion

Service request number: 6005101202 Date service completed: Oct 17, 2023
 Agilent signature: Nukoon L. Customer signature: _____
 Total number of pages in this document: 13

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PinAAcle 900F Preventive Maintenance Report

Company Name: UNITED ANALYST AND ENGINEERING

Instrument Location: BANGCHAK, PRAKHANONG

BANGKOK, 10260


Instrument Serial No.: PFBS20031902

Date: 26-Jun-2023

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PinAAcle 900F Preventive Maintenance (PM)

Company Name:	UNITED ANALYST AND ENGINEERING		
Address (Instrument Location):	BANGCHAK, PRAKHANONG, BANGKOK, 10260		
Serial Number:	PFBS20031902	PM Number:	2/2
Customer Name (if applicable):	K. SATIDA	Telephone Number:	095-558-0049
Customer Support Engineer Name:	K. DUANG	Service Order Number:	WO-02273773
Date PM Performed: (DD-MMM-YYYY)	Jun 26, 2023	Next PM Due Date: (DD-MMM-YYYY)	Dec 30, 2023
Standard Labor Hours to Complete PM :		5 hours	

Part Number	Release	Publication Date	
09370145 Rev.9	A	January 2018	

Scope

The purpose of this PM is to ensure the continued functionality of the PinAAcle 900F by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The customer should save their method before the PM begins.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM.

Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files.

The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer.

Update the PM sticker and instrument logbook as required.

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Component List

Component / Specific Model	Serial #	Configuration Notes

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
B0501696	Fan Filters	N/A
N3160156	O-Ring Kits for Sampling Introduction (Stainless Steel Nebulizer)	N/A
N3160157	O-Ring Kits for Sampling Introduction (Plastic Nebulizer)	N/A
N9301714	Replacement Acetylene Filter Cartridge	N/A
TH001022	Replacement Air Filter Cartridge	N/A

Additional Reagents and Standards Required for PM

Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300183	1000 mg/L Copper Standard	AR	26-87CUI1	30-Jan-2024

Additional Reagents and Standards Required for PM (Customer Support Solution)

Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
N/A	DI Water	250 ml.	AR	AR
N/A	0.5% HNO ₃	250 ml.	AR	AR

Additional Tools Required for PM

Part Number (if applicable)	Description	Quantity	Serial #
N1013000	0.2A Neutral density filter	1	MGO-252
N1013002	1.0A Neutral density filter	1	MGO-358
03030997	System 2 EDL Driver	1	03030997
N3050605	As System 2 EDL	1	16148
N3050121	Cu Lumina HCL	1	092216-010130
N3050109	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N3050152	Ni Lumina HCL	1	100516-030190

Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

1. General:

- ✓ Review the instrument performance with the customer and document any recent problems.
- ✓ Inspect the customer log book and make any appropriate PM entries.
- ✓ Perform general inspection of system for cleanliness.

2. PC Instrument Software:

- ✓ Instrument Software user files/databases archived, packed, and/or deleted as needed.

3. Mechanical:

- ✓ Inspect and clean all fans and filters. Replace filters if necessary
- ✓ Inspect all gas lines for leaks and/or wear. Replace if needed.
- ✓ Clean exterior of the instrument.
- ✓ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
- ✓ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking slot width. Replace if out of specification
- ✓ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
- ✓ Check the drain system for signs of wear. Replace worn or damaged parts.
- ✓ Visually check for proper flame conditions when igniting the Air-C2H2 and N2O-C2H2 flames (if applicable).

4. Electrical:

- ✓ Inspect PC boards. Clean if necessary.
- ✓ Carefully check all internal and external cable connections.
- ✓ Check instrument firmware revisions upgrade to current levels (if necessary)
- ✓ Run Diagnostics Test within the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BM Log Viewer.

5. Optics:

- ✓ Inspect and clean the sample compartment windows, if needed.
- ✓ Inspect optics. Clean or replace if necessary,

6. Gasses:

- ✓ Verify that the Gasses supplied to the instrument are within the pressure and purity specifications found in the PinAAcle 900 Series Pre-Installation Checklist SDB.
- ✓ Verify that the acetylene filter and air filter element is dry. Replace if necessary.

7. Flame Interlock Check:

Description: Check to ensure that all safety interlocks are closed.

Parameter	Specification	Test Results	Pass/Fail
Flame Sensor	Air/C ₂ H ₂ Flame correctly shuts down	Active	Passed
Drain Sensor	Air/C ₂ H ₂ Flame correctly shuts down	Active	Passed
Nebulizer Sensor	Air/C ₂ H ₂ Flame correctly shuts down	Active	Passed
C ₂ H ₂ Pressure Sensor	Air/C ₂ H ₂ Flame correctly shuts down	Active	Passed
Air Pressure Sensor	Air/C ₂ H ₂ Flame correctly shuts down	Active	Passed
Burner Head Sensor	Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down	Active	Passed

8. After PM Performance tests:

8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.9890	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.1975	Passed

8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0009	Passed

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0002	Passed

8.4 D₂ Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	-0.0062	Passed

8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0002	Passed

8.6 AA-BG Baseline Noise with Arsenic

Description: Ensures that background correction does not produce excessive noise at a low wavelength.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0014	Passed

8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

Standard Copper Sensitivity	Specification	Results (Abs.)	Pass/Fail
5 mg/L Sensitivity SS Neb (if applicable)	> 0.250 Abs.	NA	Not Applicable
2 mg/L Sensitivity HS Neb (if applicable)	> 0.250 Abs.	0.3467	Passed

10. Review:

- ☒ Review with the customer PM work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer supplied materials to have on hand.
- ☒ Attach PM sticker.

Additional Comments

Additional Comments Regarding the PM

Review

The preventive maintenance checks and if applicable performance tests for PinAAcle 900F have been completed.

This PinAAcle 900F Passes <input checked="" type="checkbox"/> For	
Review of Preventive Maintenance	
Authorized PerkinElmer Representative	te: 26-Jun-2023 (MM-YY)
Authorized Customer Representative	te: 26-Jun-2023 (MM-YY)

SITHIPORN ASSOCIATES CO.,LTD. CALIBRATION LABORATORY

651-451/1 Srinthorn Rd., Bangbunmri, Bangplud Bangkok 10700 THAILAND.
Tel: 0-2435-9800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No.: ACL23064
Pages: 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42/ Microphone UC-52 / Preamplifier NH-24
Serial No.: 00409176 / 185835 / 90622
ID No.: UAEJFPM.015/2564

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 18 JANUARY 2023
Calibration Date : 20 JANUARY 2023
Date of Issue : 23 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

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

Continuation of Calibration Certificate

Cert. No. : ACL23064
Job No. : VC66AC0027
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-5005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23064
Job No. : VC66AC0027
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23064
Job No. : VC66AC0027
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.9

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

Frequency Weighting	Measured value (dB)
A-weight	12.5
C-weight	18.3
Flat	24.1

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	2.0	2.1	2.1	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23064
Job No. : VC66AC0027
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	-0.1	0.0	±2.0
125	0.0	0.1	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.1	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23064
Job No. : VC66AC0027
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.0	0.0	±1.1
27.0	27.1	0.1	±1.1
26.0	26.1	0.1	±1.1
25.0	25.1	0.1	±1.1

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Continuation of Calibration Certificate

Cert. No. : ACL23064
Job No. : VC66AC0027
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.1	0.1	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.6	-0.8	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

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Continuation of Calibration Certificate

Cert. No. : ACL23064
Job No. : VC66AC0027
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle	-0.1	±1.5
89.6	89.5		

12. High level stability

Frequency Weighting	SLM Display at initial (dB)	SLM Display at final (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A-weight	137.9	136.9	0.1	±0.3

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

End of Calibration Certificate

QF-TS12-04-04-020664

451-451/1 Sithiporn Rd., Bangkum, Bangkok 10700 THAILAND
Tel: 0-2435-8800 Fax: 0-2432-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23026
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42; Microphone UC-52 / Preamplifier NH-24
Serial No. : 00409175 / 185834 / 90621
ID No. :

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 06 JANUARY 2023
Calibration Date : 10-12 JANUARY 2023
Date of Issue : 16 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

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เอกสารไม่ควบคุม

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23026
Job No. : VC66AC0023
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Antechamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017976	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53270104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAT-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23026
Job No. : VC66AC0023
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23026
Job No. : VC66AC0023
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
15.9

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.8
Flat	23.8

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	0.0	0.1	0.1	± 5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23026
Job No. : VC66AC0023
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.1	0.1	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23026
Job No. : VC66AC0023
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	±1.1
136.0	136.0	0.0	±1.1
135.0	135.0	0.0	±1.1
134.0	134.0	0.0	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.0	0.0	±1.1
124.0	124.0	0.0	±1.1
119.0	119.0	0.0	±1.1
114.0	114.0	0.0	±1.1
109.0	109.0	0.0	±1.1
104.0	104.0	0.0	±1.1
99.0	99.0	0.0	±1.1
94.0	94.0	0.0	±1.1
89.0	89.1	0.1	±1.1
84.0	84.1	0.1	±1.1
79.0	79.0	0.0	±1.1
74.0	74.1	0.1	±1.1
69.0	69.1	0.1	±1.1
64.0	64.0	0.0	±1.1
59.0	59.1	0.1	±1.1
54.0	54.0	0.0	±1.1
49.0	49.1	0.1	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	29.0	0.0	±1.1
28.0	28.0	0.0	±1.1
27.0	27.0	0.0	±1.1
26.0	26.0	0.0	±1.1
25.0	24.9	-0.1	±1.1

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL23026
Job No. : VC66AC0023
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, T _b (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.3	-0.1	+5.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	-
Positive half cycle	135.4	135.3	-0.1	+2.0
Negative half cycle	135.4	135.3	-0.1	+2.0

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

Continuation of Calibration Certificate

Cert. No. : ACL23026
Job No. : VC66AC0023
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.5	-0.1	±1.5

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

451-451/1 Sinitorn Rd., Bangbunru, Bangkok 10700 THAILAND
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL23025
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NL-42 / Microphone UC-52 / Preamplifier NH-24
Serial No. : 00409109 / 189688 / 90554
ID No. :

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 06 JANUARY 2023
Calibration Date : 10-12 JANUARY 2023
Date of Issue : 16 JANUARY 2023

Calibrated by : Nathakorn Pisutpaisan

Approved by :

T. Petchurui
(Thanakul Petchurui)

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

เอกสารไม่ควบคุม

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23025
Job No. : VC66AC0023
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EF-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04/0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03/0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05/0265	09-Feb-23
Programmable Attenuator	MAI-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KA1	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23025
Job No. : VC66AC0023
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23025
Job No. : VC66AC0023
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
14.6

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

Frequency Weighting	Measured value (dB)
A - weight	11.6
C - weight	17.5
Flat	23.3

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	-0.1	-0.1	-0.1	± 1.5
1000	-0.1	-0.1	-0.1	± 1.0
8000	1.5	1.6	1.6	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23025
Job No. : VC66AC0023
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
63	-0.1	-0.1	-0.1	±2.0
125	0.0	0.0	-0.1	±1.5
250	0.0	0.0	-0.1	±1.5
500	0.0	0.0	-0.1	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.0	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
A - weight	94.0	0.0	-
C - weight	94.1	0.0	± 0.2
Flat	94.1	0.0	± 0.2

5.2 Time weighting at 1 kHz

Frequency Weighting	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	94.0	0.0	-
Slow	94.0	0.0	± 0.1
Leq	94.1	0.0	± 0.1

6. Long - term stability

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23025
Job No. : VC66AC0023
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.1	0.1	±1.1
136.0	136.1	0.1	±1.1
135.0	135.1	0.1	±1.1
134.0	134.1	0.1	±1.1
133.0	133.0	0.0	±1.1
132.0	132.0	0.0	±1.1
131.0	131.0	0.0	±1.1
129.0	129.1	0.1	±1.1
124.0	124.0	0.0	±1.1
119.0	119.1	0.1	±1.1
114.0	114.1	0.1	±1.1
109.0	109.1	0.1	±1.1
104.0	104.1	0.1	±1.1
99.0	99.1	0.1	±1.1
94.0	94.0	0.0	±1.1
89.0	89.0	0.0	±1.1
84.0	84.0	0.0	±1.1
79.0	79.0	0.0	±1.1
74.0	74.0	0.0	±1.1
69.0	69.0	0.0	±1.1
64.0	64.0	0.0	±1.1
59.0	59.0	0.0	±1.1
54.0	54.0	0.0	±1.1
49.0	49.0	0.0	±1.1
44.0	44.0	0.0	±1.1
39.0	39.0	0.0	±1.1
34.0	34.0	0.0	±1.1
30.0	30.0	0.0	±1.1
29.0	28.9	-0.1	±1.1
28.0	28.0	0.0	±1.1
27.0	26.9	-0.1	±1.1
26.0	25.9	-0.1	±1.1
25.0	24.9	-0.1	±1.1

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL23025
Job No. : VC66AC0023
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	±1.1

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	±1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
SEL	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.0	0.0	±1.0

10. Peak C sound level

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

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.1	-0.3	±2.0
Negative half cycle	135.4	135.1	-0.3	±2.0

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

Continuation of Calibration Certificate

Cert. No. : ACL23025
Job No. : VC66AC0023
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.5	89.5	0.0	±1.5

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO.,LTD. HEAD OFFICE
*139 Moo 13, SOI SINTAKARN 11 TAMBON DANG KAEU,
JAMBOUR ROAD PHU SAMUT PRANG PROVINCE 10540 THAILAND
TEL : 0649-211-0960 FAX : 0649-2116-7149



Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING
Name : CONSULTANT CO.,LTD.
Address : 81 Soi Dap-dank 41, Sukhumvit Road, Bangchak, Prakanong, Bangkok 10260
Certificate No. : 33-TPM-092
Request No. : Req-2023-0719
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Thermal Environments Monitor
Manufacturer : Quon Technologies
Model : QT-34
Serial Number : TEH020027
Resolution : 0.1 °C
ID Number : UAEANV 1257551
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: GINCO (CHINA), Model: GT11/RTD193, SN: 60000257, ID: 02-TPM Which was calibrated on 27 February 2023, Calibration Certificate No. : QK23-6494
Traceability : This Certificate is traceable to SI Unit through Quanta Reborn Co., Ltd., NSC-ONSIC Accreditation No. : Calibration 0202

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 Luangrui
Technical Manager
Issue Date : 3 April 2023

The units related only to the item calibrated. The results shall not be reproduced except in full, without written approval of the Issuer.



Calibration Note

UNC Adjustment : Not Adjust

Certificate No : 23-TPM-592

Request No : Req-2023-0730

Page : 2/2

Result of Calibration :

UNC Sensor	Standard Temperature (°C)	UNC Reading (°C)	Correction (°C)	Uncertainty (°C)
WET	20.032	20.2	-0.2	0.13
	22.035	22.2	-0.2	0.13
	30.037	30.2	-0.2	0.13
	33.038	33.2	-0.2	0.13
	40.041	40.2	-0.2	0.13
	45.040	45.2	-0.2	0.13
	50.045	50.2	-0.2	0.13
	60.050	60.2	-0.2	0.13
DRY	20.033	20.8	-0.2	0.13
	25.035	24.8	+0.2	0.13
	30.034	29.8	+0.2	0.13
	35.037	34.8	+0.2	0.13
	40.039	39.8	+0.2	0.13
	45.042	44.8	+0.2	0.13
	50.044	49.8	+0.2	0.13
	60.047	59.8	+0.2	0.13
GLUEB	20.031	19.8	+0.2	0.13
	25.033	24.8	+0.2	0.13
	30.036	29.8	+0.2	0.13
	35.037	34.8	+0.2	0.13
	40.041	39.8	+0.2	0.13
	45.043	44.8	+0.2	0.13
	50.045	49.8	+0.2	0.13
	60.049	59.8	+0.2	0.13

End of Certificate

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

Certificate No : 23-TPM-592

Request No : Req-2023-2230

Address

81 Soi Udenok 41, Sukhumvit Road, Bangchak, Prakaneng,

Page : 1/2

Bangkok 10260

Unit Under Calibration Details

Calibration Parameter : Temperature

Instrument Name : Thermal Environment Monitor

Range Calibration : 20 °C to 60 °C

Manufacturer : TSI QUEST

Type of Sensor : RTD

Model : QT-32

Sensor Diameter (mm) : 4.5

Serial Number : TPT09003

Calibration Position (mm) : 67.5

Resolution : 0.1 °C

Instrument Status : Used

ID Number : UAE.FPM.219.2502

Calibration Environment and Details

Temperature : 23 °C ± 2 °C

Humidity : 55 %RH ± 15 %RH

Received Date : 18 October 2023

Calibrated Date : 2 November 2023

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

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO GINGO, Model: GT11-RTD100, SN:

0900057, ID: 02-TPM Which was calibrated on 27 February 2023, Calibration Certificate No.: CR23-

0494

Traceability : This Certificate is traceable to SI Unit through Quality Reform 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

Issue Date

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

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Calibration Note

UNC Adjustment : Not Adjust

Certificate No : 23-TPM-592

Request No : Req-2023-2230

Page : 2/2

Result of Calibration :

UNC Sensor	Standard Temperature (°C)	UNC Reading (°C)	Correction (°C)	Uncertainty (°C)
WET	20.031	20.5	0.0	0.13
	25.032	25.0	0.0	0.13
	30.035	30.0	0.0	0.13
	35.036	35.0	0.0	0.13
	40.040	40.0	0.0	0.13
	45.046	45.0	0.0	0.13
	50.043	50.0	0.0	0.13
	60.047	60.0	0.0	0.13
DRY	20.033	20.1	-0.1	0.13
	25.036	25.1	-0.1	0.13
	30.037	30.2	-0.1	0.13
	35.039	35.1	-0.1	0.13
	40.039	40.1	-0.1	0.13
	45.041	45.1	-0.1	0.13
	50.043	50.1	-0.1	0.13
	60.045	60.1	-0.1	0.13
GLUEB	20.032	20.0	0.0	0.13
	25.033	25.0	0.0	0.13
	30.034	30.0	0.0	0.13
	35.036	35.0	0.0	0.13
	40.039	40.0	0.0	0.13
	45.042	45.0	0.0	0.13
	50.045	50.0	0.0	0.13
	60.046	60.0	0.0	0.13

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.

เอกสารไม่ควรถูก



Certificate of Calibration

Customer

Name : UNITED ANALYST AND ENGINEERING

Certificate No : 23-TPM-523

Request No : Req-2023-1328

Address

81 Soi Udenok 41, Sukhumvit Road, Bangchak, Prakaneng,

Page : 1/2

Bangkok 10260

Unit Under Calibration Details

Calibration Parameter : Temperature

Instrument Name : Thermal Environment Monitor

Range Calibration : 20 °C to 60 °C

Manufacturer : TSI QUEST

Type of Sensor : RTD

Model : QT-34

Sensor Diameter (mm) : 4.5

Serial Number : QT10-8603

Calibration Position (mm) : 67.5

Resolution : 0.1 °C

Instrument Status : Used

ID Number : UAE.FPM.260-2553

Calibration Environment and Details

Temperature : 23 °C ± 2 °C

Humidity : 55 %RH ± 15 %RH

Received Date : 21 July 2023

Calibrated Date : 15 November 2023

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

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGO GINGO, Model: GT11-RTD100, SN:

0900057, ID: 02-TPM Which was calibrated on 27 February 2023, Calibration Certificate No.: CR23-

0494

Traceability : This Certificate is traceable to SI Unit through Quality Reform Co., Ltd., NSC/ONSC Accreditation No.

Calibration 0792

Note

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

Approved

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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Calibration Note : Certificate No : 23-TPM-370
UUC Adjustment : Not Adjust Request No : Req-2023-1525
Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Correction (°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
DRY	50.044	50.2	-0.2	0.13
	55.044	55.2	-0.2	0.13
	60.047	60.2	-0.2	0.13
	20.032	20.2	-0.2	0.13
	25.033	25.2	-0.2	0.13
	30.035	30.2	-0.2	0.13
AIR DRY	35.038	35.2	-0.2	0.13
	40.038	40.2	-0.2	0.13
	45.044	45.2	-0.2	0.13
	50.042	50.2	-0.2	0.13
	55.043	55.2	-0.2	0.13
	60.043	60.2	-0.2	0.13

End of Certificate

Calibrated By :

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

เอกสารไม่ควบคุม



Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING
Name : CONSULTANT CO., LTD.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok,
Prakanong, Bangkok 10260
Page : 1/2

Unit Under Calibration Details

Calibration Parameter : Temperature
Instrument Name : Thermal Environment Monitor
Manufacturer : 3M
Model : QT-32
Serial Number : TPQ070022
Resolution : 0.1 °C
ID Number : UAE.FM.09/5/2559
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 : 7 August 2023
Calibration Procedure : In-house method CP-TPM-01 by Comparison with Standard Thermometer.

Reference Standard : Digital Thermometer with Sensor, Manufacturer: GINGKO (GINGO), Model: GT1U/RTD100, SN: 0403057, 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-ONSAC Accreditation No.: Calibration 0292

Note

The reported uncertainty is based on standard uncertainty multiplied by the Coverage Factor (k=2) and is approximately 95 %.

Approved By :

Issue Date :

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the head of Calibration Laboratory.
เอกสารไม่ควบคุม
134-704-TPM-01 Rev/01 Issue date: 13/02/20



Calibration Note : Certificate No : 23-TPM-370
UUC Adjustment : Not Adjust Request No : Req-2023-1525
Page : 2/2

Result of Calibration :

UUC Sensor	Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Correction (°C)
WET	20.030	19.9	+0.1	0.13
	25.034	24.9	+0.1	0.13
	30.035	29.9	+0.1	0.13
	35.038	34.9	+0.1	0.13
	40.040	40.0	0.0	0.13
	45.042	45.0	0.0	0.13
DRY	50.043	50.0	0.0	0.13
	55.045	55.0	0.0	0.13
	20.033	20.0	0.0	0.13
	25.033	25.0	0.0	0.13
	30.035	30.0	0.0	0.13
	35.036	35.0	0.0	0.13
GLOBE	40.040	40.0	0.0	0.13
	45.041	45.0	0.0	0.13
	50.045	50.0	0.0	0.13
	20.031	19.9	+0.1	0.13
	25.035	24.9	+0.1	0.13
	30.034	29.9	+0.1	0.13
	35.039	34.9	+0.1	0.13
	40.035	40.0	0.0	0.13
	45.042	45.0	0.0	0.13
	50.042	50.1	-0.1	0.13
	55.048	55.1	-0.1	0.13
	60.048	60.1	-0.1	0.13

End of Certificate

Calibrated By :

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the head of Calibration Laboratory.
เอกสารไม่ควบคุม
134-704-TPM-01 Rev/01 Issue date: 13/02/20

SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

451-451/1 Srinthorn Rd., Banglamphu, Bangkok 10700 THAILAND.
Tel: 0-2433-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No. : ACL23063
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : RION
Model : NI-42/ Microphone UC-52 / Pre-amplifier NH-24
Serial No. : 00409050 / 189687 / 90495
ID No. : UAE.FM.012/2564

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

Received Date : 18 JANUARY 2023
Calibration Date : 20 JANUARY 2023
Date of Issue : 23 JANUARY 2023

Calibrated by : Nithakorn Pisutpaisan

Approved by :

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

QF-TS12-04-04-02664

เอกสารไม่ควบคุม

Continuation of Calibration Certificate

Cert. No. : ACL23063
Job No. : VC66AC0027
Pages : 2 of 8

Calibration Procedure : CP-AC-01

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.
For tests results of each items were made by observation of each Instruments display and also with SLM's display.

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY45017076	EP-0007-22	04-Feb-23
Waveform Generator	33511B	MY52302742	EP-0008-22	04-Feb-23
Digital Multimeter	33461A	MY53220104	EEL.BP. 04-0265	09-Feb-23
Digital Multimeter	33461A	MY53220076	EEL.BP. 03-0265	09-Feb-23
Digital Multimeter	34461A	MY60024273	EEL.BP. 05-0265	09-Feb-23
Programmable Attenuator	MAI-1070	62100114	EF-0009-22	07-Feb-23
Condenser Microphone	4180	2977900	AA-1013-22	24-Feb-23
Measuring Amplifier	NA-42KAI	34560495	AA-3005-22	22-Feb-23

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23063
Job No. : VC66AC0027
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23063
Job No. : VC66AC0027
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

Reference Acoustic Signal (dB)	Measured Value (dB)	Deviation (dB)	Acceptance Limit (dB)
93.9 (93.95)	93.9	-0.0	±0.3

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
13.8

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

Frequency Weighting	Measured value (dB)
A - weight	9.9
C - weight	16.6
Flat	22.4

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Deviation from various frequency weighting response curve (dB)			
	Flat	C-weight	A-weight	Acceptance Limits
125	0.2	0.2	0.2	± 1.5
1000	0.0	0.0	0.0	± 1.0
8000	-0.6	-0.5	-0.5	± 5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23063
Job No. : VC66AC0027
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23063
Job No. : VC66AC0027
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
137.0	137.0	0.0	± 1.1
136.0	136.0	0.0	± 1.1
135.0	135.0	0.0	± 1.1
134.0	134.0	0.0	± 1.1
133.0	133.0	0.0	± 1.1
132.0	132.0	0.0	± 1.1
131.0	131.0	0.0	± 1.1
129.0	129.0	0.0	± 1.1
124.0	124.0	0.0	± 1.1
119.0	119.0	0.0	± 1.1
114.0	114.0	0.0	± 1.1
109.0	109.0	0.0	± 1.1
104.0	104.0	0.0	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.1	0.1	± 1.1
84.0	84.1	0.1	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.1	0.1	± 1.1
69.0	69.1	0.1	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.1	0.1	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.0	0.0	± 1.1
44.0	44.0	0.0	± 1.1
39.0	39.0	0.0	± 1.1
34.0	34.1	0.1	± 1.1
30.0	30.1	0.1	± 1.1
29.0	29.1	0.1	± 1.1
28.0	28.1	0.1	± 1.1
27.0	27.1	0.1	± 1.1
26.0	26.1	0.1	± 1.1
25.0	25.1	0.1	± 1.1

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23063
Job No. : VC66AC0027
Pages : 7 of 8

8. Level linearity including the level range control

Range	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Auto	94.0	94.0	0.0	± 1.1

9. Tone burst response

Time Weighting	Tone burst duration, T _b (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.9	-0.1	1.5 ; -5.0
	2	8	117.0	117.0	0.0	1.0 ; -2.5
	200	800	134.0	134.0	0.0	± 1.0
Slow	2	8	108.0	108.0	0.0	1.5 ; -5.0
	200	800	127.6	127.6	0.0	± 1.0
SEL	0.25	1	99.0	98.9	-0.1	1.5 ; -5.0
	2	8	108.0	108.0	0.0	1.0 ; -2.5
	200	800	128.0	128.1	0.1	± 1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	136.4	0.0	± 3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.1	0.1	-
Positive half cycle	135.4	135.3	-0.1	± 2.0
Negative half cycle	135.4	135.3	-0.1	± 2.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL23063
Job No. : VC66AC0027
Pages : 8 of 8

11. Overload indication

Measured value (dB)		Deviated Value (dB)	Acceptance Limits (dB)
Positive one-half cycle	Negative one-half cycle		
89.6	89.6	0.0	± 1.5

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

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-121
Request No : Req-2023-0950

Unit Under Calibration Details

Measurement Item : Primary Flow Calibration
Manufacturer : TSI
Model : 4300
Serial Number : 53065971003
ID : 10AEJTM1602564
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 kPa ± 10 kPa
Received Date : 4 May 2023
Calibration Date : 26 May 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	Samdysinc	15 June 2023
Air Flow Meter	Gilibrator 3 High flow	18501012012	Samdysinc	15 June 2023
Air Flow Meter	4045 F	4045 0533 001	MEI	5 January 2024
Temperature meter	GT 11	12000077	Qeborn	27 February 2024
Pressure meter	CPG2400	31000KDU/651882	TFA	7 November 2023

Traceability :

This Certificate is traceable to SI Units through Samdysinc AZLA Accreditation No. 3943.01

Note :

The reported uncertainty is based on a standard uncertainty multiplied by coverage factor $k = 2$, providing approximately 95 %

Calibration By :

Approved By :

Issue Date :

Certificate No.: 23-APM-121
Request No.: Req-2023-0959

Result of Calibration:

Temperature (°C)	Pressure (kPa)	STD (L/min)	UUC (L/min)	Error (L/min)	Uncertainty (L/min)
24.60	101.43	1.604	1.51	-0.094	0.006
25.20	101.43	10.01	9.48	-0.53	0.142
25.09	101.42	20.00	19.14	-0.86	0.28
25.20	101.65	30.12	28.96	-1.14	0.30
26.70	102.24	55.9	50.58	-5.32	2.46
35.70	103.20	132.7	146.65	-6.65	3.97
41.30	104.27	202.9	192.51	-10.39	5.28

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. This certificate shall not be reproduced except in full, without written approval of the Issuing Institution.
100-708-ANAB-01 Rev.001 Issue Date: 01/07/19

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B 0316955



Certificate of Calibration

Certificate No.: 23P1855
Page: 1 of 2

Equipment: Aneroid Barometer
Manufacturer: Barigo
Model: -
Serial No.: -
ID No.: UAE/ANV 122/2550

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.

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

Reference: 2305-001/WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 10) %
Atmospheric Pressure: 1007 mbar

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

61 Soi Udomsak 41, Sukhumvit Road,
Bangrak, Phrakhanong, Bangkok 10250

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-F10, using 1 OKD-R 6-1; Calibration of Pressure Gauges, Edition 03/2014 as a guidelines.

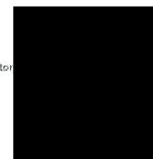
Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DP-142	1422525048	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. This certificate is valid only to the item calibrated on date and place of calibration.				
7. This Calibration is traceable to the International System of Unit maintained through:-				
- National Institute of Metrology Thailand (NIMT)				

Calibrated by: Suwan Kietnawee
Issue Date: 05 June 2023

Approved Signatory



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B 0316955



Cert.No.: 23P1655
Page: 2 of 2

Result of calibration: Without adjustment
Function: Absolute Pressure Measurements

Range: 960 MPa to 1030 MPa
Scale Interval: 1 MPa (The Fifth Error)

Increasing Pressure	Applied Pressure (MPa)	960.00	969.56	980.35	990.30	1001.01	1011.19	1020.94	1031.45
UUC* Indication (MPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0	1040.0
Error (MPa)	1.50	0.41	-0.35	-0.39	-1.01	-1.19	-0.84	-1.45	-1.45

Decreasing Pressure	Applied Pressure (MPa)	1031.45	1021.61	1012.16	1002.38	992.17	982.20	970.60	960.32
UUC* Indication (MPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0	950.0
Error (MPa)	-1.45	-1.61	-2.16	-2.38	-2.17	-2.20	-0.60	0.60	0.32

The uncertainty of measurement was ± 0.30 MPa
* 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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B 1169504



Certificate of Calibration

Certificate No.: 23H1100
Page: 1 of 2

Equipment: Digital Thermo-Hygrometer
Manufacturer: Olycom
Model: TH-02
Serial No.: 305034170
ID No.: UAE EFM 183/2505

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.

Condition As-Received: Used Item
Received Date: 10 May 2023
Calibration Date: 22 May 2023
to 24 May 2023

Reference: 2305-0641/WSC
Ambient Temperature: (25 ± 3) °C
Relative Humidity: (50 ± 20) %

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

61 Soi Udomsak 41, Sukhumvit Road, Bangrak,
Phrakhanong, Bangkok 10250

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	Daw Meter	44730	20563A	14 Jun 2023
2) Handheld Thermometer With Sensor	1521	ASA348	2211251	12 Oct 2023
2. This certificate is valid only to the item calibrated on date and place of calibration.				
3. This Calibration 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: Kraisoon Ornel
Issue Date: 25 May 2023

Approved Signatory

(y) Chiratt Watananurak
J Pongthaporn Tanayavut
J Viporn Tanayavut



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B 0314978



Cert. No.: 23H1100
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	42	1.9	1.5
25.0	50.1	52	1.9	1.5
25.0	60.0	61	1.0	1.0
25.0	70.2	69	-1.2	1.5

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	40.0	0.000	0.42

UUC* : Unit Under Calibration

The reported uncertainty of measurement was based on standard uncertainty multiplied by coverage factor $k = 2.58$, providing confidence level approximately 95%.

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a 1162381



United Analyst and Engineering Consultant Co., Ltd.
8 Soi Udomsak 41, Sukhumvit Road, Bangkok, Phra Khanong, Bangkok 10260
Tel: 0 2763 2626 Fax: 0 2763 2600 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Jan 9, 2023

Equipment : Gas Analyzer (SO₂)
Manufacturer : Thermo SCIENTIFIC

Model : 43i
Serial Number : CH22387055

Standard Gas Concentration

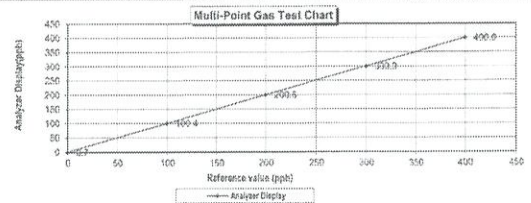
Sulphur Dioxide (SO₂) : 44.68 PPM
Nitric Oxide (NO) : 45.94 PPM
Methane (CH₄) : - PPM
Carbon Monoxide (CO) : 984.8 PPM
Cylinder No. : F80143262
Expiration Date : Jun 24, 2024

Dilutor Detail

Manufacturer : Thermo SCIENTIFIC
Model : 145i
Serial Number : 1180540071

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.7	0.70	0.70
Level 2	29.00%	100.0	100.4	0.40	0.40
Level 3	40.00%	200.0	200.6	0.30	0.30
Level 4	60.00%	300.0	300.9	0.30	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range	500.0 ppb			Average Difference (%)	0.34
Acceptable Limit ± 5%					



Page 1 of 1

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United Analyst and Engineering Consultant Co., Ltd.
8 Soi Udomsak 41, Sukhumvit Road, Bangkok, Phra Khanong, Bangkok 10260
Tel: 0 2763 2626 Fax: 0 2763 2600 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Apr 7, 2023

Equipment : Gas Analyzer (SO₂)
Manufacturer : Thermo SCIENTIFIC

Model : 43i
Serial Number : CH22387055

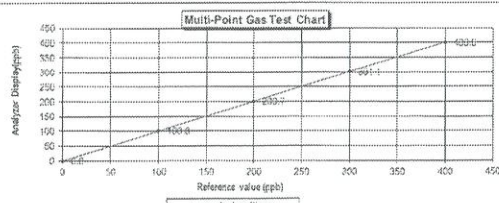
Standard Gas Concentration

Sulphur Dioxide (SO₂) : 44.68 PPM
Nitric Oxide (NO) : 45.94 PPM
Methane (CH₄) : - PPM
Carbon Monoxide (CO) : 984.8 PPM
Cylinder No. : F80143262
Expiration Date : Jun 24, 2024

Dilutor Detail
Manufacturer : Thermo SCIENTIFIC
Model : 145i
Serial Number : 1180540071

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.50	0.00	0.00
Level 2	20.00%	100.0	100.8	0.79	0.79
Level 3	40.00%	200.0	200.7	0.35	0.35
Level 4	60.00%	300.0	301.1	0.37	0.37
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range	500.0 ppb			Average Difference (%)	0.30
Acceptable Limit ± 5%					



Page 1 of 1

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United Analyst and Engineering Consultant Co., Ltd.
8 Soi Udomsak 41, Sukhumvit Road, Bangkok, Phra Khanong, Bangkok 10260
Tel: 0 2763 2626 Fax: 0 2763 2600 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

Test Date : Mar 7, 2023

Equipment : Gas Analyzer (SO₂)
Manufacturer : Thermo SCIENTIFIC

Model : 43i
Serial Number : CH22387052

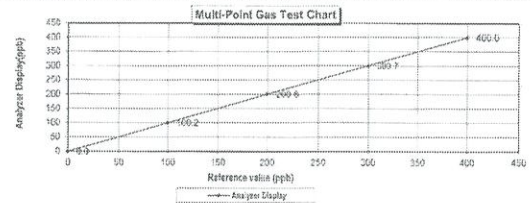
Standard Gas Concentration

Sulphur Dioxide (SO₂) : 44.68 PPM
Nitric Oxide (NO) : 45.94 PPM
Methane (CH₄) : - PPM
Carbon Monoxide (CO) : 984.8 PPM
Cylinder No. : F80143262
Expiration Date : Jun 24, 2024

Dilutor Detail
Manufacturer : Thermo SCIENTIFIC
Model : 145i
Serial Number : 1180540071

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.2	0.20	0.20
Level 3	40.00%	200.0	200.6	0.30	0.30
Level 4	60.00%	300.0	300.7	0.23	0.23
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range	500.0 ppb			Average Difference (%)	0.17
Acceptable Limit ± 5%					



Page 1 of 1

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N189E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 650
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024

Certification performed in accordance with EPA Testability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/031, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole fraction basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig (i.e. 0.7 megapascals).

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.98 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.88 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	09/14/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NR14	20001120	CCT00058	45.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12350	D985025	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.2%	Feb 23, 2026
GMIS	401423838102	CSC55581	4.345 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	15011043	CC473277	46.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14250119	CC434277	985.8 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

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

Triad Data Available Upon Request
NOTES: PO #5221002607
GROSS WT: 28.40kg
NET WT: 4.73kg



The analytical test results on this certificate relate only to the cylinder number and do not conclude the test report.



เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Feb 28, 2023

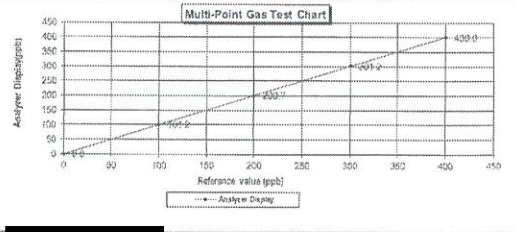
Equipment : Gas Analyzer (NO₂) Model : 42i
Manufacturer : Thermo Scientific Serial Number : 1191503036

Standard Gas Concentration	Dilutor Detail
Sulphur Dioxide (SO ₂) 44.68 PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM	Model : 146i
Methane (CH ₄) - PPM	Serial Number : 1190540071
Carbon Monoxide (CO) 984.8 PPM	
Cylinder No. : EB0143262	
Expiration Date : Jun 21, 2024	

Multi-point gas test data

Level	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	1.20	1.19	1.19
Level 3	40.00%	200.0	0.70	0.35	0.35
Level 4	60.00%	300.0	1.20	0.40	0.40
Level 5	80.00%	400.0	0.60	0.00	0.00

Remark : Measuring Range 500.0 ppb
Acceptable Limit \pm 5%



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เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Apr 20, 2023

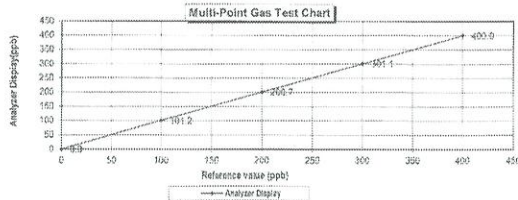
Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Electron Corporation Serial Number : 0517512001

Standard Gas Concentration	Dilutor Detail
Sulphur Dioxide (SO ₂) 44.68 PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM	Model : 146i
Methane (CH ₄) - PPM	Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM	
Cylinder No. : EB0143262	
Expiration Date : Jun 21, 2024	

Multi-point gas test data

Level	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	1.20	1.19	1.19
Level 3	40.00%	200.0	0.70	0.35	0.35
Level 4	60.00%	300.0	1.10	0.37	0.37
Level 5	80.00%	400.0	0.00	0.00	0.00

Remark : Measuring Range 500.0 ppb
Acceptable Limit \pm 5%



Page 1 of 1

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Mar 16, 2023

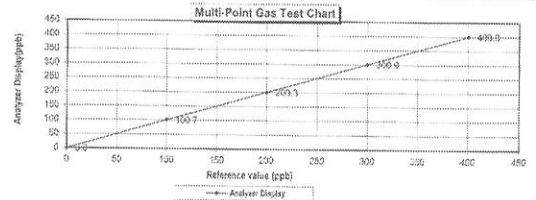
Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Electron Corporation Serial Number : 0517512001

Standard Gas Concentration	Dilutor Detail
Sulphur Dioxide (SO ₂) 44.68 PPM	Manufacturer : Thermo Scientific
Nitric Oxide (NO) 45.94 PPM	Model : 146i
Methane (CH ₄) - PPM	Serial Number : 1180540071
Carbon Monoxide (CO) 984.8 PPM	
Cylinder No. : EB0143262	
Expiration Date : Jun 21, 2024	

Multi-point gas test data

Level	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	0.70	0.70	0.70
Level 3	40.00%	200.0	0.30	0.15	0.15
Level 4	60.00%	300.0	0.90	0.30	0.30
Level 5	80.00%	400.0	0.00	0.00	0.00

Remark : Measuring Range 500.0 ppb
Acceptable Limit \pm 5%



Page 1 of 1

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Mar 18, 2023

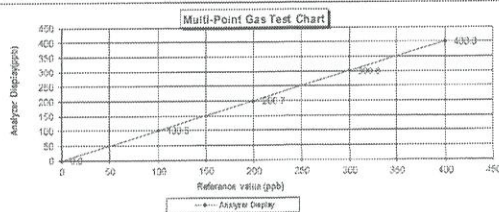
Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Electron Corporation Serial Number : 42C-0508011076

Standard Gas Concentration
Sulphur Dioxide (SO₂) : 44.68 PPM Manufacturer : Thermo Scientific
Nitric Oxide (NO) : 45.94 PPM Model : 1461
Methane (CH₄) : - PPM Serial Number : 1180540071
Carbon Monoxide (CO) : 984.8
Cylinder No. : E90143262
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	0.50	0.50	0.50
Level 3 40.00%	200.0	0.70	0.35	0.35
Level 4 60.00%	300.0	0.80	0.27	0.27
Level 5 80.00%	400.0	0.00	0.00	0.00

Remark : Measuring Range : 500.0 ppb
Acceptable Limit : ± 5%



MULTI-POINT GAS TEST REPORT

Test Date : Mar 18, 2023

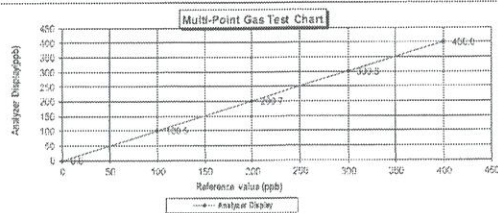
Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Electron Corporation Serial Number : 42C-0508011076

Standard Gas Concentration
Sulphur Dioxide (SO₂) : 44.68 PPM Manufacturer : Thermo Scientific
Nitric Oxide (NO) : 45.94 PPM Model : 1461
Methane (CH₄) : - PPM Serial Number : 1180540071
Carbon Monoxide (CO) : 984.8
Cylinder No. : E90143262
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	0.50	0.50	0.50
Level 3 40.00%	200.0	0.70	0.35	0.35
Level 4 60.00%	300.0	0.80	0.27	0.27
Level 5 80.00%	400.0	0.00	0.00	0.00

Remark : Measuring Range : 500.0 ppb
Acceptable Limit : ± 5%



MULTI-POINT GAS TEST REPORT

Test Date : Mar 18, 2023

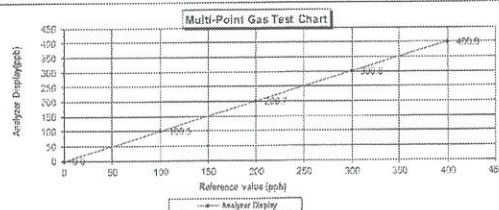
Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Electron Corporation Serial Number : 42C-0508011076

Standard Gas Concentration
Sulphur Dioxide (SO₂) : 44.68 PPM Manufacturer : Thermo Scientific
Nitric Oxide (NO) : 45.94 PPM Model : 1461
Methane (CH₄) : - PPM Serial Number : 1180540071
Carbon Monoxide (CO) : 984.8
Cylinder No. : E90143262
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	0.50	0.50	0.50
Level 3 40.00%	200.0	0.70	0.35	0.35
Level 4 60.00%	300.0	0.80	0.27	0.27
Level 5 80.00%	400.0	0.00	0.00	0.00

Remark : Measuring Range : 500.0 ppb
Acceptable Limit : ± 5%



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
50/11 WITANAKARN ROAD SOI 18, SHANGHAI, SHANGHAI, CHINA 200000
TEL: 0-2713-1000 FAX: 0-2713-1481



Certificate of Calibration

Certificate No. : 23H1200
Page : 1 of 2

Equipment : Dai Thermo-Hygrometer
Manufacturer : Bango
Model : -
Serial No. : -
ID No. : UAE-ANV-133/2550

Condition As-Received : Used Item

Received Date : 26 May 2023

Calibration Date : 30 May 2023

Reference : 2305-019WSC

Ambient Temperature : (25 ± 3) °C

Relative Humidity : (50 ± 20) %

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

Condition of this result of calibration

1. Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Hygro-M2 Dew Point Monitor	6112	2300185	20703	02 Aug 2023
2) Handheld Thermometer With Sensor	1523	3240078	231005	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-CNSO Accredited No. Calibration 0008

Calibrated by : Srirachai Dumnor
Issue Date : 07 June 2023

Approved Signatory :

[] Chakrit Wern
[] Pornthip Tanayakul
[] Viporn Tanayakul



Cert. No.: 23H1200
Page: 2 of 2

Result of Calibration:
Function:

Before Adjustment
Humidity Measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	48	7.9	1.6
25.0	60.0	63	3.0	1.7
25.0	80.0	78	-4.0	1.9

Result of Calibration:
Function:

After Adjustment
Humidity Measurement

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (±%R.H.)
25.0	40.1	44	3.9	1.6
25.0	60.0	60	0.0	1.7
25.0	80.0	75	-5.0	1.9

Result of Calibration:
Function:

Without Adjustment
Temperature Measurement

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
19.987	20.0	0.013	0.72
30.016	30.0	-0.018	0.72
39.944	39.5	-0.444	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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1165295



Branch: Automation Co., Ltd.
40/14-15, 67/35-36,
Kasikornwong 7, 1/1, 66, Quarters, Bangkok,
(Bangkok 10250 Thailand)
Tel: +662-025812
Mobile: +662-025813
E-mail: jnac@jiranatee.co.th
Web site: www.jiranatee.co.th

Accredited Calibration Laboratory
ISO/IEC 17025:2017
ACC 731-715 17025
CALIBRATION (3667)
Flow measurement laboratory
Calibration services department

CERTIFICATE OF CALIBRATION

Certificate No.: CL-003-65

Page 1 of 2 Pages

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

Top Level Office
Tach Environmental, Inc.
YE-0025A
3383
UAE EFM 052/2560
United Firm
United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsak 41, Sukhumvit Road, Bangkok, Phraekhanong,
Bangkok 10260

RECEIVED DATE
MEASUREMENT DATE
ISSUE DATE

15 Jul 2022
25 Jul 2022
26 Jul 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature: 23.6 ± 3.0 °C
Relative Humidity: 55.0 ± 15.0 %RH
Atmospheric Pressure: 1010 ± 10 hPa

CALIBRATION CONDITION:
Preconditioning
Measurement Condition

24 hours at ambient conditions.
The average values during measurement are 24.8 °C and 90.1 %RH.

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 (RSDM Meter) Model 653/741/742 dgs. The 1643-014 was used as a calibration gas.

Traceability:
The certificate provides a traceability of the measurement to recognized international standards, and to realization of the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: 02231801.

Uncertainty of Measurement:
The reported uncertainty of measurement is based on the standard uncertainty multiplied by a coverage factor $k = 2$, which has a normal distribution corresponding 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).

Calibrated by:

Mr. Satevit Thachachai
80 Mueang Road, Bangkok



Approved by:

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

เอกสารไม่ควบคุม



JIRANATEE ASSOCIATES CO., LTD.

Continuation of Certificate of Calibration Number CL-003-65

Page 2 of 2 Pages

MEASUREMENT RESULTS:

The Orifice gas flow device was calibrated by direct comparison method with the Standard Rotary Displacement Meter (RSDM Meter). The humid air was used as a medium in the system. The standard conditions are 25 °C (250 hPa) 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 (°C)	Temperature (°F)	Ap, meter mmHg	Ap, Orifice mmHg	γ	Standard Flow (Q_s) m^3/min
1	0.637	754.265	24.660	76.390	55.550	1.640	1.230	0.643
2	1.000	754.236	24.950	76.910	62.172	1.644	1.849	0.911
3	1.318	754.323	24.730	76.510	62.815	1.652	2.103	1.051
4	1.369	754.212	24.640	76.350	61.980	1.650	2.162	1.116
5	1.418	754.175	24.480	76.060	60.110	1.620	2.254	1.153

Slope (a): 2.04834
Intercept (b): -0.01939
Correlation coefficient (r): 0.99982
Uncertainty (\pm U): 0.011 m^3/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m^3/min	Pressure (Pa) mmHg	Temperature (°C)	Temperature (°F)	Ap, meter mmHg	Ap, Orifice mmHg	γ	Standard Flow (Q_s) m^3/min
1	0.637	754.265	24.660	76.390	55.550	1.640	0.819	0.647
2	1.000	754.236	24.950	76.910	62.172	1.644	1.677	0.919
3	1.318	754.323	24.730	76.510	62.815	1.652	1.945	1.056
4	1.369	754.212	24.640	76.350	61.980	1.650	1.626	1.123
5	1.418	754.175	24.480	76.060	60.110	1.620	1.728	1.183

Slope (a): 1.28277
Intercept (b): -0.01223
Correlation coefficient (r): 0.99982
Uncertainty (\pm U): 0.012 m^3/min



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
31/4 PATTANAKARN ROAD NO.18, SUKHUMVIT, SUANLUANG, BANGKOK 10250
TEL: 0-2715-3660-241X, 0-2719-0494

Certificate of Calibration

Certificate No.: 23P1401
Page: 1 of 2

Equipment: U-Tube Manometer
Manufacturer: Dwyer
Model: 1221-35-WM
Serial No.: -
ID No.: UAE EFM 052/2560
Condition As-Received: Used Item
Received Date: 29 April 2023
Calibration Date: 03 May 2023

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

Reference: 2304-0703WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1010 mbar

Submitted by: United Analyst and Engineering Consultant Co., Ltd.
91 Soi Udomsak 41, Sukhumvit Road, Bangkok,
Phraekhanong, Bangkok 10260

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-FC4, using "DKD-R 6-1: Calibration of Pressure Gauges, Edition 03/2014" as a guidelines.

Condition of this result of calibration

1. Reference standards Instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC10EP	1189	MP-0137-22	24 Aug 2023

- This result of calibration was made on requested at the point specified by customer.
- Scale and conversion factor is $1 \text{ kPa} = 4.0146325 \text{ mmHg}$.
- This instrument was used clean air and oil as pressure media.
- This instrument was calibrated by applied pressure to high-port (+) side and low-port (-) side open to atmospheric pressure.
- This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.
- This certificate is valid only to the item calibrated on date and place of calibration.
- This Certification is traceable to the International System of Unit maintained through:-
National Institute of Metrology Thailand (NIMT)

Calibrated by: Satevit Aunrasamee
Issue Date: 11 May 2023

Approved Sign:

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม
R 0314241



Cert.No.: 23P1401
Page: 2 of 2

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

Range: 0 inH₂O to 35 inH₂O
Scale Interval: 0.1 inH₂O (The Fitch Estimate)

UUC Indication				
Applied Pressure (inH ₂ O)	High-port side (inH ₂ O)	Low-port side (inH ₂ O)	ΔP (inH ₂ O)	Error (inH ₂ O)
0.00	0.00	0.00	0.00	0.00
2.00	1.00	-0.98	1.98	-0.02
4.00	2.00	-1.98	3.98	-0.02
6.00	3.00	-2.98	5.98	-0.02
8.00	4.00	-3.98	7.98	-0.02
10.00	5.00	-4.98	9.98	-0.02
12.00	6.00	-5.98	12.00	0.00
14.00	7.00	-6.98	14.00	0.00
16.00	8.00	-7.98	16.00	0.00
18.00	9.00	-8.98	18.00	0.00
20.00	10.00	-9.98	20.00	0.00
22.00	11.00	-10.98	22.00	0.00
24.00	12.00	-11.98	24.00	0.02
26.00	13.00	-12.98	26.00	0.02
28.00	14.00	-13.98	28.00	0.02
30.00	15.00	-14.98	30.00	0.04
32.00	16.00	-15.98	32.00	0.04
34.00	17.00	-16.98	34.00	0.02
35.00	18.00	-17.98	35.00	0.02

The uncertainty of measurement was ± 0.11 inH₂O
* UUC = Unit Under Calibration

* ΔP = High-port side - Low-port side

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

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Attaporn P.
เอกสารไม่ควบคุม
๑ 1160340



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
3343 PATTANAKARN ROAD SU 18, SUKUMVIT 41, BANGKOK, 10250
TEL: 0-2373-3030-34 FAX: 0-2373-9888



Certificate of Calibration

Certificate No.: 23P1653
Page: 1 of 2

Equipment: Aneroid Barometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE/ANV 124/2550

Condition As Received: Used Item

Received Date: 26 May 2023

Calibration Date: 02 June 2023

Reference: 2305-0019W5G

Ambient Temperature: (20 ± 2) °C

Relative Humidity: (50 ± 15) %

Atmospheric Pressure: 1007 mbar

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

81 Soi Udomsuk 41, Sukhumvit Road,
Bangkok, Phraechang, Bangkok 10250

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

Condition of this result of calibration

1. Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DP1142	14225504B	MP-0084-23	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: Sukarn Khankharn
Issue Date: 08 June 2023

Approved Signatory

Signature
Attaporn Parach

เอกสารไม่ควบคุม
๑ 0316958



Cert.No.: 23P1653
Page: 2 of 2

Result of calibration: Without adjustment
Function: Absolute Pressure Measurement

Range: 950 hPa to 1030 hPa
Scale Interval: 1 hPa (The Fitch Estimate)

Increasing Pressure

Applied Pressure (hPa)	959.53	970.47	981.93	993.32	1002.28	1011.84	1021.14	1032.30
UUC Indication (hPa)	962.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	0.07	-0.47	-1.93	-1.32	-2.28	-1.84	-1.14	-2.30

Decreasing Pressure

Applied Pressure (hPa)	1032.30	1021.14	1011.84	1002.28	993.32	981.93	970.47	959.53
UUC Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-2.30	-1.14	-1.84	-2.28	-1.32	-1.93	-0.47	0.07

The uncertainty of measurement was ± 0.30 hPa

* 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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Attaporn P.
เอกสารไม่ควบคุม
๑ 1165508

SITHIPORN ASSOCIATES CO., LTD. CALIBRATION LABORATORY

451-451/1 Srinthorn Rd., Banglumru, Bangpuet Bangkok 10700 THAILAND
Tel: 0-2435-8800 Fax: 0-2433-1679 e-mail: cal-center@sithiporn.com http://www.sithiporn.com



Cert. No.: ACL22081
Pages: 1 of 8

Calibration Certificate

Equipment: SOUND LEVEL METER

Manufacturer: LARSON DAVIS

Model: LxT2/ Microphone 375B02 / Pre-amplifier PRML x 12B

Serial No.: 0005286 / 011740 / 0506087

ID No.: -

Condition As Found: GOOD

Customer: UNITED ANALYST AND ENGINEERING CONSULTANT (UAE)

81 SOI UDOMSUK 41, SUKUMVIT ROAD,
BANGCHAK SUB-DISTRICT,
PHRAKLANG DISTRICT, BANGKOK 10260
THAILAND.

Location: -

Ambient Temperature: (23.0 ± 3) °C

Pressure: (101.3 ± 3) kPa

Relative Humidity: (50.0 ± 20) %

Received Date: 18 JANUARY 2022

Calibration Date: 26 JANUARY 2022

Date of Issue: 28 JANUARY 2022

Calibrated by: Nathakorn Pisutpaisan

Approved by:

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

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QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22081
Job No. : VC65AC0044
Pages : 2 of 8

Calibration Procedure : CP-AC-02

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments :

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

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22081
Job No. : VC65AC0044
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22081
Job No. : VC65AC0044
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
31.0

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

Frequency Weighting	Measured value (dB)
A - weight	30.8
C - weight	30.6
Flat	36.8

3. Acoustical signal tests of frequency weightings

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

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
125	-0.1	0.1	0.0	± 1.5
1000	-0.2	-0.2	-0.2	± 1.0
8000	3.1	3.2	3.2	±5.0

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22081
Job No. : VC65AC0044
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

Frequency (Hz)	Flat	C-weight	A-weight	Acceptance Limits
63	0.0	0.0	0.0	±2.0
125	0.0	0.0	0.0	±1.5
250	0.0	0.0	0.0	±1.5
500	0.0	0.0	0.0	±1.5
1000	0.0	0.0	0.0	±1.0
2000	0.0	0.1	0.0	±2.0
4000	0.0	0.0	0.0	±3.0
8000	0.0	0.0	0.0	±5.0
16000	-0.1	0.0	0.1	±5.0 (-∞)

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long - term stability

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

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL22081
Job No. : VC65AC0044
Pages : 6 of 8

7. Level linearity on the reference level range

Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
135.0	135.1	0.1	± 1.1
134.0	134.1	0.1	± 1.1
133.0	133.1	0.1	± 1.1
132.0	132.1	0.1	± 1.1
131.0	131.1	0.1	± 1.1
129.0	129.1	0.1	± 1.1
124.0	124.1	0.1	± 1.1
119.0	119.1	0.1	± 1.1
114.0	114.1	0.1	± 1.1
109.0	109.1	0.1	± 1.1
104.0	104.1	0.1	± 1.1
99.0	99.0	0.0	± 1.1
94.0	94.0	0.0	± 1.1
89.0	89.0	0.0	± 1.1
84.0	84.0	0.0	± 1.1
79.0	79.0	0.0	± 1.1
74.0	74.0	0.0	± 1.1
69.0	69.0	0.0	± 1.1
64.0	64.0	0.0	± 1.1
59.0	59.0	0.0	± 1.1
54.0	54.0	0.0	± 1.1
49.0	49.1	0.1	± 1.1
44.0	44.2	0.2	± 1.1
39.0	39.6	0.6	± 1.1

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL22081
Job No. : VC65AC0044
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.8	-0.2	1.5 ; -5.0
	2	8	117.0	116.7	-0.3	1.0 ; -2.5
	200	800	134.0	133.9	-0.1	±1.0
Slow	2	8	108.0	107.8	-0.2	1.5 ; -5.0
	200	800	127.6	127.5	-0.1	±1.0
	0.25	1	N/A	N/A	N/A	1.5 ; -5.0
SEL	2	8	N/A	N/A	N/A	1.0 ; -2.5
	200	800	N/A	N/A	N/A	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, L _{peak} (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	136.4	135.7	-0.7	±3.0

Number of cycle in test signal	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
Positive half cycle	135.4	135.2	-0.2	±2.0
Negative half cycle	135.4	135.2	-0.2	±2.0

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL22081
Job No. : VC65AC0044
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

QF-TS12-04-04-020664

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451-451/1 Srinthorn Rd., Bangtumru, Bangkok 10706 THAILAND.
Tel:0-2435-8800 Fax:0-2433-1679 e-mail:cal-center@sithiporn.com http://www.sithiporn.comCert. No. : ACL22082
Pages : 1 of 8

Calibration Certificate

Equipment : SOUND LEVEL METER
Manufacturer : LARSON DAVIS
Model : IxT2/ Microphone 375B02 / Preamplifier PRML x 12B
Serial No. : 0005289 / 011732 / 056076
ID No. : -

Condition As Found : GOOD

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

Location : -
Ambient Temperature : (23.0 ± 3) °C
Pressure : (101.3 ± 3) kPa
Relative Humidity : (50.0 ± 20) %

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

Calibrated by : Nathakorn Pisatpaisan

Approved by :

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

QF-TS12-04-04-020664

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Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 2 of 8

Calibration Procedure : CP-AC-02

Calibration Method :

This equipment was calibrated by based on IEC-61672-3 (2013) Standard for sound level meter (SLM).
The SLM had tests to Acoustical and Electrical signal tests of frequency weighting with Anechoic chamber and Reference Standard Instruments.

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

Condition of this result of calibration :

1. Reference Standard Instruments :

Instrument	Model	Serial No.	Cert. No.	Due Date
Waveform Generator	33210A	MY48017076	EF-0012-21	10-Feb-22
Waveform Generator	33511B	MY52302742	FF-0011-21	10-Feb-22
Digital Multimeter	33461A	MY33220104	EEL_BP_05/0264	10-Feb-22
Digital Multimeter	33461A	MY33220076	EEL_BP_05/0264	08-Feb-22
Digital Multimeter	34461A	MY60024273	1-15180725251-1	15-Sep-22
Programmable Attenuator	MAT-1070	62100114	1500-07774E	08-Mar-22
Condenser Microphone	4180	2977900	AA-1008-21	05-Feb-22
Measuring Amplifier	NA-42KAI	34560495	AA-3003-21	16-Feb-22

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

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

3.1 National Institute of Metrology (Thailand).

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 3 of 8

Summary of Measurement Result :

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

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 4 of 8

Result of calibration :

1. Absolute sensitivity

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

2. Self-generated noise

2.1 Normal test

Measured Value (dB)
29.6

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

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

3. Acoustical signal tests of frequency weightings

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

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

QF-TS12-04-04-020664

Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 5 of 8

4. Electrical signal tests of frequency weightings

Weighting network response with relative to 1 kHz.

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

5. Frequency and time weightings at 1 kHz

5.1 Frequency weightings at 1 kHz

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

5.2 Time weighting at 1 kHz

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

6. Long-term stability

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

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 6 of 8

7. Level linearity on the reference level range

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

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 7 of 8

8. Level linearity including the level range control

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

9. Tone burst response

Time Weighting	Tone burst duration, Tb (ms)	Cycle	Anticipated Value (dB)	Measured Value (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Fast	0.25	1	108.0	107.8	-0.2	1.5 ; -5.0
	2	8	117.0	116.7	-0.3	1.0 ; -2.5
	200	800	124.0	123.9	-0.1	±1.0
Slow	2	8	108.0	107.8	-0.2	1.5 ; +5.0
	200	800	127.6	127.6	0.0	±1.0
	0.25	1	N/A	N/A	N/A	1.5 ; -5.0
SEL	2	8	N/A	N/A	N/A	1.0 ; -2.5
	200	800	N/A	N/A	N/A	±1.0

10. Peak C sound level

Number of cycle in test signal	Anticipated Value (dB)	Measured Value, Lepeak (dB)	Deviated Value (dB)	Acceptance Limits (dB)
Continuous	133.0	133.0	0.0	-
One	126.4	125.8	-0.8	±3.0

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

QF-TS12-04-04-020664

เอกสารไม่ควบคุม

Continuation of Calibration Certificate

Cert. No. : ACL22082
Job No. : VC65AC0044
Pages : 8 of 8

11. Overload indication

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

12. High level stability

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

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

End of Calibration Certificate

เอกสารไม่ควบคุม

QF-TS12-04-04-020664

Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD
Name : 81 Soi Udomak 41, Sukhumvit Road, Bangkok, Prachin Buri, Thailand
Address : 10200
Certificate No : 22-AC-7248
Request No : Req-2022-0538

Unit Under Calibration Details

Measurement Item : Sound Level Meter
Manufacturer : LARSON DAVIS
Model : LS12
Serial Number : 003544
ID : UAL-EM-0412503
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : 175A04
Microphone SN : 229362
Preamplifier Model : PRA16A7C
Preamplifier SN : 071494
Instrument Status : Good

Calibration Environment and Details

Temperature : 25 °C ± 2 °C
Humidity : 50 %RH ± 20 %RH
Barometric Pressure : 1013.25 hPa ± 10 hPa
Received Date : 25 March 2022
Calibration Date : 1 April 2022
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-1 : 2013 Flatness/curvature - Sound level meters - Part 2: Periodic tests
Location of Calibration : 1.1b Acoustic

Reference Standard

Instrument	Brand	Model	SN	Date calibration	Traceability
Standard Microphone	GRAS	38A01	188273	15 September 2022	GRAS
Multi-frequency Calibrator	Quest	Quest cal	EP400C14	14 June 2022	TSA
Audio Generator	Swanick	Swanick	131	18 October 2022	WK Electric

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 :
Calibration OfficerApproved By :
CIssue Date :
C

The results related only to the items calibrated. The certificate shall not be reproduced except in full, without written approval of the responsible authority.
เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

Certificate No : 22-ACT-048
Request No : Req-2022-0628

1. Indication at the calibration check frequency

UUC Setting	Measured	Before adjust	Adjust	UNCERTAINTY	Acceptance
FAST / A : 37-139	Level	UUC	ERR	UUC	ERR
Calibration Setting	(dB)	(dB)	(dB)	(dB)	(dB)
100 Hz 114.06 dB	113.85	113.7	-0.15	113.9	0.05
				0.20	0.3

Note: Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SY 15A, SLR, SD 19

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	28.1	0.10

3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	25.8	0.10
C	23.4	0.10
Z	22.6	0.10

4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance
FAST / 37-139	Weighting Response curve		
STD Setting	A (dB) C (dB) Z (dB)	(± dB)	(± dB)
125 Hz	0.0 0.1 0.1	0.50	2.0
160 Hz	0.0 0.0 0.0	0.50	1.0
4000 Hz	0.2 0.2 0.2	0.60	2.0
1000 Hz	0.0 0.0 0.1	0.70	3.0

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the calibration laboratory.
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Certificate No : 22-ACT-048
Request No : Req-2022-0628

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance
FAST / 37-139	Weighting Response curve		
STD Setting	A (dB) C (dB) Z (dB)	(± dB)	(± dB)
63 Hz	-0.2 -0.1 -0.1	0.2	2.0
125 Hz	-0.1 0.0 0.0		1.0
250 Hz	-0.1 0.0 0.0		1.0
500 Hz	-0.1 0.0 0.0		1.0
1000 Hz	0.0 0.0 0.0		1.0
2000 Hz	0.0 0.0 0.0		1.0
4000 Hz	0.0 0.0 0.0		1.0
8000 Hz	-0.1 -0.1 0.0		1.0
16000 Hz	-0.1 -0.1 -0.1		+5, -0.5

6. Frequency and time weightings at 1 kHz

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / 37-139	REF	UUC	ERR	
UUC Weighting	(dB)	(dB)	(dB)	(± dB)
A	114.00	114.0	0.0	0.2
C	114.00	114.0	0.0	0.2
Z	114.00	114.0	0.0	0.2

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
37-139 / A	REF	UUC	ERR	
UUC Time Response	(dB)	(dB)	(dB)	(± dB)
Fast	114.00	114.0	0.0	0.1
Slow	114.00	114.0	0.0	0.1
1sec	114.00	114.0	0.0	0.1

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the calibration laboratory.
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Certificate No : 22-ACT-048
Request No : Req-2022-0628

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A : 37-139	UUC		
STD Setting	(dB)	(± dB)	(± dB)
Initial	114.0		
Final	114.0		
Deviation	0.0	0.1	0.3

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation	UNCERTAINTY	Acceptance
FAST / A : 37-139	REF	UUC	ERR	
STD dB	(dB)	(dB)	(dB)	(± dB)
130.0	129	129.0	0.0	1.1
134.0	134	134.0	0.0	1.1
138.0	138	138.0	0.0	1.1
142.0	142	142.0	0.0	1.1
146.0	146	146.0	0.0	1.1
150.0	150	150.0	0.0	1.1
154.0	154	154.0	0.0	1.1
158.0	158	158.0	0.0	1.1
162.0	162	162.0	0.0	1.1
166.0	166	166.0	0.0	1.1
170.0	170	170.0	0.0	1.1
174.0	174	174.0	0.0	1.1
178.0	178	178.0	0.0	1.1
182.0	182	182.0	0.0	1.1
186.0	186	186.0	0.0	1.1
190.0	190	190.0	0.0	1.1
194.0	194	194.0	0.0	1.1
198.0	198	198.0	0.0	1.1
202.0	202	202.0	0.0	1.1
206.0	206	206.0	0.0	1.1
210.0	210	210.0	0.0	1.1
214.0	214	214.0	0.0	1.1
218.0	218	218.0	0.0	1.1
222.0	222	222.0	0.0	1.1
226.0	226	226.0	0.0	1.1
230.0	230	230.0	0.0	1.1
234.0	234	234.0	0.0	1.1
238.0	238	238.0	0.0	1.1
242.0	242	242.0	0.0	1.1
246.0	246	246.0	0.0	1.1
250.0	250	250.0	0.0	1.1
254.0	254	254.0	0.0	1.1
258.0	258	258.0	0.0	1.1
262.0	262	262.0	0.0	1.1
266.0	266	266.0	0.0	1.1
270.0	270	270.0	0.0	1.1
274.0	274	274.0	0.0	1.1
278.0	278	278.0	0.0	1.1
282.0	282	282.0	0.0	1.1
286.0	286	286.0	0.0	1.1
290.0	290	290.0	0.0	1.1
294.0	294	294.0	0.0	1.1
298.0	298	298.0	0.0	1.1
302.0	302	302.0	0.0	1.1
306.0	306	306.0	0.0	1.1
310.0	310	310.0	0.0	1.1
314.0	314	314.0	0.0	1.1
318.0	318	318.0	0.0	1.1
322.0	322	322.0	0.0	1.1
326.0	326	326.0	0.0	1.1
330.0	330	330.0	0.0	1.1
334.0	334	334.0	0.0	1.1
338.0	338	338.0	0.0	1.1
342.0	342	342.0	0.0	1.1
346.0	346	346.0	0.0	1.1
350.0	350	350.0	0.0	1.1
354.0	354	354.0	0.0	1.1
358.0	358	358.0	0.0	1.1
362.0	362	362.0	0.0	1.1
366.0	366	366.0	0.0	1.1
370.0	370	370.0	0.0	1.1
374.0	374	374.0	0.0	1.1
378.0	378	378.0	0.0	1.1
382.0	382	382.0	0.0	1.1
386.0	386	386.0	0.0	1.1
390.0	390	390.0	0.0	1.1
394.0	394	394.0	0.0	1.1
398.0	398	398.0	0.0	1.1
402.0	402	402.0	0.0	1.1
406.0	406	406.0	0.0	1.1
410.0	410	410.0	0.0	1.1
414.0	414	414.0	0.0	1.1
418.0	418	418.0	0.0	1.1
422.0	422	422.0	0.0	1.1
426.0	426	426.0	0.0	1.1
430.0	430	430.0	0.0	1.1
434.0	434	434.0	0.0	1.1
438.0	438	438.0	0.0	1.1
442.0	442	442.0	0.0	1.1
446.0	446	446.0	0.0	1.1
450.0	450	450.0	0.0	1.1
454.0	454	454.0	0.0	1.1
458.0	458	458.0	0.0	1.1
462.0	462	462.0	0.0	1.1
466.0	466	466.0	0.0	1.1
470.0	470	470.0	0.0	1.1
474.0	474	474.0	0.0	1.1
478.0	478	478.0	0.0	1.1
482.0	482	482.0	0.0	1.1
486.0	486	486.0	0.0	1.1
490.0	490	490.0	0.0	1.1
494.0	494	494.0	0.0	1.1
498.0	498	498.0	0.0	1.1
502.0	502	502.0	0.0	1.1
506.0	506	506.0	0.0	1.1
510.0	510	510.0	0.0	1.1
514.0	514	514.0	0.0	1.1
518.0	518	518.0	0.0	1.1
522.0	522	522.0	0.0	1.1
526.0	526	526.0	0.0	1.1
530.0	530	530.0	0.0	1.1
534.0	534	534.0	0.0	1.1
538.0	538	538.0	0.0	1.1
542.0	542	542.0	0.0	1.1
546.0	546	546.0	0.0	1.1
550.0	550	550.0	0.0	1.1
554.0	554	554.0	0.0	1.1
558.0	558	558.0	0.0	1.1
562.0	562	562.0	0.0	1.1
566.0	566	566.0	0.0	1.1
570.0	570	570.0	0.0	1.1
574.0	574	574.0	0.0	1.1
578.0	578	578.0	0.0	1.1
582.0	582	582.0	0.0	1.1
586.0	586	586.0	0.0	1.1
590.0	590	590.0	0.0	1.1
594.0	594	594.0	0.0	1.1
598.0	598	598.0	0.0	1.1
602.0	602	602.0	0.0	1.1
606.0	606	606.0	0.0	1.1
610.0	610	610.0	0.0	1.1
614.0	614	614.0	0.0	1.1
618.0	618	618.0	0.0	1.1
622.0	622	622.0	0.0	1.1
626.0	626	626.0	0.0	1.1
630.0	630	630.0	0.0	1.1
634.0	634	634.0	0.0	1.1
638.0	638	638.0	0.0	1.1
642.0	642	642.0	0.0	1.1
646.0	646	646.0	0.0	1.1
650.0	650	650.0	0.0	1.1
654.0	654	654.0	0.0	1.1
658.0	658	658.0	0.0	1.1
662.0	662	662.0	0.0	1.1
666.0	666	666.0	0.0	1.1
670.0	670	670.0	0.0	1.1
674.0	674	674.0	0.0	1.1
678.0	678	678.0	0.0	1.1
682.0	682	682.0	0.0	1.1
686.0	686	686.0	0.0	1.1
690.0	690	690.0	0.0	1.1
694.0	694	694.0	0.0	1.1
698.0	698	698.0	0.0	1.1
702.0	702	702.0	0.0	1.1
706.0	706	706.0	0.0	1.1
710.0	710	710.0	0.0	1.1
714.0	714	714.0	0.0	1.1
718.0	718	718.0	0.0	1.1
722.0	722	722.0	0.0	1.1
726.0	726	726.0	0.0	1.1
730.0	730	730.0	0.0	1.1
734.0	734	734.0	0.0	1.1
738.0	738	738.0	0.0	1.1
742.0	742	742.0	0.0	1.1
746.0	746	746.0	0.0	1.1
750.0	750	750.0	0.0	1.1
754.0	754	754.0	0.0	1.1
758.0	758	758.0	0.0	1.1
762.0	762	762.0	0.0	1.1
766.0	766	766.0	0.0	1.1
770.0	770	770.0	0.0	1.1
774.0	774	774.0	0.0	1.1
778.0	778	778.0	0.0	1.1
782.0	782	782.0	0.0	1.1
786.0	786	786.0	0.0	1.1
790.0	790	790.0	0.0	1.1

Certificate No : 22-ACT-245
Request No : Req-2022-0628

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	143.7	(± dB)	(± dB)
STD Setting	(dB)		
Positive one-half cycle	143.2		
Negative one-half cycle	143.1		
Deviation	0.4	0.2	1.5

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	UUC	(± dB)	(± dB)
STD Setting	(dB)		
Initial	178.0		
Final	178.0		
Deviation	0.0	0.1	0.3

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 calibration laboratory.
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Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD. Certificate No : 22-ACT-034
Address : 81 Soi Udomrak 41, Sukhumvit Road, Bangchak, Pratuang, Bangkok 10260 Request No : Req-2022-0692

Unit Under Calibration Details

Measurement Item : Sound Level Meter Microphone Class : 2
Manufacturer : LARSON DAVIS Microphone Model : 375A04
Model : LxT2 Microphone S/N : 229361
Serial Number : 0005194 Pre-amplifier Model : PRMLX12C
ID : UAE EFM031/2564 Pre-amplifier S/N : 073810
Resolution : 0.1 dB Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 2 °C
Humidity : 50 %RH ± 23 %RH
Barometric Pressure : 1013 hPa ± 19 hPa
Received Date : 14 January 2022
Calibrated Date : 21 January 2022
Calibration Procedure : In-house method CP-SLM-01 based on IEC 61672-1:2013 Electroacoustics - Sound level meters - Part 3: Periodic tests
Location of Calibration : Lab Acoustic

Reference Standard

Instrument	Brand	Model	S/N	Date of Calibration	Traceability
Standard Microphone	GRAS	40AN	183273	15 September 2022	GRAS
Multi-frequency Calibrator	Quest	Quest-60	EFA00234	14 June 2022	TST
Audio Generator	Sennheiser	SW-050	421	18 October 2022	WK Electric

Note

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

Calibration

Approved By :

Issue Date :

The results related only to the items calibrated. The certificate shall not be reproduced except in full, without written approval of the calibration laboratory.
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Certificate No : 22-ACT-034
Request No : Req-2022-0692

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust	Adjust	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	Level	UUC	ERR	UUC	ERR
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)
1000 Hz 114.00 dB	113.85	113.9	+0.05	113.9	0.05
					0.20
					0.3

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SVANTEK, Model SV 35A, S/N:50079

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	27.8	0.10

3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	27.5	0.10
C	27.0	0.10
Z	31.8	0.10

4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance Limit
FAST / 37-139	Weighting Response curve	(± dB)	(± dB)
STD Setting	A C Z	(dB)	(dB)
125 Hz	0.6 0.3 0.0	0.50	2.0
1000 Hz	0.6 0.6 0.0	0.50	1.0
4000 Hz	0.2 0.7 0.2	0.50	2.0
8000 Hz	0.3 0.3 0.3	0.70	2.0

The results related only to the items calibrated. The certificate shall not be reproduced except in full, without written approval of the calibration laboratory.
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Certificate No : 22-ACT-034
Request No : Req-2022-0692

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance Limit
FAST / 37-139	Weighting Response curve	(± dB)	(± dB)
STD Setting	A (dB) C (dB) Z (dB)		
63 Hz	-0.2 -0.1 0.0	0.2	2.0
125 Hz	-0.1 0.0 0.0		1.5
250 Hz	-0.1 0.0 0.0		1.5
500 Hz	-0.1 0.0 0.0		1.5
1000 Hz	0.0 0.0 0.0		1.0
2000 Hz	0.0 0.0 0.0		2.0
4000 Hz	0.0 0.0 0.0		2.0
8000 Hz	-0.1 -0.1 0.0		5
16000 Hz	-0.1 -0.1 -0.1		-5, -10F

6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance Limit
FAST / 37-139	REF	UUC	ERR	(± dB)
UUC Weighting	(dB)	(dB)	(dB)	(± dB)
A	114.00	114.0	0.0	0.2
C	114.00	114.0	0.0	0.2
Z	114.00	114.0	0.0	0.2

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance Limit
37-139 / A	REF	UUC	ERR	(± dB)
UUC Time Response	(dB)	(dB)	(dB)	(± dB)
Fast	114.00	114.0	0.0	0.1
Slow	114.00	114.0	0.0	0.1
Leq	114.00	114.0	0.0	0.1

The results related only to the items calibrated. The certificate shall not be reproduced except in full, without written approval of the calibration laboratory.
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Certificate No : 22-ACT-034
Request No : Req-2022-0092

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	UUC	(± dB)	(± dB)
STD Setting	(dB)		
Initial	134.9		
Final	134.9		
Deviated	0.0	0.1	0.3

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	REF	UUC	(± dB)	(± dB)
STD dB	(dB)	(dB)		
134.00	134	134.0	0.0	1.1
134.00	134	134.0	0.0	1.1
129.00	129	129.0	0.0	1.1
124.00	124	124.0	0.0	1.1
119.00	119	119.0	0.0	1.1
114.00	114	114.0	0.0	1.1
109.00	109	109.0	0.0	1.1
104.00	104	104.0	0.0	1.1
99.00	99	99.0	0.0	1.1
94.00	94	94.0	0.0	1.1
89.00	89	89.0	0.0	1.1
84.00	84	84.0	0.0	1.1
79.00	79	79.0	0.0	1.1
74.00	74	74.0	0.0	1.1
69.00	69	69.0	0.0	1.1
64.00	64	64.0	0.0	1.1
59.00	59	59.0	0.0	1.1
54.00	54	54.0	0.0	1.1
49.00	49	49.0	0.0	1.1
44.00	44	44.0	0.0	1.1
39.00	39	39.0	0.0	1.1
34.00	34	34.0	0.0	1.1
29.00	29	29.0	0.0	1.1
24.00	24	24.0	0.0	1.1
19.00	19	19.0	0.0	1.1
14.00	14	14.0	0.0	1.1
9.00	9	9.0	0.0	1.1

The results relate only to the items submitted. The certificate shall not be reproduced except in full, without written approval of the issuing body.

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Certificate No : 22-ACT-034
Request No : Req-2022-0092

9. Level linearity including the level range control

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance Limit
FAST / A	REF	UUC	(± dB)	(± dB)
UUC Range	(dB)	(dB)		
37-139	42.5	42.5	0.2	1.1
	114	114.0	0.0	1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY	Acceptance Limit
A / 37-139	Toneburst	Ref	UUC	(± dB)	(± dB)
UUC Time Response	(ms)	(dB)	(dB)		
Fast	200	125.0	125.0	0.0	1.1
	2	115.0	117.7	-0.3	+1.0, -2.3
	0.25	109.0	108.3	-0.2	+1.5, -5.0
Slow	200	128.6	128.5	-0.1	1
	2	109.0	108.9	-0.1	+1.0, -5.0
SEA	200	129.0	129.0	0.0	1
	2	109.0	109.1	+0.1	+1.0, -2.5
	0.25	100.0	100.0	0.0	+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY	Acceptance Limit
FAST / C 95-142	REF	UUC	(± dB)	(± dB)
STD Setting	(dB)	(dB)		
Complete cycle	137.4	136.8	-0.60	3.0
Positive half cycle	136.4	136.1	-0.30	2.0
Negative half cycle	134.4	136.2	-0.20	2.0

The results relate only to the items submitted. The certificate shall not be reproduced except in full, without written approval of the issuing body.

เอกสารนี้เกี่ยวข้องกับ

Certificate No : 22-ACT-034
Request No : Req-2022-0092

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	UUC	(± dB)	(± dB)
STD Setting	(dB)		
Positive one-half cycle	141.7		
Negative one-half cycle	141.3		
Deviated	-0.1	0.2	1.0

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	UUC	(± dB)	(± dB)
STD Setting	(dB)		
Initial	135.0		
Final	135.0		
Deviated	0.0	0.1	0.3

End of Certificate

The results relate only to the items submitted. The certificate shall not be reproduced except in full, without written approval of the issuing body.

เอกสารนี้เกี่ยวข้องกับ

Certificate of Calibration

Customer : UNITED ASALASE AND ENGINEERING CONSULTANT CO., LTD.
Name : 21 Soi Udonrak 41, Sukhumvit Road, Bangkok, Praking, Bangkok 10260
Certificate No : 22-ACT-247
Request No : Req-2022-0027

Unit Under Calibration Details

Measurement item : Sound Level Meter
Manufacturer : L ARSON DAVIS
Model : 1.472
Serial Number : 000195
ID : LAE.FM.022.2564
Resolution : 0.1 dB
Microphone Model : 375A03
Microphone S/N : 220333
Pre-amplifier Model : PRM1 xTAC
Pre-amplifier S/N : 072797
Instrument Status : Used

Calibration Environment and Details

Temperature : 23 °C ± 2 °C
Humidity : 50 % RH ± 10 % RH
Barometric Pressure : 1013 hPa ± 10 hPa
Received Date : 23 March 2022
Calibrated Date : 1 April 2022
Calibration Procedure : In-house method CP-8136-01 based on IEC 61672-2:2013 Electromechanics - Sound level meters - Part 3: Periodic tests
Location of Calibration : Lab Accurate

Reference Standard

Instrument	Brand	Model	S/N	Date calibration	Traceability
Standard Microphone	GRAS	80A0	18273	15 September 2022	GRAS
Multi-frequency Calibrator	Qtek	Qmucal	EPFAR0234	14 June 2022	FSB
Audio Generator	Svank	Swav40	131	18 October 2022	WR Ykente

Note

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



The results relate only to the items submitted. The certificate shall not be reproduced except in full, without written approval of the issuing body.

เอกสารนี้เกี่ยวข้องกับ

Certificate No : 22-ACT-247
Request No : Req-2022-0827

1. Indication at the calibration check frequency

UUC Setting	Measured	Before Adjust	Adjust	UNCERTAINTY	Acceptance
FAST / A / 37-139	Level	UUC	ERR	UUC	ERR
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)
1000 Hz 114.00 dB	113.85	113.8	-0.05	113.9	0.05
					0.3

Note: Absolute sensitivity was established by the use of Sound Calibrator Brand SYANTER, Model SV 35A, SV-38075

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	28.4	0.10

3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	28.3	0.10
C	27.7	0.10
Z	37.0	0.10

4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency Weighting Response curve	UNCERTAINTY	Acceptance
FAST / 37-139	A C Z	(± dB)	Limit
STD Setting	(dB) (dB) (dB)	(± dB)	(± dB)
125 Hz	0.0 0.1 0.1	0.50	2.0
1000 Hz	0.0 0.0 0.0	0.60	1.0
4000 Hz	0.4 0.5 0.5	0.60	0.9
8000 Hz	0.2 0.1 0.1	0.70	0.9

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 : 22-ACT-247
Request No : Req-2022-0827

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency Weighting Response curve	UNCERTAINTY	Acceptance
FAST / 37-139	A (dB) C (dB) Z (dB)	(± dB)	Limit
STD Setting	(dB) (dB) (dB)	(± dB)	(± dB)
43 Hz	-0.2 -0.1 -0.1	0.2	2.0
125 Hz	-0.1 0.0 0.0	0.2	1.5
250 Hz	-0.1 0.0 0.0	0.2	1.5
500 Hz	-0.1 0.0 0.0	0.2	1.5
1000 Hz	0.0 0.0 0.0	0.2	1.0
2000 Hz	0.0 0.0 0.0	0.2	2.0
4000 Hz	0.0 0.0 0.0	0.2	2.0
8000 Hz	-0.1 -0.1 -0.1	0.2	2.0
16000 Hz	-0.1 -0.1 -0.1	0.2	+5, -INF

6. Frequency and time weightings at 1 kHz

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / 37-139	REF	UUC	ERR	Limit
UUC Weighting	(dB)	(dB)	(dB)	(± dB)
A	114.90	114.0	0.0	0.2
C	114.90	114.0	0.0	0.2
Z	114.90	114.0	0.0	0.2

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
37-139 / A	REF	UUC	ERR	Limit
UUC Time Response	(dB)	(dB)	(dB)	(± dB)
Fast	114.90	114.0	0.0	0.1
Slow	114.90	114.0	0.0	0.1
1.0s	114.90	114.0	0.0	0.1

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 : 22-ACT-247
Request No : Req-2022-0827

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC	(± dB)	Limit
STD Setting	(dB)	(± dB)	(± dB)
Initial	114.0		
Final	114.0		
Deviation	0.0	0.1	0.5

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation	UNCERTAINTY	Acceptance
FAST / A / 37-139	REF	UUC	ERR	Limit
STD dB	(dB)	(dB)	(dB)	(± dB)
120.00	130	139.5	0.5	1.1
134.00	134	134.5	0.5	1.1
129.00	129	129.5	0.5	1.1
124.00	124	124.5	0.5	1.1
119.00	119	119.5	0.5	1.1
114.00	114	114.5	0.5	1.1
109.00	109	109.5	0.5	1.1
104.00	104	104.5	0.5	1.1
99.00	99	99.5	0.5	1.1
94.00	94	94.0	0.5	1.1
89.00	89	89.0	0.5	1.1
84.00	84	84.0	0.5	1.1
79.00	79	79.0	0.5	1.1
74.00	74	74.0	0.5	1.1
69.00	69	69.0	0.5	1.1
64.00	64	64.0	0.5	1.1
59.00	59	59.0	0.5	1.1
54.00	54	54.0	0.5	1.1
49.00	49	49.0	0.5	1.1
44.00	44	44.0	0.5	1.1
39.00	39	39.0	0.5	1.1
34.00	34	34.0	0.5	1.1
29.00	29	29.0	0.5	1.1
24.00	24	24.0	0.5	1.1
19.00	19	19.0	0.5	1.1
14.00	14	14.0	0.5	1.1
9.00	9	9.0	0.5	1.1

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 : 22-ACT-247
Request No : Req-2022-0827

9. Level linearity including the level range control

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / A	REF	UUC	ERR	Limit
UUC Range	(dB)	(dB)	(dB)	(± dB)
43.4	43.5	0.1	0.3	1.1
114	114.0	0.0	0.3	1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY	Acceptance
A / 37-139	Toneburst	Ref	UUC	ERR	Limit
UUC Time Response	(ms)	(dB)	(dB)	(dB)	(± dB)
Fast	200	135.0	134.9	-0.1	1.0
	2	138.5	137.8	-0.7	+1.0, -2.5
	0.25	159.0	158.7	-0.3	+1.5, -5.0
Slow	200	128.6	128.4	-0.2	1.0
	2	159.0	158.8	-0.2	+1.0, -5.0
	200	129.0	129.0	0.0	1.0
	2	159.0	159.1	+0.1	+1.0, -2.5
SEL	0.25	159.0	159.0	-0.1	+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY	Acceptance
FAST / C / 95-142	REF	UUC	ERR	Limit
STD Setting	(dB)	(dB)	(dB)	(± dB)
Complete cycle	137.2	136.1	-0.60	1.0
Full cycle	136.4	136.2	-0.20	2.0
Negative half cycle	136.4	136.2	-0.20	2.0

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 : 22-ACT-047
Request No : Req-2022-0227

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(± dB)	(± dB)
Positive one-half cycle	142.2		
Negative one-half cycle	142.2		
Deviation	0.0	0.2	1.5

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(± dB)	(± dB)
Initial	138.0		
Final	138.0		
Deviation	0.0	0.1	0.2

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

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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 : 22-ACT-103
Request No : Req-2022-0229

Unit Under Calibration Details

Measurement item : Sound Level Meter
Manufacturer : LARSON DAVIS
Model : LA12
Serial Number : 0003396
ID : UAE.FPM.013/2564
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : 375A04
Microphone SN : 329350
Preamplifier Model : FEMLAT2C
Preamplifier SN : 073312
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 : 31 January 2022
Calibrated Date : 11 February 2022
Calibration Procedure : In-house method GP-SLM-01 based on IEC 61672-3 : 2013 Electroacoustics - Sound level meters - Part 3: Periodic tests
Location of Calibration : Lab Acoustic

Reference Standard

Instrument	Brand	Model	SN	Due calibration	Traceability
Standard Microphone	GRAS	40AN	188273	15 September 2022	GRAS
Multi-frequency Calibrator	Quest	Quest-cal	EFA600234	14 June 2022	TST
Audio Generator	Svanick	Svan-01	137	18 October 2022	WK Electric

Note

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

Calibrated

Approved

Issue By

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 : 22-ACT-105
Request No : Req-2022-0229

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust	Adjust	UNCERTAINTY	Acceptance
FAST / A / 37-139	Level	UUC	ERR	UUC	ERR
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)
1000 Hz 114.00 dB	113.35	113.9	-0.65	113.9	0.05
				0.20	0.3

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand SYMTEK, Model SV 35A, SN: 53079

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-129		
UUC Weighting	(dB)	(± dB)
A	27.5	0.10

3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 37-129		
UUC Weighting	(dB)	(± dB)
A	27.8	0.10
C	27.3	0.10
Z	22.1	0.10

4. Acoustic signal test of frequency weightings (Without Windscreen)

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance
FAST / 37-139	Weighting Response curve		Limit
STD Setting	A C Z	(± dB)	(± dB)
125 Hz	0.1 0.1 0.2	0.50	2.0
1800 Hz	0.5 0.6 0.3	0.60	1.0
4000 Hz	0.6 0.5 0.5	0.50	1.0
8000 Hz	0.1 0.0 0.2	0.70	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

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Certificate No : 22-ACT-105
Request No : Req-2022-0229

5. Electrical signal test of frequency weightings, Weighting network response with relative to 1 kHz

UUC Setting	Deviation from various Frequency	UNCERTAINTY	Acceptance
FAST / 37-139	Weighting Response curve		Limit
STD Setting	A (dB) C (dB) Z (dB)	(± dB)	(± dB)
63 Hz	-0.2 0.0 0.0		2.0
125 Hz	-0.1 0.0 0.0		1.5
250 Hz	-0.1 0.0 0.0		1.5
500 Hz	-0.1 0.0 0.0		1.5
1000 Hz	0.0 0.0 0.0	0.2	1.0
2500 Hz	0.0 0.1 0.0		2.0
4000 Hz	0.0 0.0 0.0		2.0
8000 Hz	0.0 0.0 0.0		5.0
15000 Hz	-0.1 -0.1 -0.1		-5, -4dB

6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / 37-139	REF	UUC	ERR	Limit
UUC Weighting	(dB)	(dB)	(dB)	(± dB)
A	114.00	114.0	0.0	0.2
C	114.00	114.0	0.0	0.2
Z	114.00	114.0	0.0	0.2

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
37-139 / A	REF	UUC	ERR	Limit
UUC Time Response	(dB)	(dB)	(dB)	(± dB)
Fast	114.00	114.0	0.0	0.1
Slow	114.00	114.0	0.0	0.1
Leq	114.00	114.0	0.0	0.1

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เอกสารไม่ควบคุม

Certificate No : 22-ACT-103
Request No : Req-2022-0229

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(± dB)	(± dB)
Initial	114.0		
Final	114.0		
Deviated	0.0	0.1	0.3

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation	UNCERTAINTY	Acceptance
FAST / A / 37-139	REF	UUC	ERR	Limit
STD dB	(dB)	(dB)	(dB)	(± dB)
139.00	139	139.0	0.0	1.1
134.00	134	134.0	0.0	1.1
129.00	129	129.0	0.0	1.1
124.00	124	124.0	0.0	1.1
119.00	119	119.0	0.0	1.1
114.00	114	114.0	0.0	1.1
109.00	109	109.0	0.0	1.1
104.00	104	104.0	0.0	1.1
99.00	99	99.0	0.0	1.1
94.00	94	93.9	-0.1	1.1
89.00	89	88.9	-0.1	1.1
84.00	84	83.9	-0.1	1.1
79.00	79	78.9	-0.1	1.1
74.00	74	73.9	-0.1	1.1
69.00	69	68.9	-0.1	1.1
64.00	64	63.9	-0.1	1.1
59.00	59	58.9	-0.1	1.1
54.00	54	53.9	-0.1	1.1
49.00	49	48.9	-0.1	1.1
44.00	44	44.0	0.0	1.1
39.00	39	39.2	0.2	1.1
34.00	34	33.3	-0.7	1.1

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ISO 9001:2015 Rev.0 Issue date 01/01/21

เอกสารไม่ควบคุม

Certificate No : 22-ACT-103
Request No : Req-2022-0229

9. Level linearity including the level range control

UUC Setting	STD	Measured	UNCERTAINTY	Acceptance
FAST / A	REF	UUC	ERR	Limit
UUC Range	(dB)	(dB)	(dB)	(± dB)
37-139	42.2	42.8	-0.4	1.1
	114	114.0	0.0	1.1

10. Tone burst response

UUC Setting	STD	Anticipated	Measured	UNCERTAINTY	Acceptance
A / 37-139	Toneburst	Ref	UUC	ERR	Limit
UUC Time Response	(ms)	(dB)	(dB)	(dB)	(± dB)
Fast	200	135.8	134.9	-0.1	1.0
	2	138.0	137.6	-0.4	+1.0, -2.5
	0.25	109.0	108.7	-0.3	+1.5, -5.0
Slow	200	128.6	128.5	-0.1	1.0
	2	109.0	108.9	-0.1	+1.0, -5.0
	0.25	109.0	108.9	-0.1	+1.0, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured	UNCERTAINTY	Acceptance
FAST / C / 95-142	REF	UUC	ERR	Limit
STD Setting	(dB)	(dB)	(dB)	(± dB)
Complete cycle	137.4	136.7	-0.70	3.0
Positive half cycle	136.4	136.2	-0.20	2.0
Negative half cycle	136.4	136.2	-0.20	2.0

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

ISO 9001:2015 Rev.0 Issue date 01/01/21

เอกสารไม่ควบคุม

Certificate No : 22-ACT-103
Request No : Req-2022-0229

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(± dB)	(± dB)
Positive one-half cycle	141.7		
Negative one-half cycle	141.8		
Deviated	-0.1	0.2	1.5

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(± dB)	(± dB)
Initial	136.0		
Final	136.0		
Deviated	0.0	0.1	0.3

End of Certificate

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

ISO 9001:2015 Rev.0 Issue date 01/01/21

เอกสารไม่ควบคุม

THAI METEOROLOGICAL DEPARTMENT
4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0416
Calibration Certificate

Issued by : Calibration & Test Section Meteorological Instruments Bureau

Date of Issue : 31 March 2023

Certificate No : 145/23

Page : 1 of 5

Object : WIRELESS ANEMOMETER

Manufacturer : SCARLET

Type : WIRELESS RECEIVER : WL-21

WIND SENSOR : WL-21

Mfg Code : WIRELESS RECEIVER : 21110R0041

WIND SENSOR : 21110T0041

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

81 Soi Udomsuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260

Calibration Condition : Temperature : 26.1 °C Barometric Pressure : 1008.2 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 SN 01563

: HOOK GAGE NO 1426 : Wind Axi-Plotting Board

: N.I.S.T. Test Reference Number 731241460

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

: Serial Number 110730020 (sensor 120520508)

: JAPAN QUALITY ASSURANCE ORGANIZATION

STANDARD THERMOMETER : Theodor Fricdrich : Dry No. 639094 Wet No. 636094

: Thermochneider No 818902

ST : Meter Velocity Type 019320 No. V122016

Co : Meter Velocity Type PT0330 No. V122001

M : Authorizing Signatory

For the Chief

THAI METEOROLOGICAL DEPARTMENT

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 143/23

31 March, 2023

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	velocity	Correction
Ultrasonic Anemometer	m/sec	mmHg	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.14	-	-	-	6.8	0.14
9.02	-	-	-	9.0	0.02
11.02	-	-	-	10.9	0.12
13.01	-	-	-	13.0	-0.01
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

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



เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 143/23

31 March, 2023

Page : 3 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1014.20	1014	0.20
1014.02	1014	0.02
1011.47	1012	-0.55
1011.28	1011	0.28
1011.11	1011	0.11
1011.38	1012	-0.52
1011.71	1012	-0.20
1013.48	1014	-0.52
1015.81	1014	-0.19
1014.02	1014	0.02
1013.73	1013	0.73
1013.02	1013	0.02
1014.92	1015	-0.08
1014.75	1015	-0.25
1014.98	1014	0.98
1016.11	1014	0.11
1013.57	1013	0.57
1013.61	1013	0.61
	1011	0.28
	1012	-0.41

Calibrated by



เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 143/23

31 March, 2023

Page : 4 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
750.78	761	-0.22
750.58	761	-0.42
756.00	750	-0.54
756.50	758	0.50
756.39	758	0.39
758.60	759	0.40
758.84	759	-0.16
760.17	760	0.17
760.42	760	0.42
760.58	761	-0.42
760.561	760	0.56
760.65	760	0.65
761.25	761	0.25
761.12	761	0.12
760.85	761	-0.15
760.72	761	-0.28
760.24	760	0.24
759.82	760	-0.18
	758	-0.49
	758	-0.28

Average



เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

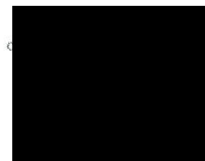
The Result of Calibration

Certification No. 143/23

31 March, 2023

Page : 5 of 5

Standard Temp.	Temperature Sensor Reading	
	Reading	Correction
'C	'C	'C
45.24	45.4	-0.16
22.16	22.3	-0.14
18.42	18.5	-0.02



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Certificate of Calibration

Customer : UNITED ANALYST AND ENGINEERING CONSULTANT
Name : CO., LTD.
Address : 31 Soi Udomsak 41, Sukhumvit Road, Bangkok,
Prakanong, Bangkok 10260

Certificate No : 23-ACT-067
Request No : Req-2023-0978

Unit Under Calibration Details
Measurement Item : Acoustic Calibrator
Manufacturer : LARSON DAVIS
Model : CAL150
Serial Number : 6307
ID : UAE EFM.049/2563

Class : 2
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 : 9 May 2023
Calibration Date : 12 May 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	58979	EEI	31 May 2023
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 confidence of calibration

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the responsible management.

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Certificate No : 23-ACT-067
Request No : Req-2023-0978

Sound pressure level		Calibration Results : Without Adjustment			
Calibration Range (dB)		Without Adjustment (dB)		Adjustment (dB)	
		Measured	Error	Measured	Error
94 dB / 1000 Hz		93.98	-0.02	-	-
114 dB / 1000 Hz		114.12	0.12	-	-

Frequency of Sound pressure level		Calibration Results : Without Adjustment			
Calibration Range (Hz)		Without Adjustment		Adjustment	
		Measured (Hz)	Error (%)	Measured (Hz)	Error (%)
94 dB / 1000 Hz		999.11	0.09	-	-
114 dB / 1000 Hz		999.11	0.09	-	-

Total Harmonic Distortion plus Noise of Sound pressure level (THD+N %)		Calibration Results : Without Adjustment			
Calibration Range (Hz)		Without Adjustment		Adjustment	
		Measured (%)	Error (%)	Measured (%)	Error (%)
94 dB / 1000 Hz		0.12	-	-	-
114 dB / 1000 Hz		0.22	-	-	-

Note :
- Acceptance limit was IEC 60942:2017 Class 1
- The calibration results exclude the calibration pressure transducer
- 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 responsible management.

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

CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E04N199E15A01D3
Cylinder Number: EB0143262
Laboratory: 124 - Durham (SAP) - NC
PGVP Number: B22021
Gas Code: CO,NO,NOX,SO2,BALN
Reference Number: 122-402135167-1
Cylinder Volume: 144.4 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 650
Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 800/R-12/531, using the assay procedures listed. Analytical methodology does not require correction for analytical interference. The cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a micro-mole basis unless otherwise noted.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.86 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 05/21/2021
NITRIC OXIDE	45.00 PPM	45.84 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 05/21/2021
SULFUR DIOXIDE	45.00 PPM	44.58 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 05/21/2021
CARBON MONOXIDE	1000 PPM	584.8 PPM	G1	+/- 0.7% NIST Traceable	05/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20051123	CC700058	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12346	D680328	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 29, 2020
QMS	401423838102	CC555581	4.345 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	16011043	CC473277	46.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14050119	CC434277	590.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

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

Triad Data Available Upon Request
NOTES-PO #6221002607
GROSS WT: 28.40kg
NET WT: 4.73kg



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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.: 23TW89
Page: 1 of 2

Certificate of Testing

Equipment : DO Meter
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE1L0034
ID No. : UAE.EFM.018/2585(EFM.DO.02/05)
Received Date : 28 March 2023
Test Date : 29 March 2023
Reference : 2303-0966WSC-5
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsak 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 Sinihean
Approved by :
(✓) Malee Butkruea
() Sathip Meangmai
() Warakorn Lemgagtrakul
Issue Date : 31 March 2023

เอกสารไม่ควบคุม



Cert.No.: 23TW89
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	23CG1172	22 Mar 2025
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.: 9K1K0075

Titration Method (Azide Modification Method)	DO Meter Reading	Standard Deviation
(mg/L)	(mg/L)	(mg/L)
8.16	8.15	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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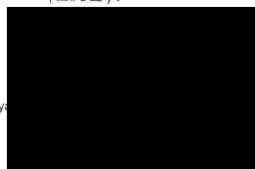


TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
334/4 PATTANAKARN ROAD SOI 15, SUANLUANG, SUANLUANG BANGKOK 10259
TEL: 0-2317-3000-29 FAX: 0-2317-9484



Cert. No.: 23LM80
Page.: 1 of 2

Certificate of Calibration

Equipment : DO Meter With Sensor
Manufacturer : Horiba
Model : LAQUA-DO210
Serial No. : HE1L0034
ID No. : UAE-EFM.018/2565(EFM.DO.02/05)
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Sol Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : TPA On Site Calibration Laboratory
Received Order : 28 March 2023
Calibrated Date : 31 March 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
AC Line Voltage : (220 ± 22) V
Calibrated by : 
Approved by :
() Ponthippa Tamey
(✓) Suwit Imjai
Issue Date : 12 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



Equipment : DO Meter With Sensor
Condition As-Received : Used Item
Reference : Z303-0966WSC-6

Cert. No.: 23LM80
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	A52847	2211325	31 Oct 2023

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

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

Result of Calibration :- (*) Without Adjustment

Function : Temperature measurement.

This instrument was connected with temperature sensor, S/N: 9K1K0075

Calibration Point (°C)	Immersion Depth (mm)	Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty (± °C)	Coverage Factor k
25.0	90	24.998	25.0	0.002	0.16	2.00
30.0	90	30.003	29.9	-0.103	0.16	2.00
35.0	90	35.006	34.9	-0.106	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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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
334/4 PATTANAKARN ROAD SOI 15, SUANLUANG, SUANLUANG BANGKOK 10259
TEL: 0-2317-3000-29 FAX: 0-2317-9484



Cert.No.: 23CH423
Page.: 1 of 3

Certificate of Calibration

Equipment : pH Meter
Manufacturer : Horiba
Model : LAQUA-PH210
Serial No. : HA1M0043
ID No. : UAE-EFM.013/2565(EFM.pH.03/05)
Condition As-Received: Used Item
Received Date : 28 March 2023
Calibration Date : 30 March 2023
Reference : Z303-1001WSC-6
Submitted by : United Analyst and Engineering Consultant Co., Ltd.
3 Sol Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong, Bangkok 10260
Ambient Temperature : (25 ± 2.5) °C
Relative Humidity : (50 ± 15) %
Calibration Procedure : In - house method :
- CP-CH5 by direct measurement with standard voltage calibrator and direct measurement with certified reference material (CRM)
- CP-CH8 by comparison with standard thermometer

Calibrated by : 

Approved by :

(✓) Malee Butkruea
() Sathip Meangmai
() Warakorn Lemgagtrakul

Issue Date : 31 March 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



Cert.No.: 23CH423
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	22I1306	27 Oct 2023

This certification is traceable to the International System of Unit maintained at:-
- Traceable to National Institute of Metrology (Thailand), NIMT

2. Certified Reference Materials

The measurement results are traceable to SI through CPA chem Ltd.,
ANSI-ASQ National Accreditation Board, Accredited No. AR-1635

Buffer Solution	Manufacturer	Lot No.	Exp. date
pH 4.008	CPA chem	863932	28 Dec 2024
pH 6.987	CPA chem	826589	09 July 2023
pH 10.010	CPA chem	863935	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
			mV	pH		
pH Meter S/N.: HA1M0043	4.00	177.48	177.4	4.01	0.058	2.00
	7.00	0.00	-0.2	7.00	0.059	2.00
	7.00	0.00	-0.2	7.00	0.058	2.00
	10.00	-177.48	-177.6	10.01	0.058	2.00

Signature

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Cert.No.: 23CH423
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.: Q92M0159	4.008	4.01	180.8	0.0085	2.05
	6.987	6.99	6.8	0.011	2.00
	6.987	7.00	6.3	0.011	2.00
	10.010	10.00	-168.9	0.0092	2.00

Function : Temperature Measurement

(*) Without adjustment

This equipment was connected with Temperature Probe;

- Model : 8652-10D
- Serial No. : Q92M0159
Dimension of probe;
- Length : 107 mm
- Diameter : 16 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	25.004	25.0	-0.004	0.13	2.00
30.0	30.001	30.0	-0.001	0.13	2.00
35.0	35.004	35.0	-0.004	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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Signature

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