

ภาคผนวก ต

เอกสารสอบเทียบ/ทวนสอบเครื่องมือ



ภาคผนวก ต-1
เอกสารสอบเทียบ/ทวนสอบ
เครื่องมือเก็บตัวอย่างและวิเคราะห์
คุณภาพอากาศ ระดับเสียง และความสั่นสะเทือน



List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Tisch Environmental, Inc.	TE-5025A 3540	Jiranatee Associates Co., Ltd.	CL-011-65	31 Oct 22	30 Oct 24	-
2	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Andersen Instruments, Inc.	G25A 1901	Tisch Environmental, Inc.	05072022	5 Jul 22	4 Jul 24	-
3	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	23P1400	9 May 23	8 May 24	-
4	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	24P1250	10 Apr 24	9 Apr 25	-
5	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23P1856	2 Jun 23	1 Jun 24	-
6	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23P1858	2 Jun 23	1 Jun 24	-
7	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23H1201	5 Jun 23	5 Jun 24	-
8	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23H1200	6 Jun 23	5 Jun 24	-
9	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1200636462	UAE Consultant Co., Ltd.	28032023	28 Mar 23	27 Mar 24	-
10	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM19050150	UAE Consultant Co., Ltd.	01112023	1 Nov 23	31 Oct 24	-
11	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
12	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
13	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48C 48C-62011-333	UAE Consultant Co.,Ltd.	14032023	14 Mar 23	13 Mar 24	-
14	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i CM08140004	UAE Consultant Co.,Ltd.	13112023	13 Nov 23	12 Nov 24	-
15	Standard Gases (Mixture)	Carbon Monoxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
16	Standard Gases (Mixture)	Carbon Monoxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
17	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2301DR0024	Thai Meteorological Department	176/23	10 Apr 23	9 Apr 24	-
18	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2111DR0041	Thai Meteorological Department	119/24	13 Mar 24	12 Mar 25	-
19	Vibration Meter	Vibration Level Acceleration Level	Instantel Inc.	Micromate UM12889	Calibration Laboratory Co.Ltd	Q23055680	26 May 23	25 May 24	-
20	Vibration Meter	Vibration Level Acceleration Level	Instantel Inc.	Micromate UM12865	Calibration Laboratory Co.Ltd	Q23102597	15 Sep 23	14 Sep 24	-
21	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Larson Davis	CAL150 6695	Innovative Instrument Co.,Ltd.	23-ACT-056	20 Apr 23	19 Apr 24	-
22	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV35A 73246	Innovative Instrument Co.,Ltd.	23-ACT-110	27 Jun 23	26 Jun 24	-
23	Sound Level Meter	L_{Aeq} 24 hours, L_{Amax} , L_{A90} , L_{Adn}	Larson Davis	LxT2 0005344	Innovative Instrument Co.,Ltd.	22-ACT-248	1 Apr 22	31 Mar 24	-
24	Sound Level Meter	L_{Aeq} 24 hours, L_{Amax} , L_{A90} , L_{Adn}	Larson Davis	LxT2 0005288	Innovative Instrument Co.,Ltd.	23-SLM187	2 Jun 23	1 Jun 24	-

CERTIFICATE OF CALIBRATION

Certificate No. : CL-011-65

Page 1 of 2 Pages

MEASUREMENT ITEM : Top Load Orifice
MANUFACTURER : TSCH
MODEL/TYPE : TE-5025A
SERIAL NUMBER : 3540
ID NUMBER : UAE.EFM.176/2561
CONDITION AS-RECEIVED : Used item
CUSTOMER : United Analyst and Engineering Consultant Co.,Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong,
Bangkok 10260

RECEIVED DATE : 25 Oct 2022
MEASUREMENT DATE : 31 Oct 2022
ISSUE DATE : 02 Nov 2022

ENVIRONMENTAL CONDITIONS:

Ambient condition in the laboratory are as follow:
Temperature : 23.0 ± 3.0 °C
Relative Humidity : 55.0 ± 15.0 %RH
Atmospheric Pressure : 1010 ± 10 hPa

CALIBRATION CONDITION:

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

TABULATION OF RESULTS:

The table on next page give the measured values.

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

Traceability:
This certificate provides a traceability of The
measurement to realization of the national
standards and to realization of the international
system of units (SI) through the VSL (National
Metrology Institute of Netherlands) via Certificate
number: 02211801

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

Calibrated by:
Mr. Sotawat Thachalad
Mr. Mittra Jiraporn Lertsomphol



Approved signatory: Mr. Parinya Booncharoen
Calibration Department Manager

Continuation of Certificate of Calibration Number CL-011-65

Page 2 of 2 Pages

MEASUREMENT RESULTS:

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

Table 1: The results of Q Standard calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_meter mmHg	Δp_Orifice inH ₂ O	γ	Standard Flow [Q _s] m ³ /min
1	0.702	758.204	24.560	23.900	57.190	1.568	1.252	0.690
2	0.999	758.182	24.620	24.010	60.852	3.088	1.756	0.919
3	1.119	758.204	24.550	23.960	40.965	4.167	2.041	1.060
4	1.169	758.228	24.540	24.060	30.007	4.728	2.174	1.124
5	1.419	758.202	24.720	24.250	28.776	7.044	2.652	1.366

Slope (m): 1.96180
Intercept (b): -0.03332
Correlation coefficient (r): 0.99914
Uncertainty (k=2): 0.017 m³/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m ³ /min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_meter mmHg	Δp_Orifice inH ₂ O	γ	Standard Flow [Q _s] m ³ /min
1	0.702	758.204	24.560	23.900	57.190	1.568	0.785	0.651
2	0.999	758.182	24.620	24.010	60.852	3.088	1.101	0.920
3	1.119	758.204	24.550	23.960	40.965	4.167	1.279	1.060
4	1.169	758.228	24.540	24.060	30.007	4.728	1.362	1.124
5	1.419	758.202	24.720	24.250	28.776	7.044	1.664	1.368

Slope (m): 1.22877
Intercept (b): -0.02091
Correlation coefficient (r): 0.99914
Uncertainty (k=2): 0.018 m³/min

End of Certificate of Calibration



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

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

Certificate of Calibration

Certificate No. : 23P1400
Page : 1 of 2

Equipment : U-Tube Manometer

Manufacturer : Dwyer

Model : 1221-36-W/M

Serial No. : -

ID No. : UAE.EFM.020/2560

Condition As-Received : Used item

Received Date : 26 April 2023

Calibration Date : 09 May 2023

Reference : 2304-0703WSC

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

Ambient Temperature : (23 ± 2) °C

Relative Humidity : (50 ± 15) %

Atmospheric Pressure : 1010 mbar

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

Procedure used : The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P04, using "DKD-R 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	PC106P	1189	MP-0137-22	24 Aug 2023

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

3. Scale and conversion factor is 1 kPa = 4.0146293 inH₂O

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

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

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

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suwit Aussarree
Issue Date : 11 May 2023

Approved Signatory :
[] Phalinee Prabpaipal
[] Sura Suwannasri
[x] Attapol Panurach

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

Result of calibration:- Without adjustment

Function:- Pressure Measurement

Increasing Pressure

Range: 0 inH₂O to 36 inH₂O

Scale Interval: 0.1 inH₂O (The Fifth Estimate)

Applied Pressure (inH ₂ O)	UUC Indication			ΔP (inH ₂ O)	Error (inH ₂ O)
	High-port side (inH ₂ O)	Low-port side (inH ₂ O)			
0.00	0.00	0.00		0.00	0.00
2.00	1.00	-1.00		2.00	0.00
4.00	2.00	-2.00		4.00	0.00
6.00	3.00	-3.00		6.00	0.00
8.00	4.00	-4.00		8.00	0.00
10.00	5.00	-5.00		10.00	0.00
12.00	6.00	-6.00		12.00	0.00
14.00	7.02	-7.02		14.04	0.04
16.00	8.02	-8.02		16.04	0.04
18.00	9.04	-9.04		18.08	0.08
20.00	10.04	-10.04		20.08	0.08
22.00	11.02	-11.02		22.04	0.04
24.00	12.02	-12.02		24.04	0.04
26.00	13.02	-13.00		26.02	0.02
28.00	14.00	14.00		0.00	-28.00
30.00	15.00	-15.00		30.00	0.00
32.00	16.00	-15.98		31.98	-0.02
34.00	17.00	-16.96		33.96	-0.04
36.00	18.00	-17.94		35.94	0.14

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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Certificate of Calibration

Certificate No.: 23P1856
Page: 1 of 2

Equipment: Aneroid Barometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE.EMA2.110/2555

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 02 June 2023

Reference: 2305-0919WSC

Ambient Temperature: (23 ± 2) °C

Relative Humidity: (50 ± 15) %

Atmospheric Pressure: 1006 mbar

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Corporate Services 3: Equipment Calibration and Testing Services.

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

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

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

Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DPI142	1422505046	MP-0094-23	03 May 2024

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

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

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

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

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by: Suksan Khankaew
Issue Date: 08 June 2023

Approved Signatory: [Signature]
[] Phalinee Prabpaipal
[] Sura Suwannasri
[x] Attapol Panurach

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Result of calibration:- Without adjustment

Function:- Absolute Pressure Measurement

Range: 720 mmHg to 800 mmHg

Scale Interval: 1 mmHg (The Fifth Estimate)

Increasing Pressure

Applied Pressure (mmHg)	720.43	730.67	740.34	751.52	756.56	761.83	773.53	798.76
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	755.0	760.0	770.0	790.0
Error (mmHg)	-0.43	-0.67	-0.34	-1.52	-1.56	-1.83	-3.53	-8.76

Decreasing Pressure

Applied Pressure (mmHg)	798.76	773.60	761.89	756.65	751.59	740.72	730.68	720.59
UUC* Indication (mmHg)	790.0	770.0	760.0	755.0	750.0	740.0	730.0	720.0
Error (mmHg)	-8.76	-3.60	-1.89	-1.65	-1.59	-0.72	-0.68	-0.59

The uncertainty of measurement was ± 0.24 mmHg

* UUC = Unit Under Calibration

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

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Certificate of Calibration

Certificate No.: 23H1201
Page: 1 of 2

Equipment: Dial Thermo-Hygrometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE.EMA2.014/2555

Condition As-Received: Used Item

Received Date: 26 May 2023

Calibration Date: 30 May 2023

Reference: 2305-0919WSC

Ambient Temperature: (25 ± 3) °C

Relative Humidity: (50 ± 20) %

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except with the prior written approval of the head of
Corporate Services 3: Equipment Calibration and Testing Services.

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

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

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

Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Hygro-M2 Dew Point Monitor	S112	2360195	20703	02 Aug 2023
2) Handheld Thermometer With Sensor	1523	3240076	231305	15 Mar 2024

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

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

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

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

Calibrated by: Somchai Dumwor
Issue Date: 07 June 2023

Approved Signatory: [Signature]
[x] Chakrit Waeewwanjua
[] Pornthippa Tameyakul
[] Viporn Tantiyawutti

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B 0316275



Result of Calibration:-

Function: Humidity Measurement

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

Result of Calibration:-

Function: Humidity Measurement

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

Result of Calibration:-

Function: Temperature Measurement

Standard Temperature	UUC* Reading	Error	Uncertainty of Measurement
(°C)	(°C)	(°C)	(±°C)
19.987	20.0	0.013	0.72
30.016	30.0	-0.016	0.72
39.944	39.0	-0.944	0.72

UUC* : Unit Under Calibration

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

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MULTI-POINT GAS TEST REPORT

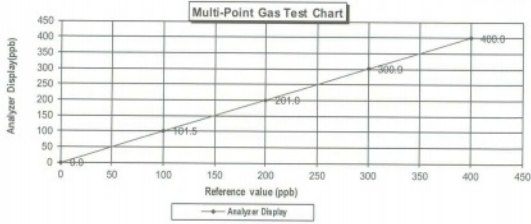
Test Date : Mar 28, 2023

Equipment : Gas Analyzer (NO₂) Model : 421
Manufacturer : Thermo Scientific Serial Number : 1200536462

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO ₂)	44.68 PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.94 PPM	Model :	1461
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

Reference Value (ppb)			Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.5	1.50	1.48	1.48
Level 3	40.00%	200.0	201.0	1.00	0.50	0.50
Level 4	60.00%	300.0	300.9	0.90	0.30	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)		0.45



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MULTI-POINT GAS TEST REPORT

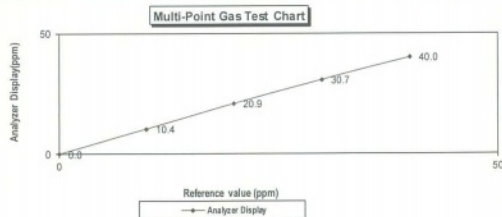
Test Date : Mar 14, 2023

Equipment : Gas Analyzer (CO) Model : 48C
Manufacturer : Thermo Environmental Instruments Serial Number : 48C-62011-333

Standard Gas Concentration		Dilutor Detail	
Sulphur Dioxide (SO ₂)	44.68 PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.94 PPM	Model :	1461
Methane (CH ₄)	- PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	984.8 PPM		
Cylinder No. :	EB0143262		
Expiration Date :	Jun 20, 2024		

Multi-point gas test data

Reference Value (ppm)			Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.0	0.0	0.0
Level 2	20.00%	10.0	10.4	0.4	3.8	3.8
Level 3	40.00%	20.0	20.9	0.9	4.3	4.3
Level 4	60.00%	30.0	30.7	0.7	2.3	2.3
Level 5	80.00%	40.0	40.0	0.0	0.0	0.0
Remark : Measuring Range			50.0 ppm	Average Difference (%)		2.09



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CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E64N159E15A31D3 Reference Number: 122-402135187-1
Cylinder Number: ED0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durram (SA) - NC Cylinder Pressure: 2015 PSIG
P/GVP Number: B2202 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO₂,BALN Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024

Certificate performed in accordance with EPA Testability Tables for Analytical and Calibration of Gases Calibration Standards (May 2012) document L-1-A (2008) (2012) using the assay procedure as follows: Analytical Methodology must require concentration for analytical reference. The cylinder has a valid analysis immediately at stated volume with a confidence level of 95%. Note: See the qualification requirements with the use of this calibration certificate. All concentrations are in % unless otherwise noted.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.80 PPM	45.86 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIG OXIDE	45.80 PPM	45.84 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.80 PPM	44.30 PPM	G1	+/- 1.3% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	984.8 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021, 06/21/2021
NITROGEN	Balance	Balance	G1	+/- 0.7% NIST Traceable	06/14/2021, 06/21/2021

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20091128	ED0143262	49.32 PPM NITRIG OXIDE/NITROGEN	+/- 0.4%	Feb 07, 2025
FSM	12333	D653823	5.91 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Feb 20, 2020
GMIS	481423338132	CC4391891	4.349 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1%	Feb 18, 2023
NTRM	15011043	CC473277	46.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 17, 2022
NTRM	14002113	CC474077	860.3 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
Nicel 670C A-HR0101333 CO	FTIR	Jun 28, 2021
Nicel 670C A-HR0101333 NO	FTIR	Jun 28, 2021
Nicel 670C A-HR0101333 NO ₂	FTIR	Jun 03, 2021
Nicel 670C A-HR0101333 SO ₂	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTES: PO #521002827

QXJSS WT: 28.40kg

SET WT: 4.73kg

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

Approved for Release



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CERTIFICATE OF ANALYSIS Grade of Product: EPA Protocol

Part Number: E64N159E15A31D3 Reference Number: 122-402135187-1
Cylinder Number: ED0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durram (SA) - NC Cylinder Pressure: 2015 PSIG
P/GVP Number: B2202 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO₂,BALN Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024

Certificate performed in accordance with EPA Testability Tables for Analytical and Calibration of Gases Calibration Standards (May 2012) document L-1-A (2008) (2012) using the assay procedure as follows: Analytical Methodology must require concentration for analytical reference. The cylinder has a valid analysis immediately at stated volume with a confidence level of 95%. Note: See the qualification requirements with the use of this calibration certificate. All concentrations are in % unless otherwise noted.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.80 PPM	45.86 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIG OXIDE	45.80 PPM	45.84 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.80 PPM	44.30 PPM	G1	+/- 1.3% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	984.8 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021, 06/21/2021
NITROGEN	Balance	Balance	G1	+/- 0.7% NIST Traceable	06/14/2021, 06/21/2021

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20091128	ED0143262	49.32 PPM NITRIG OXIDE/NITROGEN	+/- 0.4%	Feb 07, 2025
FSM	12333	D653823	5.91 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.0%	Feb 20, 2020
GMIS	481423338132	CC4391891	4.349 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1%	Feb 18, 2023
NTRM	15011043	CC473277	46.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jul 17, 2022
NTRM	14002113	CC474077	860.3 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
Nicel 670C A-HR0101333 CO	FTIR	Jun 28, 2021
Nicel 670C A-HR0101333 NO	FTIR	Jun 28, 2021
Nicel 670C A-HR0101333 NO ₂	FTIR	Jun 03, 2021
Nicel 670C A-HR0101333 SO ₂	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTES: PO #521002827

QXJSS WT: 28.40kg

SET WT: 4.73kg

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

Approved for Release



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THAI METEOROLOGICAL DEPARTMENT

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 10 April, 2023

Certification No. 176/23

Page : 1 of 5

Object : WIRELESS ANEMOMETER

Manufacturer : SCARLET

Type : WIRELESS RECEIVER : WL-21

WIND SENSOR : WL-21

Mfg Code : WIRELESS RECEIVER : 2301DR0024

WIND SENSOR : 2301DT0024

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

81 Soi Udumsuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1007.5 hPa

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

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

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

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

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

: testo, testo 645 Serial No. 02648057 : Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB330 No. V1220015

Barometer Vaisala Type PTB330 No. V1220001

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

(Authorized Signatory)

for the Chief

Sub-Standard Instrument

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THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

10 April, 2023

Certification No. 176/23

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer	m/sec	inches H2O	inches H2O	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	6.9	0.14
9.02	-	-	-	9.0	0.02
11.02	-	-	-	11.0	0.02
13.01	-	-	-	13.0	0.01
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

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

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

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THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 176/23

10 April, 2023

Page : 3 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1013.17	1013	0.17
1013.43	1013	0.43
1014.15	1014	0.15
1014.22	1014	0.22
1009.63	1009	0.63
1009.71	1009	0.71
1009.95	1010	-0.05
1010.31	1010	0.31
1010.72	1011	-0.28
1010.80	1011	-0.20
1011.47	1011	0.47
1011.21	1011	0.21
1011.33	1011	0.33
1011.59	1012	-0.41
1011.89	1012	-0.11
1012.40	1013	-0.60
1008.64	1009	-0.36
1008.80	1009	-0.20
1009.25	1010	-0.75
1009.45	1010	-0.55

Average

0.01

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

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THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

10 April, 2023

Certification No. 176/23

Page : 4 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
759.94	760	-0.06
760.13	760	0.13
760.67	761	-0.33
760.73	761	-0.27
757.28	757	0.28
757.34	757	0.34
757.52	757	0.52
757.79	758	-0.21
758.10	758	0.10
758.16	758	0.16
758.66	759	-0.34
758.47	758	0.47
758.56	759	-0.44
758.75	759	-0.25
758.98	759	-0.02
759.36	759	0.36
759.54	757	-0.46
759.66	757	-0.34
757.00	757	0.00
757.15	757	0.15

Average

0.01

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

10 April, 2023

Certification No. 176/23

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Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.15	45.3	-0.15
31.05	31.1	-0.05
15.32	15.4	-0.08

Calibrated by :

Mr. Watchapol Subwat
Mechanical Engineer



CALIBRATION LABORATORY CO., LTD.

2/10-11, 14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cai-laboratory.com E-mail: sale@cai-laboratory.com



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VIBRATION METER
MANUFACTURER : INSTANTEL
MODEL / TYPE : 721A2501/721A2901
SERIAL NO. : UM12889/UM12889
CLID. NO. : 251801805
JOB CONTROL NO. : 230525055680

CUSTOMER : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,
BANGCHAK, PHRAKHANONG, BANGKOK 10260

DATE OF RECEIVED : 25 May 2023

DATE OF ISSUED : 29 May 2023

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Suwit Phuanbusabong
Calibration Engineer



Approved By : Mongkol Yotsoontorn
Authorized Signatory
29 May 2023

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q23055680

F3-011-04/01-12

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CALIBRATION LABORATORY CO., LTD.

2/10-11, 14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cai-laboratory.com E-mail: sale@cai-laboratory.com



REPORT OF CALIBRATION

FOR

NOMENCLATURE : VIBRATION METER
MANUFACTURER : INSTANTEL
MODEL / TYPE : 721A2501/721A2901
SERIAL NO. : UM12889/UM12889
DATE OF CALIBRATION : 26 May 2023

ENVIRONMENT CONDITIONS :

Temperature : $(23 \pm 2) ^\circ\text{C}$ Relative Humidity : $(55 \pm 15) \% \text{RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPEE-08 based on ISO 16063-21 as calibration guideline.
The calibration was performed by using Digital Multimeter, Universal Counter, Accelerometer and Measuring Amplifier which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

- Digital Multimeter, Keysight Technologies Model 3458A S/N. MY59352733.
- High Resolution Programmable Timer/Counter, Philips Model PM6680B S/N. SM607101.
- Accelerometer with Measuring Amplifier, Bruel & Kjaer Model 8305, 2525 S/N. 397018, 2434988.

TRACEABILITY :

- The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. EE-00010-23, Due Date 27 March 2024.
- The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. 07-0043/23, Due Date 03 April 2024.
- The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand) Certificate No. AV-0009-22, Due Date 22 June 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k=2.00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"

Certificate No. Q23055680

F3-011-04/01-12

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CALIBRATION LABORATORY CO., LTD.

2/10-11, 14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cai-laboratory.com E-mail: sale@cai-laboratory.com



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

CALIBRATION DATA

1. ACCELERATION RESULT

Test point		Mode	STD Reading	DUC Reading	Correction	Uncertainty
(g)	(frequency)		(g)	(g)	(g)	\pm (% of rdg.)
0.3	50 Hz	peak	0.300	0.301	-0.001	1.9
0.4	50 Hz		0.400	0.398	+0.002	1.9
0.5	50 Hz		0.500	0.496	+0.004	1.3
0.6	50 Hz		0.600	0.594	+0.006	1.3
0.7	50 Hz		0.700	0.692	+0.008	1.3
0.3	100 Hz	peak	0.300	0.302	-0.002	1.9
0.4	100 Hz		0.400	0.408	-0.008	1.9
0.5	100 Hz		0.500	0.506	-0.006	1.3
0.6	100 Hz		0.600	0.602	-0.002	1.3
0.7	100 Hz		0.700	0.702	-0.002	1.3

2. VELOCITY RESULT

Test point		Mode	STD Reading	DUC Reading	Correction	Uncertainty
(mm/s)	(frequency)		(mm/s)	(mm/s)	(mm/s)	\pm (% of rdg.)
3	50 Hz	peak	3.000	3.009	-0.009	1.8
4	50 Hz		4.000	4.013	-0.013	1.8
5	50 Hz		5.000	5.017	-0.017	1.8
6	50 Hz		6.000	6.026	-0.026	1.8
7	50 Hz		7.000	7.035	-0.035	1.8
3	100 Hz	peak	3.000	3.018	-0.018	1.8
4	100 Hz		4.000	4.021	-0.021	1.8
5	100 Hz		5.000	5.024	-0.024	1.8
6	100 Hz		6.000	6.033	-0.033	1.8
7	100 Hz		7.000	7.051	-0.051	1.8

Certificate No. Q23055680

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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



CALIBRATION DATA

3. DISPLACEMENT RESULT

Test point		Mode	STD Reading	DUC Reading	Correction	Uncertainty
(mm)	(frequency)		(mm)	(mm)	(mm)	± (% of rdg.)
*0.03	50 Hz	peak	0.030	0.030	0.000	2.1
*0.04	50 Hz		0.040	0.039	+0.001	1.7
*0.05	50 Hz		0.050	0.049	+0.001	1.5
*0.06	50 Hz		0.060	0.060	0.000	1.3
*0.07	50 Hz		0.070	0.071	-0.001	1.2
0.03	100 Hz	peak	0.030	0.030	0.000	2.1
0.04	100 Hz		0.040	0.039	+0.001	1.7
0.05	100 Hz		0.050	0.049	+0.001	1.5
0.06	100 Hz		0.060	0.060	0.000	1.3
0.07	100 Hz		0.070	0.071	-0.001	1.2

Note. * means Calibrations marked "Not ANAB Accredited" in this Certificate have been included for completeness.

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 1 of 58

This report is valid for the above stated instrument/s only.

End of Certificate

Certificate No. Q23055680

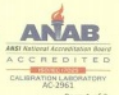
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เอกสารไม่ควบคุม

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAE0,
AMPHOE BANG PHI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 16609-2116-5860-1 FAX: 16609-2116-7140



Certificate of Calibration

Customer

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

Certificate No : 23-ACT-056
Request No : Req-2023-0788

Unit Under Calibration Details

Measurement item : Acoustic Calibrator
Manufacturer : LARSON DAVIS
Model : CAL150
Serial Number : 6695
ID : UAE.EFM.140/2565
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 : 17 April 2023
Calibration Date : 20 April 2023
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

Reference Standard	Model	Serial Number	Traceable	Due Calibration
Sound Calibrator	SV 35A	58079	EEL	31 May 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 uncertainty is based on standard uncertainty multiplied by the Coverage Factor $k=2$, providing a level of confidence approximately 95 %.

Calibrated By :

Mr. Noppadon Luangart
Service Calibration Engineer

Approved By :

Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 20 April 2023

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

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INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAE0,
AMPHOE BANG PHI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 16609-2116-5860-1 FAX: 16609-2116-7140



Certificate No : 23-ACT-056

Request No : Req-2023-0788

Sound pressure level

Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 2 (± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	93.86	-0.14	-	-	0.13	0.40
114 dB / 1000 Hz	113.96	-0.04	-	-	0.13	0.40

Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 2 (± %)
	Measured (Hz)	Error (%)	Measured (Hz)	Error (%)		
94 dB / 1000 Hz	1000.00	0.00	-	-	0.01	1.7
114 dB / 1000 Hz	1000.00	0.00	-	-	0.01	1.7

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

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 2 (± %)
	Measured (%)	Error (%)	Measured (%)	Error (%)		
94 dB / 1000 Hz	0.27	-	-	-	0.40	3.0
114 dB / 1000 Hz	0.33	-	-	-	0.40	3.0

Note :

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

End of Calibration

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAE0,
AMPHOE BANG PHI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 16609-2116-5860-1 FAX: 16609-2116-7140



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Certificate of Calibration

Customer

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

Certificate No : 22-ACT-248
Request No : Req-2022-0628

Unit Under Calibration Details

Measurement item : Sound Level Meter
Manufacturer : LARSON DAVIS
Model : LxT2
Serial Number : 0005344
ID : UAE.EFM.041/2563
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : 375A04
Microphone S/N : 329362
Preamplifier Model : PRMLA72C
Preamplifier S/N : 071494
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 : 23 March 2022
Calibrated Date : 1 April 2022
Calibration Procedure : In-house method CP-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	13 September 2022	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA060234	14 June 2022	TSI
Audio Generator	Svante	Svan401	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 :

Mr. Noppadon Luangart
Calibration Officer

Approved By :

Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 1 April 2022

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

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-248
Request No : Req-2022-0628

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust		Adjust		UNCERTAINTY	Acceptance
FAST / A / 37-139	Level (dB)	UUC (dB)	ERR (dB)	UUC (dB)	ERR (dB)	(± dB)	Limit (± dB)
Calibrator Setting							
1000 Hz 114.00 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 SYANTEK, Model SV 35A, SN.58079

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139	(dB)	(± dB)
UUC Weighting		
A	29.1	0.10

3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139	(dB)	(± dB)
UUC Weighting		
A	28.8	0.10
C	28.4	0.10
Z	32.6	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 (± dB)
STD Setting	(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	0.2	0.2	0.2	0.60	3.0
8000 Hz	0.0	0.0	0.1	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 Calibration Laboratory.
เอกสารไม่ควบคุม

Certificate No : 22-ACT-248
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 Weighting Response curve			UNCERTAINTY	Acceptance
FAST / 37-139	Weighting Response curve			(± dB)	Limit (± dB)
STD Setting	A (dB)	C (dB)	Z (dB)		
63 Hz	-0.2	-0.1	-0.1	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		3.0
8000 Hz	-0.1	-0.1	0.0		5.0
16000 Hz	-0.1	-0.1	-0.1		+5, -INF.

6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance
FAST / 37-139	REF	UUC	ERR	(± dB)	Limit (± dB)
UUC Weighting	(dB)	(dB)	(dB)		
A	114.00	114.0	0.0	0.2	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	(± dB)	Limit (± dB)
UUC Time Response	(dB)	(dB)	(dB)		
Fast	114.00	114.0	0.0	0.2	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 item calibrated. The certificate shall not be reproduced except in full, without written approval of the Calibration Laboratory.
เอกสารไม่ควบคุม

Certificate No : 22-ACT-248
Request No : Req-2022-0628

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC	(± dB)	Limit (± dB)
STD Setting	(dB)		
Initial	114.0	0.1	0.3
Final	114.0		
Deviated	0.0		

8. Level linearity on the reference level range

UUC Setting	Anticipated	Deviation		UNCERTAINTY	Acceptance
FAST / A / 37-139	REF	UUC	ERR	(± dB)	Limit (± dB)
STD dB	(dB)	(dB)	(dB)		
139.00	139	139.0	0.0	0.3	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	98.9	-0.1		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	44.1	0.1		1.1
39.00	39	39.4	0.4		1.1
38.00	38	38.5	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 Calibration Laboratory.
เอกสารไม่ควบคุม

Certificate No : 22-ACT-248
Request No : Req-2022-0628

9. Level linearity including the level range control

7. Level intensity including the level range control				UNCERTAINTY (± dB)	Acceptance
UUC Setting	STD	Measured			Limit (± dB)
FAST / A	REF	UUC	ERR		
UUC Range	(dB)	(dB)	(dB)		
44.2	44.4	44.4	0.2	0.3	1.1
37-139	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	(± dB)	Limit (± dB)
UUC Time Response	(ms)	(dB)	(dB)	(dB)		
Fast	200	135.0	135.0	0.0	0.3	1.0
	2	118.0	117.7	-0.3		+1.0, -2.5
	0.25	109.0	108.8	-0.2		+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
	200	129.0	129.1	+0.1		1.0
SEL	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
FAST / C / 95-142	REF	UUC	ERR	(± dB)	Limit (± dB)
STD Setting	(dB)	(dB)	(dB)		
Complete cycle	137.4	136.7	-0.70	0.2	3.0
Positive half cycle	136.4	136.1	-0.30		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 Calibration Laboratory.
เอกสารไม่ควบคุม

Certificate No : 22-ACT-248
Request No : Req-2022-0628

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	UUC		
STD Setting	(dB)	(± dB)	(± dB)
Positive one-half cycle	143.2		
Negative one-half cycle	143.1		
Deviated	0.1	0.2	1.5

13. High Level Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance Limit
FAST / A / 37-139	UUC		
STD Setting	(dB)	(± dB)	(± dB)
Initial	138.0		
Final	138.0		
Deviated	0.0	0.1	0.3

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 head of the laboratory.
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Certificate of Calibration

Calibration Certification Information			
Cal. Date: July 5, 2022	Rootsometer S/N: 438320	Ta: 297 °K	
Operator: Jim Tisch		Pa: 750.1 mm Hg	
Calibration Model #: G25A	Calibrator S/N: 1901		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3540	3.3	2.00
2	3	4	1	0.9650	6.4	4.00
3	5	6	1	0.8640	8.0	5.00
4	7	8	1	0.8200	8.9	5.50
5	9	10	1	0.6780	12.9	8.00

Data Tabulation

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \times \frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9859	0.7281	1.4073	0.9956	0.7353	0.8899
0.9818	1.0174	1.9902	0.9915	1.0274	1.2585
0.9797	1.1339	2.2251	0.9893	1.1451	1.4071
0.9785	1.1933	2.3337	0.9881	1.2050	1.4757
0.9732	1.4354	2.8146	0.9828	1.4496	1.7798
m=		1.98897	m=		1.24546
b=		-0.03691	b=		-0.02334
r=		0.99996	r=		0.99996

Calculations

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

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH:	calibrator manometer reading (in H2O)
ΔP:	rootsometer manometer reading (mm Hg)
Ta:	actual absolute temperature (°K)
Pa:	actual barometric pressure (mm Hg)
b:	intercept
m:	slope

RECALIBRATION
US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30

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

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Tel: (937)7-9009

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

Certificate of Calibration

Certificate No.: 24P1250
Page: 1 of 2

Equipment:	U Tube Manometer	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.
Manufacturer:	Dwyer	
Model:	122-1-36-W/M	
Serial No.:	-	
ID No.:	UAE,EFM,076/2566	
Condition As-Received:	Used Item	
Received Date:	03 April 2024	
Calibration Date:	10 April 2024	
Reference:	2404-0118WSC	Submitted by: United Analyst and Engineering Consultant Co., Ltd.
Ambient Temperature:	(23 ± 2) °C	
Relative Humidity:	(50 ± 15) %	81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Atmospheric Pressure:	1007 mbar	

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

Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PC106P	1189	MP-0176-23	12 Sep 2024

- This result of calibration was made on requested at the point specified by customer.
- Scale and conversion factor is 1 kPa = 4.0146293 inH₂O
- This instrument was used clean air 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.
- The certificate is valid only to the item calibrated on date and place of calibration.
- This Calibration is traceable to the International System of Unit maintained through:-
-National Institute of Metrology (Thailand), NSC-ONSC Accredited No, Calibration 0144

Calibrated by : Suksan Khankaew
Issue Date : 17 April 2024

Approved Signatory :
[] Phalinee Prabpaipal
[] Sura Suwannasri
[✓] Attapol Panurach

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Cert.No.: 24P1250
Page: 2 of 2

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

Range: 0 inH₂O to 36 inH₂O
Scale Interval: 0.1 inH₂O (The Second Estimate)

Applied Pressure		High-port side		UUC Indication		ΔP		Error	
				Low-port side					
0.00	0.00			0.00	0.00			0.00	0.00
2.00	0.00			-1.00	2.00			0.00	0.00
4.00	2.00			-2.00	4.00			0.00	0.00
6.00	3.00			-3.00	6.00			0.00	0.00
8.00	4.00			-4.00	8.00			0.00	0.00
10.00	5.00			-4.95	10.00			0.00	0.00
12.00	6.00			-5.95	12.00			0.00	0.00
14.00	7.00			-6.95	14.00			0.00	0.00
16.00	8.10			-7.95	16.00			0.05	0.05
18.00	9.10			-8.95	18.00			0.05	0.05
20.00	10.10			-9.95	20.00			0.05	0.05
22.00	11.10			-10.95	22.00			0.05	0.05
24.00	12.10			-11.95	24.00			0.05	0.05
26.00	13.15			-12.95	26.10			0.10	0.10
28.00	14.15			-13.95	28.10			0.10	0.10
30.00	15.20			-14.95	30.15			0.15	0.15
32.00	16.20			-15.95	32.15			0.15	0.15
34.00	17.20			-16.95	34.15			0.15	0.15
35.50	18.00			-17.70	35.70			0.20	0.20

The uncertainty of measurement was ± 0.11 inH₂O
* ΔP = High-port side - Low-port side
* 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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Certificate of Calibration

Certificate No. : 23P1858
Page : 1 of 2

Equipment : Aneroid Barometer
Manufacturer : Barigo
Model : -
Serial No. : -
ID No. : UAE.ANV.124/2550

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: 2305-0919WSC
Ambient Temperature: (23 ± 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,
Bangchak, Phrakhanong, Bangkok 10260

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

Condition of this result of calibration

1.Reference standards instruments :

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DPI142	1422505046	MP-0094-23	03 May 2024

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

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

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

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

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

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

-National Institute of Metrology Thailand (NIMT)

Calibrated by : Suksan Khankaew
Issue Date : 08 June 2023

Approved Signatory :

[] Phalinee Prabpaipal
[] Sura Suwannasri
[x] Attapol Panurach

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B 0316958



Cert.No.: 23P1858
Page: 2 of 2

Result of calibration:- Without adjustment

Function:- Absolute Pressure Measurement

Range: 960 hPa to 1030 hPa

Scale Interval : 1 hPa (The Fifth Estimate)

Increasing Pressure

Applied Pressure (hPa)	959.93	970.47	981.93	991.32	1002.29	1011.64	1021.14	1032.30
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	0.07	-0.47	-1.93	-1.32	-2.29	-1.64	-1.14	-2.30

Decreasing Pressure

Applied Pressure (hPa)	1032.30	1021.44	1011.67	1002.36	992.35	981.94	970.49	959.94
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-2.30	-1.44	-1.67	-2.36	-2.35	-1.94	-0.49	0.06

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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a 1165506



Certificate of Calibration

Certificate No. : 23H1200
Page : 1 of 2

Equipment : Dial Thermo-Hygrometer
Manufacturer : Barigo
Model : -
Serial No. : -
ID No. : UAE.ANV.130/2550

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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: 30 May 2023
to 06 June 2023

Reference: 2305-0919WSC
Ambient Temperature: (25 ± 3) °C
Relative Humidity: (50 ± 20) %

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

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

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

Condition of this result of calibration

1.Reference standards instruments :

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

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

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

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

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

Calibrated by : Somchal Durnwor
Issue Date : 07 June 2023

Approved Signatory :

[x] Chakrit Waewwanjua
[] Pornthippa Tameyakul
[] Viporn Tantiyawutti

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B 0316274



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	76	-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	-0.016	0.72
39.944	39.5	-0.444	0.72

UUC* : Unit Under Calibration

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

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a 1165295



THAI METEOROLOGICAL DEPARTMENT

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 13 March, 2024

Certification No. 119/24

Page : 1 of 5

Object : Wind Speed & Wind Direction Data Logger

Manufacturer : SCARLET/TECH

Type : WL-21

Mfg Code : Wireless Receiver 2111DR0041
Wind Sensor 2111DT0041

Customer : United Analyst and Engineering Consultant Co.,Ltd.
81 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1010.6 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Aloft Plotting Board

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

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 ~ 30 m/sec

: Ultrasonic Anemometer Model DA-850-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)

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

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

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

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015

: Digital Barometer Vaisala Type PTB330 No. 24320001

Calibrated by : [Redacted] (Authorized Signatory)
for the Chief

Mr. Watcharapol Subwat Sub-Standard Instrument
Mechanical Engineer

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THAI METEOROLOGICAL DEPARTMENT

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The Result of Calibration

13 March, 2024

Certification No. 119/24

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.0	0.04
9.02	-	-	-	8.9	0.12
11.02	-	-	-	11.0	0.02
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.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by : [Redacted]
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

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THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

13 March, 2024

Certification No. 119/24

Page : 3 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mbar
1009.59	1009	0.59
1009.45	1009	0.45
1010.10	1010	0.10
1010.94	1011	-0.06
1011.46	1011	0.46
1011.84	1012	-0.16
1012.06	1012	0.06
1013.04	1013	0.04
1013.18	1013	0.18
1012.89	1013	-0.11
1013.20	1013	0.20
1013.44	1014	-0.56
1013.81	1014	-0.19
1014.19	1014	0.19
1015.96	1016	-0.04
1016.23	1016	0.23
1015.64	1016	-0.36
1015.23	1015	0.23
1012.87	1013	-0.13
1013.63	1014	-0.37

Average 0.04

Calibrated by : [Redacted]
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

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

The Result of Calibration

13 March, 2024

Certification No. 119/24

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Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	mmHg
757.25	757	0.25
757.15	757	0.15
757.64	758	-0.36
758.27	758	0.27
758.66	758	0.66
758.94	759	-0.06
759.11	759	0.11
759.84	760	-0.16
759.95	760	-0.05
759.73	760	-0.27
759.96	760	-0.04
760.14	760	0.14
760.42	761	-0.58
760.70	761	-0.30
762.03	762	0.03
762.24	762	0.24
761.79	762	-0.21
761.48	761	0.48
759.71	760	-0.29
760.28	760	0.28

Average 0.02

Calibrated by : [Redacted]
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

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THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

13 March, 2024

Certification No. 119/24

Page : 5 of 5

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.1	45	0.1
30.2	30	0.2
15.4	15	0.4

Calibrated by :

Mr. Watcharapol Subwat
Mechanical Engineer



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CALIBRATION LABORATORY Co.,LTD.

210-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : VIBRATION METER
MANUFACTURER : INSTANTEL
MODEL / TYPE : 721A2501/721A2901
SERIAL NO. : UM12865/UM12865
CLID. NO. : 251801712
JOB CONTROL NO. : 230914102597

CUSTOMER : UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
81 SOI UDOMSUK 41, SUKHUMVIT ROAD,
BANGCHAK, PHRAKHANONG, BANGKOK 10260

DATE OF RECEIVED : 14 September 2023

DATE OF ISSUED : 19 September 2023

Report of calibration screening must not be taken in part. Except complete. Without the approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Suwit Phuanbusabong
Calibration Engineer

Approved By : Mongkol Yotsoontorn
Authorized Signatory
19 September 2023



This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q23102597

F3-011-04/01-12

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REPORT OF CALIBRATION

FOR

NOMENCLATURE : VIBRATION METER
MANUFACTURER : INSTANTEL
MODEL / TYPE : 721A2501/721A2901
SERIAL NO. : UM12865/UM12865
DATE OF CALIBRATION : 15 September 2023

ENVIRONMENT CONDITIONS :

Temperature : $(23 \pm 2) ^\circ\text{C}$ Relative Humidity : $(55 \pm 15) \% \text{RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPEE-08 based on ISO 16063-21 as calibration guideline.
The calibration was performed by using Digital Multimeter, Programmable Timer/Counter, Accelerometer and Measuring Amplifier which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

1. Programmable Timer/Counter, Philips Model PM6680B S/N. SM607101.
2. Digital Multimeter, Keysight Technologies Model 3458A S/N. MY59352733.
3. Accelerometer with Conditioning Amplifier, Bruel & Kjaer Model 8305, 2626 S/N. 705491, 1741406.

TRACEABILITY :

1. The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. 07-0043/23, Due Date 03 April 2024.
2. The measurements are traceable to International System of Units (SI), through Aeronautical Radio of Thailand Ltd. Certificate No. EE-00010-23, Due Date 27 March 2024.
3. The measurements are traceable to International System of Units (SI), through National Institute of Metrology (Thailand) Certificate No. AV-0025-22, Due Date 12 October 2023.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2.00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %.
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration (EA-4/02 M:2022)"

Certificate No. Q23102597

F3-011-04/01-12

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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



CONDITION OF CALIBRATION ITEM : GOOD

MEASUREMENT RESULTS : (X) without adjustment () adjustment

CALIBRATION DATA

1. ACCELERATION RESULT

Test point		Mode	STD Reading (g)	DUC Reading (g)	Correction (g)	Uncertainty \pm (% of rdg.)
(g)	(frequency)					
0.3	50 Hz	peak	0.300	0.301	-0.001	1.9
0.4	50 Hz		0.400	0.403	-0.003	1.9
0.5	50 Hz		0.500	0.505	-0.005	1.3
0.6	50 Hz		0.600	0.606	-0.006	1.3
0.7	50 Hz		0.700	0.708	-0.008	1.3
0.3	100 Hz	peak	0.300	0.301	-0.001	1.9
0.4	100 Hz		0.400	0.403	-0.003	1.9
0.5	100 Hz		0.500	0.505	-0.005	1.3
0.6	100 Hz		0.600	0.607	-0.007	1.3
0.7	100 Hz		0.700	0.712	-0.012	1.3

2. VELOCITY RESULT

Test point		Mode	STD Reading (mm/s)	DUC Reading (mm/s)	Correction (mm/s)	Uncertainty \pm (% of rdg.)
(mm/s)	(frequency)					
3	50 Hz	peak	3.000	3.025	-0.025	1.8
4	50 Hz		4.000	4.033	-0.033	1.8
5	50 Hz		5.000	5.054	-0.054	1.8
6	50 Hz		6.000	6.067	-0.067	1.8
7	50 Hz		7.000	7.087	-0.087	1.8
3	100 Hz	peak	3.000	3.029	-0.029	1.8
4	100 Hz		4.000	4.036	-0.036	1.8
5	100 Hz		5.000	5.046	-0.046	1.8
6	100 Hz		6.000	6.072	-0.072	1.8
7	100 Hz		7.000	7.093	-0.093	1.8

Certificate No. Q23102597

F3-011-04/01-12

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เอกสารไม่ควบคุม





CALIBRATION LABORATORY CO.,LTD.

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Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO.,LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAE0,
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 0660-2116-5860-1 FAX: 0660-2116-7140



Page 1 of 2.

CALIBRATION DATA

3. DISPLACEMENT RESULT

Test point		Mode	STD Reading	DUC Reading	Correction	Uncertainty
(mm)	(frequency)		(mm)	(mm)	(mm)	± (% of rdg.)
*0.03	50 Hz	peak	0.030	0.030	0.000	2.1
*0.04	50 Hz		0.040	0.040	0.000	1.7
*0.05	50 Hz		0.050	0.051	-0.001	1.5
*0.06	50 Hz		0.060	0.061	-0.001	1.3
*0.07	50 Hz		0.070	0.071	-0.001	1.2
0.03	100 Hz	peak	0.030	0.030	0.000	2.1
0.04	100 Hz		0.040	0.040	0.000	1.7
0.05	100 Hz		0.050	0.050	0.000	1.5
0.06	100 Hz		0.060	0.061	-0.001	1.3
0.07	100 Hz		0.070	0.071	-0.001	1.2

Note. * means Calibrations marked " Not ANAB Accredited " in this Certificate have been included for completeness.

The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 008 Page 1 of 58

This report is valid for the above stated instrument/s only.

End of Certificate

Certificate No. Q23102597

FM-011-04/01-12

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@iccalibration

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Page 2 of 2.

Certificate No : 23-ACT-110

Request No : Req-2023-1407

Sound pressure level

Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	93.82	-0.18	-	-	0.13	0.25
114 dB / 1000 Hz	113.77	-0.23	-	-	0.13	0.25

Frequency of Sound pressure level

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

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

Calibration Range (Hz)	Without Adjustment		Adjustment		Uncertainty (± %)	Acceptance limit Class 1 (± %)
	Measured (%)	Error (%)	Measured (%)	Error (%)		
94 dB / 1000 Hz	0.09	-	-	-	0.40	2.5
114 dB / 1000 Hz	0.28	-	-	-	0.40	2.5

Note :

- Acceptance limit was IEC60942:2017 Class 1

- The calibration results exclude the calibrator pressure correction

- The calibration results exclude the microphone volume correction

End of Calibration

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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TEL: 0660-2116-5860-1 FAX: 0660-2116-7140



Page 1 of 2.

Certificate of Calibration

Customer

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

Certificate No : 23-ACT-110
Request No : Req-2023-1407

Unit Under Calibration Details

Measurement item : Acoustic Calibrator
Manufacturer : SVANTEK
Model : SV 35A
Serial Number : 73246
ID : UAE.EFM.104/2561
Class : 1
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 : 26 June 2023
Calibration Date : 27 June 2023
Location of Calibration : LAB 1 Acoustic
Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

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

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

Note

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

Calibrated By :

Mr. Noppadon Luangart
Service Calibration Engineer

Approved By :

Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 27 June 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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Page 1 of 6.

Certificate of Calibration

Customer

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

Certificate No : 23-SLM-187
Request No : Req-2023-1166

Unit Under Calibration Details

Measurement item : Sound Level Meter
Manufacturer : LARSON DAVIS
Model : LxT2
Serial Number : 0005288
ID : UAE.EFM.104/2562
Resolution : 0.1 dB
Microphone Class : 2
Microphone Model : 375B02
Microphone S/N : 011731
Preamplifier Model : PRLMT2B
Preamplifier S/N : 056075
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 : 26 May 2023
Calibrated Date : 2 June 2023
Calibration Procedure : In-house method CP-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	6 October 2023	GRAS
Multifrequency Calibrator	Quest	Quest-cal	EFA000234	29 June 2023	TSI
Audio Generator	Svante	Svan401	131	12 October 2023	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 :

Mr. Noppadon Luangart
Calibration Officer

Approved By :

Mr. Pacit Mathavorn
Calibration Engineer Supervisor

Issue Date : 2 June 2023

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

เอกสารไม่ควบคุม

Certificate No : 23-SLM-187
Request No : Req-2023-1166

1. Indication at the calibration check frequency

UUC Setting	Nominal	Before Adjust		After Adjust		UNCERTAINTY	Acceptance
FAST / A / 37-139	Level	UUC	ERR	UUC	ERR	(± dB)	Limit
Calibrator Setting	(dB)	(dB)	(dB)	(dB)	(dB)		
1000 Hz 114 dB	114.54	114.6	+0.06	114.5	-0.04	0.2	0.3

Note : Absolute sensitivity was established by the use of Sound Calibrator Brand 3M, Model AC-300, SN: AC-300001087

2. Self-generated noise, Microphone installed

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	30.7	0.1

3. Self-generated noise, Microphone replaced by the electrical input signal device

UUC Setting	Measured	UNCERTAINTY
FAST / 37-139		
UUC Weighting	(dB)	(± dB)
A	30.5	0.1
C	30.1	0.1
Z	34.1	0.1

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)		
125 Hz	0.0	0.1	0.0	0.6	2.0
1000 Hz	0.0	0.0	0.0	0.6	1.0
4000 Hz	1.2	1.2	1.2	0.6	3.0
8000 Hz	2.9	2.8	2.9	0.7	5.0

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

เอกสารไม่ควบคุม

Certificate No : 23-SLM-187
Request No : Req-2023-1166

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)		
63 Hz	-0.1	0.0	0.0	0.2	2.0
125 Hz	-0.1	0.0	0.0		1.5
250 Hz	0.0	0.0	0.0		1.5
500 Hz	0.0	0.0	0.0		1.5
1000 Hz	0.0	0.0	0.0		1.0
2000 Hz	0.1	0.1	0.0		2.0
4000 Hz	0.0	0.1	0.0		3.0
8000 Hz	0.0	0.1	0.0		5
16000 Hz	0.0	-0.1	0.0		+5, -INF.

6. Frequency and time weightings at 1kHz

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance
FAST / 37-139	REF	UUC	ERR	(± dB)	Limit
UUC Weighting	(dB)	(dB)	(dB)		
A	114.00	114.0	0.0	0.2	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	(± dB)	Limit
UUC Time Response	(dB)	(dB)	(dB)		
Fast	114.00	114.0	0.0	0.2	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 : 23-SLM-187
Request No : Req-2023-1166

7. Long Term Stability

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC	(± dB)	Limit
STD Setting	(dB)		
Initial	114.0		
Final	114.0		
Deviated	0.0		
	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	(± dB)	Limit
STD dB	(dB)	(dB)	(dB)		
139.00	139	139.0	0.0	0.3	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	54.1	0.1		1.1
49.00	49	49.1	0.1		1.1
44.00	44	44.2	0.2		1.1
39.00	39	39.7	0.7		1.1

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

เอกสารไม่ควบคุม

Certificate No : 23-SLM-187
Request No : Req-2023-1166

9. Level linearity including the level range control

UUC Setting	STD	Measured		UNCERTAINTY	Acceptance
FAST / A	REF	UUC	ERR	(± dB)	Limit
UUC Range	(dB)	(dB)	(dB)		
37-139	45.0	45.2	0.2	0.3	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	(± dB)	Limit
UUC Time Response	(ms)	(dB)	(dB)	(dB)		
Fast	200	135.0	135.0	0.0	0.2	1
	2	118.0	117.9	-0.1		+1.0, -2.5
	0.25	109.0	108.8	-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
	200	129.0	129.0	0.0		1
SEL	2	109.0	108.9	-0.1		+1.0, -2.5
	0.25	100.0	99.9	-0.1		+1.5, -5.0

11. Peak C Sound level

UUC Setting	Anticipated	Measured		UNCERTAINTY	Acceptance
FAST / C / 95-142	REF	UUC	ERR	(± dB)	Limit
STD Setting	(dB)	(dB)	(dB)		
Complete cycle	137.4	136.9	-0.50	0.2	3.0
Positive half cycle	136.4	136.3	-0.10		2.0
Negative half cycle	136.4	136.3	-0.10		2.0

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

เอกสารไม่ควบคุม

Certificate No : 23-SLM-187

Request No : Req-2023-1166

12. Overload indication

UUC Setting	Measured	UNCERTAINTY	Acceptance
FAST / A / 37-139	UUC		Limit
STD Setting	(dB)	(± dB)	(± dB)
Positive one-half cycle	142.3		
Negative one-half cycle	142.5		
Deviated	-0.2	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		
Deviated	0.0	0.1	0.3

End of Certificate

ภาคผนวก ต-2
เอกสารสอบเทียบ/ทวนสอบ
เครื่องมือเก็บตัวอย่างและวิเคราะห์คุณภาพน้ำผิวดิน



List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Laboratory Equipment for Water Analysis									
1	pH Meter	ความเป็นกรด-ด่าง (pH) อุณหภูมิน้ำ (Temperature)	Mettler-Toledo	Seven Easy S20 / 1230525212	National Food Institute, Ministry of Industry, Thailand	2401718-001-01	11 Mar 24	10 Mar 25	-
2	Conductivity Meter	ความเค็ม (Salinity), ค่าความนำไฟฟ้า (Conductivity)	SI Analytics	Lab955 / 16300356	SPC Calibration Center Co.,Ltd.	C24240057	11 Mar 24	10 Mar 25	-
3	BOD Incubator	ความสกปรกในรูปความต้องการใช้ออกซิเจนสำหรับย่อยสลายอินทรีย์ (BOD ₅)	Arco	UR-1320 / (UAE.WAO.006/2553)	Technology Promotion Association (Thailand-Japan)	24TM588	1 Apr 24	31 Mar 25	-
4	BOD Incubator		Arco	UR-1320 / (UAE.WAO.018/2551)	Technology Promotion Association (Thailand-Japan)	24TM587	1 Apr 24	31 Mar 25	-
5	Analytical Balance (Repeatability 0.01 mg)	ของแข็งแขวนลอย (Suspended Solids)	Mettler-Toledo	1129361010	Technology Promotion Association (Thailand-Japan)	24MM292	11 May 24	10 May 25	-
6	Hot Air Oven		Memmert	UF55 / B212.0411	Technology Promotion Association (Thailand-Japan)	24TM589	2 Apr 24	1 Apr 25	-
7	Analytical Balance (Repeatability 0.1 mg)	น้ำมันและไขมัน (Oil & Grease)	Mettler-Toledo	XSR204 / C117635043	National Food Institute, Ministry of Industry, Thailand	24MM293	11 May 24	10 May 25	-
8	Atomic Absorption Spectrometer (AAS)	ตะกั่ว (Pb) แคดเมียม (Cd) เหล็กทั้งหมด (Total Iron)	Agilent Technologies	System ID:G8432A AA240FS / MY13160001	Thailand Institute Of Science And Technological Research (TISTR)	MTC.ACL. No. 486/65	24 Jan 24	23 Jan 25	-
9	Inductively Coupled Plasma (ICP)			System ID:G8015A G8015AA / MY18030001	Agilent Technologies (Thailand) Co.,Ltd.	Preventive Maintenance Checklist	13 Nov 23	12 Nov 24	-

List of Instruments Certification for Water Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Laboratory Equipment for Water Analysis									
10	Incubator	แบคทีเรียกลุ่มโคลิฟอร์มทั้งหมด (Total coliform bacteria) แบคทีเรียกลุ่มฟีคอลโคลิฟอร์ม (Fecal coliform bacteria)	Memmert	IPP 260	Technology Promotion Association (Thailand-Japan)	24TM648	1 Apr 24	31 Mar 25	-
11	Incubator		Memmert	IPP 260	Technology Promotion Association (Thailand-Japan)	24TM650	3 Apr 24	2 Apr 25	-
12	Water Bath		Memmert	WNE 14 / L416.0606	Technology Promotion Association (Thailand-Japan)	24TM29	10 Feb 24	9 Feb 25	-
13	Water Bath		Memmert	WNE 14 / L416.0612	Technology Promotion Association (Thailand-Japan)	24TM30	10 Feb 24	9 Feb 25	-
14	Analytical Balance		OHAUS	C236754745	DKSH (Thailand) Ltd.	C01234158	8 Dec 23	7 Dec 24	-
15	Auto Clave		ALP	CL-40L / 808763	Technology Promotion Association (Thailand-Japan)	2402281-001-01	2 Aug 24	1 Aug 25	-

Due Date of Calibration* : กำหนดตามแผนการสอบเทียบประจำปี อย่างน้อยปีละ 1 ครั้ง

Calibration Certificate

Certificate No.: 2401718-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhonong, Bangkok 10260

Page 1 of 5

Equipment: pH Meter
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1231155210
ID No.: UAE.WAT.010/2553
Order No.: 2401718
Operation No.: 2401718-001
Date of Receipt: 27 February 2024
Date of Calibration: 11 March 2024

Calibrated by Mr.Manas Somsak Specialist
Approved by (Mr.Pheraphat Tuanjit)
Manager, Division of Calibration Laboratory
Responsible for the Technical Management Team
Date of Issue: 12 March 2024

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

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

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

2008 บลจ.จุฬาลงกรณ์ 35 นุสาฎกนาครีวงศ์ แขวงคลองเตย เขตวัฒนา กรุงเทพมหานคร 10110
2008 Soi 35, Anu Amarn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10110, Thailand
Tel :+66(0) 2422 8568 Fax :+66(0) 2422 8545



Calibration Report

Certificate No.: 2401718-001-01
Equipment: pH Meter
Resolution: 0.01 pH ; 1 mV
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1231155210
Type: Bench top
ID No.: UAE.WAT.010/2553

Date of Calibration: 11 March 2024 Page 2 of 5

Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: Ambient Temperature: (23.4 ± 1.5) °C Relative Humidity: (51 ± 3) %
Condition of Equipment: Good Condition
Condition of this Results of Calibration

1. Calibration Method: W-CC-002 : in house method based on direct measurement by using standard voltage calibrator and certified reference material (CRM)
2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date	
2.1 DC Voltage Calibrator	2709007	Fluke	23E2003	14 June 2024	
2.2 Digital Thermometer	2709007	Fluke	CC 660570-01	30 October 2024	
2.3 Thermo-Hygro Meter	NFLBTH 014/23	testo	CC 660353-01	3 April 2024	
Certified Reference Material		Lot No.	Manufacturer	Ref N	Expires Date
2.4 pH buffer 4.006 (Primary pH buffer Solution)	888842	CPAchem	PH216 L5	13 April 2025	
2.5 pH buffer 6.865 (Primary pH buffer Solution)	888843	CPAchem	PH217 L5	13 April 2025	
2.6 pH buffer 10.01 (Primary pH buffer Solution)	888844	CPAchem	PH220 L5	13 April 2024	
2.7 pH buffer 7.00 (Standard pH buffer Solution)	C03109	HACH LANGE GmbH	S11M004	16 October 2025	

3. This certification is traceable to The International System of Unit (SI Unit)
3.1 Instruments Ng.2.1 through NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0008
3.2 Instruments Ng.2.2 and 2.3 through NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.3 Certified Reference Material Ng.2.4 to 2.6 traceable to Primary measurement method- Hamed cell using calibrated thermometer, barometer, and nanovoltmeter. The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.4 Certified Reference Material Ng.2.7 traceable to PTB Certificate Nr. PTB-PHQA-563/30504/23 and Certificate Nr. PTB-PHOB-555/30620/22 (PTB: Physikalisch-Technische Bundesanstalt, Braunschweig, Germany)
4. This certificate was certified only for the instrument we calibrated.
5. This result of calibration was found accurate as shown on date and place of calibration only.

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

2008 บลจ.จุฬาลงกรณ์ 35 นุสาฎกนาครีวงศ์ แขวงคลองเตย เขตวัฒนา กรุงเทพมหานคร 10110
2008 Soi 35, Anu Amarn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10110, Thailand
Tel :+66(0) 2422 8568 Fax :+66(0) 2422 8545

Calibration Report

Certificate No.: 2401718-001-01
Equipment: pH Meter
Resolution: 0.01 pH ; 1 mV
Manufacturer: METTLER TOLEDO
Model: SevenEasy pH
Serial No.: 1231155210
Type: Bench top
ID No.: UAE.WAT.010/2553

Date of Calibration: 11 March 2024 Page 3 of 5

Calibration Results: 1. Calibration of pH Meter (Manual Temperature Compensation at 25 °C)
(offset value before adjust: -0.4 mV)

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.121	414	0.00	0.58	2.00
2	295.814	296	2.00	0.58	2.00
4	177.464	178	4.00	0.58	2.00
6	59.160	59	6.00	0.58	2.00
7	0.001	0	7.00	0.58	2.00
8	-59.159	-59	8.00	0.58	2.00
10	-177.461	-177	10.00	0.58	2.00
12	-295.811	-296	12.00	0.58	2.00
14	-414.118	-414	14.00	0.58	2.00

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

Equipment:	pH Electrode	Type:	Combined Electrode
Manufacturer:	METTLER TOLEDO	Model:	InLab Solids
Serial No.:	3065701	ID No.:	N/A

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

Certified Value @25 °C (pH)	Average Indicator Reading		Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
	pH	mV			
4.008	4.01	188	-	0.0071	2.00
7.001	7.00	13	96.9	0.0086	2.00
10.010	10.01	-160	97.2	0.0085	2.00
6.865	6.87	21	-	0.0074	2.00

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

2008 บลจ.จุฬาลงกรณ์ 35 นุสาฎกนาครีวงศ์ แขวงคลองเตย เขตวัฒนา กรุงเทพมหานคร 10110
2008 Soi 35, Anu Amarn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10110, Thailand
Tel :+66(0) 2422 8568 Fax :+66(0) 2422 8545



Calibration Report

Certificate No.: 2401718-001-01
Equipment: Digital Thermometer with RTD (pH Meter)
Resolution: 0.1 °C
Model: SevenEasy pH
Serial No.: 1231155210
ID No.: UAE.WAT.010/2553
Manufacturer: METTLER TOLEDO

Date of Calibration: 11 March 2024 Page 4 of 5

Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: Ambient Temperature 23 °C ± 1 °C
Relative Humidity 51 % ± 2 %

Condition of this results of Calibration:

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

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
HANDHELD THERMOMETER	1523	2118154	PSL-T 0877/66	06-Jun-24	TISTR
Platinum Resistance Thermometer (PRT)	5627A	877332			

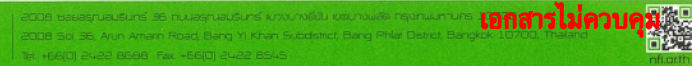
Support Equipment : - Low Temperature Bath (ISOCAL-6), Model: Europa-6 Plus Basic, S/N: 341592/2

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

6. Condition of Calibrated item : Good
7. Result of Calibration : ☒ Without adjustment ☐ After adjustment

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

2008 บลจ.จุฬาลงกรณ์ 35 นุสาฎกนาครีวงศ์ แขวงคลองเตย เขตวัฒนา กรุงเทพมหานคร 10110
2008 Soi 35, Anu Amarn Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10110, Thailand
Tel :+66(0) 2422 8568 Fax :+66(0) 2422 8545



Certificate of Calibration

Certificate No.: 2401718-001-01
Equipment: Digital Thermometer with RTD (pH Meter)
Resolution: 0.1 °C Model: SevenEasy pH
Serial No.: 1231155210 ID No.: UAE.WAT.010/2553
Manufacturer: METTLER TOLEDO
Date of Calibration: 11 March 2024 Page 5 of 5

Calibration point: 15.0, 25.0 and 35.0 °C
Calibration result:

- The probe was immersed in liquid bath or dry bath to a minimum depth of 100 mm.
- Description of probe, model: N/A S/N: N/A
Dimension of probe: Diameter 4 mm., Length 120 mm.,
Sheath material: Stainless Steel

UUC* Reading (°C)	Standard Temperature (°C)	Correction Value (°C)	Uncertainty ± (°C)
15.1	14.998	0.1	0.099
25.1	24.998	0.1	0.099
35.1	34.997	0.1	0.099

Note
- UUC*: Unit Under Calibration

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

----- End -----

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

2008 ถนนสุขุมวิท 35 แขวงคลองตัน เขตคลองเตย กรุงเทพมหานคร 10110
2008 Soi 35, Asoke Road, Bang Yi Khan Subdistrict, Bang Phai District, Bangkok 10110 Thailand
Tel: +66(0) 2422 6660 Fax: +66(0) 2422 6545 nfi.or.th

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Certificate No.: C24240057 Page: 2 of 2

Calibration Results:

Before Adjustment

Standard	Unit Under Calibration		Coverage Factor	
Conductivity Solution	Reading	Correction	(k)	Uncertainty (±)
25.000 μS/cm	26.7 μS/cm	-1.700 μS/cm	2.00	0.21 μS/cm
1413.0 μS/cm	1428 μS/cm	-15.0 μS/cm	2.00	9.0 μS/cm
111.3 mS/cm	108.4 mS/cm	2.9 mS/cm	2.00	0.67 mS/cm

After Adjustment ; at 1413 µS/cm

Standard	Unit Under Calibration		Coverage Factor	
Conductivity Solution	Reading	Correction	(k)	Uncertainty (±)
25.000 μS/cm	25.9 μS/cm	-0.900 μS/cm	2.00	0.21 μS/cm
1413.0 μS/cm	1413 μS/cm	0.0 μS/cm	2.00	9.0 μS/cm
111.3 mS/cm	107.5 mS/cm	3.8 mS/cm	2.00	0.67 mS/cm

The End of Certificate

เอกสารไม่ควบคุม

CAL-PM-C24-09: 12 Sep 2022

Equipment: CONDUCTIVITY METER Certificate No.: C24240057
Model: Lab 955 Issued Date: 11 March 2024
Serial No. (or ID.): 16300356 Job No.: WO-00020309
Manufacturer: SI Analytic Page: 1 of 2
Electrode Serial No. 16070067 Model: LF413T Brand: SI Analytic
Condition: In Condition

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

Environment Condition: Temperature 23 °C ± 2 °C
Humidity 50 %RH ± 15 %RH

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

Calibration By: Mr. Pongpisut Suebchantha
Calibration Date: 11 March 2024
The Method used: In house method, CAL-WI-49, base on ASTM D 1125-14 and D 5391-14
Traceability: This certificate is traceable to the SI Units maintained by CRM of NIST(SRM) through CPA chem Co., Ltd. (ISO/IEC 17034) Certificate No. 960753, 890591, 890593



(Mr. Pongpisut Suebchantha)

Person in charge



(Mr. Nitinun Srihawan)

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.

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

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CAL-PM-C24-09: 12 Sep 2022



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



Cert. No.: 24TM588

Page : 1 of 3

Certificate of Calibration

Equipment : BOD Incubator
Manufacturer : ARCO
Model : UR-1320
Serial No. : -
ID No. : UAE.WAO.006/2553
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangkok, Phrakhanong,
Bangkok 10260
Location : Lab Floor 2
Received Order : 01 April 2024
Calibration Date : 01 April 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Krisda Malee
Approved by :
() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 5 April 2024

The Uncertainties are for a confidence probability of approximately 95%

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เอกสารไม่ควบคุม

A 0065064



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2404-0004OC-2

Cert. No.: 24TM588
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 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	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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

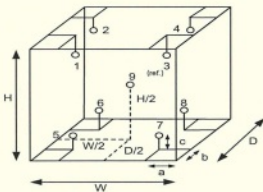
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available



Probe Installation Details :

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

Dimension of Chamber :

D = 0.62 m
W = 1.2 m
H = 1.2 m
Capacity = 0.89 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	27
REL.Humid. (%)	45	47
AC Supply (Volt)	220	221

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

เอกสารไม่ควบคุม

a 1209741

UAE.FM.6.4.016-1(0)/09-SEP-2020

กำหนดจุดห้ามใช้งาน

References Certificate Number. : 234TM588

Equipment : BOD Incubator

Model : UR-1320

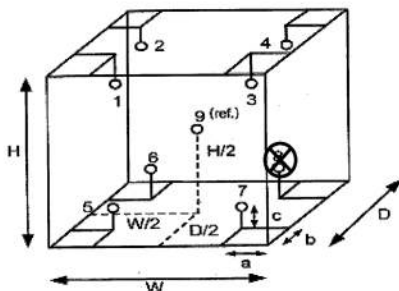
Serial No. : -

ID No. : UAE.WAO.006/2553

Manufacturer : ARCO

Calibration Point : 20.0 °C

Unit Under Calibration Setting : 20.0 °C



รูปภาพเครื่องมือ แสดงจุดที่ได้รับการสอบเทียบ และสัญลักษณ์ ⊗ แสดงจุดห้ามใช้งาน

กำหนดจุดห้ามใช้งานตำแหน่งที่...8.....

หมายเหตุ เก็บใบแน้ม...../.....

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เอกสารไม่ควบคุม



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2404-0004OC-2

Cert. No.: 24TM588
Page : 3 of 3

Result of Calibration :-

(*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
20.0	20.0	19.9	0.47	0.69	1.4	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	20.289	19.835	20.129	19.985	20.190	20.180	20.300	20.457	20.248	0.67

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

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

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

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

UUC* : Unit Under Calibration

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

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

-o0o-

เอกสารไม่ควบคุม

a 1209740



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



Cert. No.: 24TM587
Page : 1 of 3

Certificate of Calibration

Equipment : BOD Incubator

Manufacturer : ARCO

Model : UR-1320

Serial No. : -

ID No. : UAE.WAO.018/2551

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

Location : Lab Floor 2

Received Order : 01 April 2024

Calibration Date : 01 April 2024

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Krisda Malee

Approved by :

() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 5 April 2024

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0065063



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2404-0004OC-1

Cert. No.: 24TM587
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 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	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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

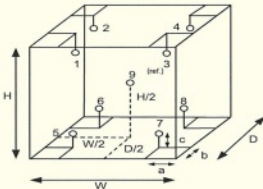
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available



Probe Installation Details :

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

Dimension of Chamber :

D = 0.62 m
W = 1.2 m
H = 1.2 m
Capacity = 0.89 m³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	27	26
REL.Humid. (%)	48	49
AC Supply (Volt)	221	220

Position :	Ref. Std. ID No.:
1	18-18RTD-01
2	18-18RTD-02
3	18-18RTD-03
4	18-18RTD-04
5	18-18RTD-05
6	23-18RTD-06
7	18-18RTD-07
8	22-18RTD-08
9 (ref.)	18-18RTD-09

เอกสารไม่ควบคุม
a 1209743



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2404-0004OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 24TM587
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
20.0	20.0	20.0	0.45	0.55	1.3	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	19.954	20.183	20.235	19.707	19.706	19.739	19.785	19.821	19.828	0.66

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

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

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

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

UUC* : Unit Under Calibration

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

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

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a 1209742



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



Certificate of Calibration

Cert.No.: 24MM292
Page.: 1 of 3

Equipment : Electronic Balance
Manufacturer : Mettler Toledo
Model : AB204-S/FACT
Serial No. : 1129361010
ID No. : UAE.WAS.002/2552
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udornsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Balance Room (108)
Received order : 11 May 2024
Calibration Date : 11 May 2024
Ambient Temperature : 15 °C to 40 °C
Relative Humidity : 30 % to 90 %
Calibrated by : Khitt Ruttanaprapachai
Approved by : [Signature]
() Ponpan Palpim
() Suwit Imjai
(✓) Kunchit Promprat

Issue Date : 15 May 2024

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2405-0166OC-1
Procedure used :-

Cert.No.: 24MM292
Page: 2 of 3

Calibration were conducted using in-house calibration procedure CP-OB01 based on UKAS LAB 14 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-0013-24	25 Jan 2026

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 certificate 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	100.0000	0.0000	0.19	2.03
200	200.0006	-0.0006	0.30	2

After Adjustment :

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

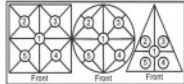
Applied Weight (g)	Standard Deviation of Reading (g)
100	0.00007
200	0.00005

เอกสารไม่ควบคุม



Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2405-0166OC-1
Result of calibration

Cert.No.: 24MM292
Page: 3 of 3



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

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)
-0.0004	-0.0004	-0.0003	-0.0003	-0.0004

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
0.01	0.0100	0.0000	0.15	2.13
0.05	0.0500	0.0000	0.15	2.13
0.1	0.1000	0.0000	0.15	2.13
0.5	0.5000	0.0000	0.15	2.13
1	1.0000	0.0000	0.15	2.13
10	10.0000	0.0000	0.15	2.11
50	49.9999	+0.0001	0.17	2.06
100	99.9999	+0.0001	0.19	2.03
150	149.9998	+0.0002	0.29	2
200	199.9990	+0.0010	0.30	2

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



Cert. No.: 24TM589
Page : 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UF 55
Serial No. : B212.0411
ID No. : UAE.WAO.005/2556
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 : 01 April 2024
Calibration Date : 01 - 02 April 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Krisda Malee
Approved by :
() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 5 April 2024

The Uncertainties are for a confidence probability of approximately 95%

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A 0065065



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2404-0004OC-3
Procedure Used :-

Cert. No.: 24TM589
Page : 2 of 3

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 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	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY57013711	23LM115	TPA	11 Jul 2024

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

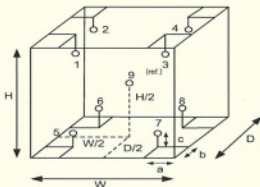
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

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	26
REL.Humid. (%)	47	48
AC Supply (Volt)	221	220

Ref. Std. ID No.: @ Calibration Point		
Position :	(120 to 180) °C	(104) °C
1	21-18TC-01	22-18RTD-2/1
2	21-18TC-02	18RTD-2/2
3	21-18TC-03	18RTD-2/3
4	21-18TC-04	18RTD-2/4
5	21-18TC-05	18RTD-2/5
6	21-18TC-06	18RTD-2/6
7	21-18TC-07	18RTD-2/7
8	21-18TC-08	18RTD-2/8
9 (ref.)	21-18TC-09	18RTD-2/9



Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2404-0004OC-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM589
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	0.032	0.47	0.84	2
120.0	120.0	120.0	0.12	0.72	1.3	2
180.0	180.0	180.0	0.13	1.2	1.5	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
104.0	104.464	103.847	104.226	104.232	104.106	103.691	104.275	104.127	104.013	0.42
120.0	120.486	120.089	120.635	120.596	119.531	119.644	120.364	120.144	120.158	1.1
180.0	180.574	179.769	180.285	180.870	179.594	179.790	180.287	179.961	179.802	1.1

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

Temperature stability : One-half of the greatest maximum difference of measured temperatures 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 1209738



Certificate of Calibration

Cert.No.: 24MM293
Page.: 1 of 3

Equipment : Electronic Balance
Manufacturer : Mettler Toledo
Model : XSR204
Serial No. : C117635043
ID No. : UAE.WAS.012/2564
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Balance Room (108)
Received order : 11 May 2024
Calibration Date : 11 May 2024
Ambient Temperature : 15 °C to 40 °C
Relative Humidity : 30 % to 90 %
Calibrated by : Khiti Ruttanaprapachai
Approved by :
() Nonpan Paipim
() Suwit Imjai
(✓) Kunchit Promprat
Issue Date : 15 May 2024

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2405-0166OC-2
Procedure used :-

Cert.No.: 24MM293
Page: 2 of 3

Calibration were conducted using in-house calibration procedure CP-OB01 based on UKAS LAB 14
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-0013-24	25 Jan 2026

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

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

Range capacity : 0 g to 220 g Resolution 0.0001 g

Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
100	100.0000	0.0000	0.27	2.03
200	200.0001	-0.0001	0.31	2

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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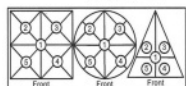
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2405-0166OC-2
Result of calibration

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)
+0.0002	-0.0001	0.0000	+0.0002	0.0000

Cert.No.: 24MM293
Page: 3 of 3



Maximum difference between
off-center and central loading
(g)
0.0003

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
1	1.0000	0.0000	0.15	2.13
5	5.0000	0.0000	0.15	2.13
10	10.0000	0.0000	0.15	2.11
20	20.0000	-0.0000	0.19	2.03
50	50.0001	-0.0001	0.19	2.06
60	60.0001	-0.0001	0.19	2.04
80	80.0001	-0.0001	0.27	2
100	100.0002	-0.0002	0.27	2.03
120	120.0001	-0.0001	0.29	2
200	200.0001	-0.0001	0.31	2

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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Agilent 55 240 280 Series Atomic Absorption Spectroscopy Systems

Preventive Maintenance Checklist

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

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

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

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

Introduction

Customer Information

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



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Important Customer Web Links

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

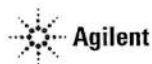
Service Engineer's Responsibilities

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

This information is subject to change without notice.

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Instrument Maintenance

System Information

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

Instrument System Name and ID	
Instrument System Site and Location	UNITED ANALYST AND ENGINEERING CONSULTANT / 2nd Lab FI

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 8432 A	MY 016 0001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

Preparation, Safe operation and Initial performance checks

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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 N/A

Optics components

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

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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

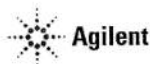
- ☐ Check that external optical surfaces are clean – Clean or replace as required.
- ☐ Use SVD and perform **Mono Wavelength Correction**.
- ☐ Use SVD and perform **Slit Calibration**.
- ☐ Use SVD and perform **Grating Squareness Diagnostic**.
- ☐ Use SVD and perform **Zero Order Offset/Mono Correction**.
- ☐ 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.

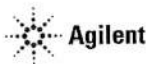
Sample introduction pump system (SIPS) accessory

☒ 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 ⑥ 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

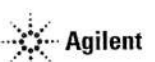
- ☒ If you have altered the customer's instrumentation during the course of PM, restore to the original status to allow the customer to conduct their normal activities (e.g., reload the customer's method.)

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		
Flame optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	44 %
Flame performance test with 5 ppm copper sample		
Air /acetylene, mixing paddle removed	Abs value > 0.5	0.7401 A
Air /acetylene, mixing paddle installed. 10 replicates	%RSD < 1.0	0.5 % RSD
Deuterium furnace optics PMT Gain test		
For copper at 324.8 nm, 4 mA, 0.5 nm slit width	< 55 %	N/A
Deuterium furnace performance test with 25 ppb copper sample (324.8 nm)		
Precision %RSD	≤ 4.0%	N/A
Abs value	≥ 0.15	N/A
Zeeman furnace analytical performance: 25 ppb copper sample (327.4 nm)		
Precision %RSD	≤ 4.0%	N/A
Abs value	≥ 0.10	N/A
MSR%	≥ 70 %	N/A

AA consumable and parts list table

Part Description		Product/Model # where used	PM supplied or Consumable	Instrument-Type
Test Solution - Cu Sppm 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, M7 O-rings, aqueous, complete set	9910093400	50 55 140 240 280	PM supplied	Flame
Organic Kit	9910093500	50 55 140 240 280	PM supplied	Flame
Wire Nebulizer Cleaning	9910024700	50 55 140 240 280	consumable	Flame
Tubing-Capillary Std Nebs	9910024800	50 55 140 240 280	consumable	Flame
Capillary Tube Hivac Neb (3) (organics only)	9910044000	50 55 140 240 280	consumable	Flame
Glass impact beads (5/pk)	9910025700	50 55 140 240 280	consumable	Flame
Teflon impact beads (5/pk): (organics only)	9910053300	50 55 140 240 280	consumable	Flame
Burner cleaning strip (100/pk)	9910053900	50 55 140 240 280	consumable	Flame
Window UV silica - round	2010082600	50 55 140 240 280	PM supplied	Common
Window UV silica - rectangular (left side)	2010082500	50 55 140 240 280	PM supplied	Common
Pad adhesive window (round)	4910012700	50 55 140 240 280	PM supplied	Common
Pad adhesive window (rectangular)	4910012800	50 55 140 240 280	PM supplied	Common
Electrode kit (1 pr) (D2)	6310003400	GTA120	PM supplied	Furnace
Shroud (D2)	6310003100	GTA120	PM supplied	Furnace
Zeeman electrode kit (1 pr)	6310003500	GTA120	PM supplied	Furnace
Zeeman shroud	6310003600	GTA120	PM supplied	Furnace
O-ring PSD rinse bottle	6910025900	PSD120	PM supplied	Furnace

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

Items classified as PM supplied in the above table are included in the standard PM Those classified as consumable should be provided by the customer or charged to the customer if supplied by the Agilent service engineer.

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Service Engineer Comments (optional)

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

Service Completion

Service request number: 6006371115

Agilent signature: [Signature]

Total number of pages in this document: 13

Date service completed: 24 January 2024

Customer signature: [Signature]

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SVD Results Report



Report ID: 1	Diagnostic Start Time: 1/24/2024 9:41:24 AM	Diagnostic End Time: 1/24/2024 10:10:55 AM
Customer:	Service Engineer: Worawit T.	
Address:	Contact Details:	
Instrument Configuration		
Configuration:		
Serial Number: MY13160001	Turret Type: Automatic	
Instrument Model: Varian AA140/240/280	Number Of Lamps: 4	
Flame Instrument: True	Mono Type: Automatic	
Furnace Instrument: True	Gasbox Type: Y Gas Box	
Zeeman Present: False	Auto Burner Adjuster: False	
Internal Zeeman: False	Mains Frequency: 50	
Internal UltraAA: False	Firmware Version: 2.11	
Optics Type: Double Beam	Photomultiplier Type: Normal(900nm)	
D2 BG Correction Fitted: True	PWB Version: 45	
Boot Block Version: 1.09		

EEPROM Data:

Instrument Run Hours: 62609.832	D2 Run Hours: 49136.000
Zero Wavelength Offset: 30.148	D2 Serial Number: not set !
Mono Correction: 0.765	D2 Install Date: 1/1/1970
Flame Hours: 29802.416	D2 Original Intensity: 1.000
	D2 Last Intensity: 475.000

Frequency:

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

Result: Passed

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Power Supply:

Averaging Period: 30.0
Datapoint Count: 20

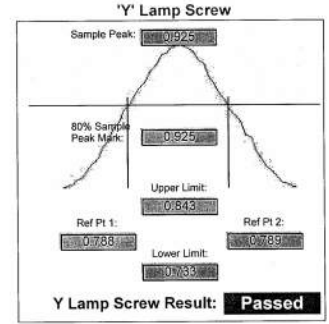
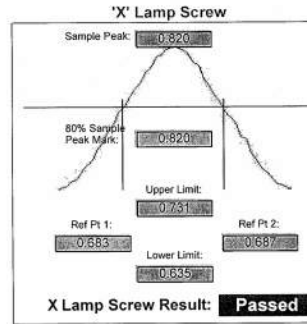
	Lower Limit (V)	Actual (V)	Upper Limit (V)	Result:
12.00 V Rail	10.80	12.19	13.20	Passed
-12.00 V Rail	-13.20	-11.90	-10.80	Passed
5.00 V Rail	4.50	5.05	5.50	Passed
310.00 V Rail	279.00	320.00	341.00	Passed

Optics

Beam Balance:

Lamp Type: Copper
Lamp Socket Used: 3

Peak Selected: 324.80
Lamp Alignment: Performed



Grating Squareness:

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

	Lower Limit (nm)	Actual (nm)	Upper Limit (nm)	Result:
Zero Order	-0.10	0.00	0.10	Passed
First Order	324.45	324.75	325.15	Passed
Second Order	649.23	649.52	649.97	Passed

Wavelength Repeatability:

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

Lamp Alignment: Performed

Lower Limit(nm) 324.768	324.888	Upper Limit(nm)
(Approach from Zero Order)	(Approach from end)	
Sample 1: 324.828	Sample 2: 324.828	
Sample 3: 324.828	Sample 4: 324.823	
Sample 5: 324.823	Sample 6: 324.823	
Sample 7: 324.823	Sample 8: 324.823	
Sample 9: 324.823	Sample 10: 324.823	

Mean: 324.825

Standard Deviation: 0.002

Result: Passed

Mechanical

Wavelength Drive:

Passed

Slit Drive:

Passed

Turret Drive:

Passed

Auto Burner Adjuster Drive:

Untested

Miscellaneous

Signal Processing Linearity:

Calculate Mode: New Calc Mode

	Lower Limit	Actual	Upper Limit	Result:
S0	114	261	297	Passed
S1	156	165	191	Passed
S2	271	296	332	Passed
S3	474	507	579	Passed
S4	825	918	1008	Passed
S5	1435	1528	1754	Passed
S6	2498	2769	3053	Passed
S7	4347	4752	5313	Passed

Interlocks:

Burner Fitted: Working	Flame Detect: Working
N2O Burner Fitted: Untested	GCU Active: Working
Flame Shield Closed: Working	Oxidant Pressure: Working
Gas Control Fitted: Untested	Oxidant Changeover: Untested
Pressure Release Bung Fitted: Working	Ignition: Working
Liquid Trap Fitted: Working	

Auto Lamp Recognition:

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

Result: Passed

GTA Temperature Monitoring:

Not Performed

Notes:

PM 24 Jan 2024

Signatures:

[Signature]

24/1/24
Date

[Signature]

Worawit T.
Date

24/1/24
Date

Report Generated At: 1/24/2024 10:11:18 AM

6

SVD Results Report

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เอกสารไม่ควบคุม

Sequential by time report

1/24/2024 11:46 AM
Page 1 of 1

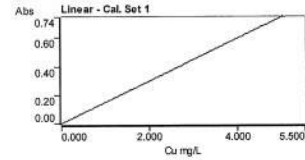
SpectraAA

Analyst
Date Started 1/24/2024 11:39 AM GMT: 1/24/2024 4:39 AM
Worksheet Cu 5 PPM Sense check
Comment
Methods Cu
Computer name DESKTOP-RSUFIRS
Serial Number: MY13160001

Method: Cu (Flame)

Sample ID	Conc mg/L	%RSD	Mean Abs
CAL ZERO	0.000	55.0	0.0003
Readings	0.0002	0.0002	0.0004

STANDARD 1	5.000	1.7	0.7419
Readings	0.7274	0.7515	0.7468



Curve Fit = Linear
Characteristic Conc = 0.028 mg/L
r = 1.0000
Calculated Conc = 0.000 5.000
Residuals = 0.000 0.000

Abs = 0.14833 x C + 0.00025

Sample 001	4.988	0.7	0.7401
Readings	0.7454	0.7399	0.7349

Sequential by time report

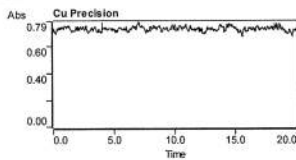
1/24/2024 11:50 AM
Page 1 of 1

SpectraAA

Analyst
Date Started 1/24/2024 11:47 AM GMT: 1/24/2024 4:47 AM
Worksheet Cu 5 PPM Precision
Comment
Methods Cu
Computer name DESKTOP-RSUFIRS
Serial Number: MY13160001

Method: Cu (Flame)

Sample ID	Exp Abs	%RSD	Mean Abs
Cu Precision	0.723	0.5	0.7232
Readings	0.7221	0.7196	0.7226
	0.7201	0.7213	0.7266



Agilent
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From Insight to Outcome

Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES
Preventive Maintenance

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

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

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

เอกสารไม่ควบคุม

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Introduction

Customer Information

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

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Important Customer Web Links

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

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Service Engineer's Responsibilities

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

เอกสารไม่ควบคุม

Instrument Maintenance

System Information

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

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

List System Component Product Numbers	List the Serial Numbers of each Component
1. G 8013A	77 16030001
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	

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

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Preparation

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

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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

เอกสารไม่ควบคุม

Preventive Maintenance Procedures

Record Pre-PM instrument performance

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

Clean and inspect ICP-OES system

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

Agilent Water Recirculator

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

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ICP-OES adjustment

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

Record Post-PM instrument performance

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

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Restore Instrument

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

Service Review

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

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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	0.84 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	7.00 L/min
RF Power	No measurement	1199.5 W
RF Supply Current	No measurement	8.223 A
RF Supply Voltage	No measurement	1944.81 V

*1 If option installed

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Test Results

Instrument Performance Test Results Table

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

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	4190.3	6849.9	4700.8	7564.2
Mn 257.610 nm SRBR	13681.0	27295.3	14569.1	29992.5
Al 396.152 nm SBR	12.1	14.6	11.3	13.6
K 766.491 nm SBR	8.0	31.2	7.4	39.7

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

Instrument Test Results Table

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

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

เอกสารไม่ควบคุม

Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Agilent Cool Clear Coolant Fluid	5799-0037	Agilent Water Recirculator	-
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	-
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	-
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	-
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	-
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	-
PVC waste tubing, 8mm od x 5mm id, 2m	G8410-80122	SPS 4	-
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047500	SPS 3	-
Z axis drive belt	5410047400	SPS 3	-
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	-

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

☐ Section Not Applicable

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

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Signature Page

Service Engineer Comments (optional)

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

Service Verification

Service Request Number:

600637120

Date Service Completed:

15 Nov 2023

Service Engineer Name:

Customer Name:

Service Engineer Signature:

Customer Signature:

Total number of pages in this document:

14

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

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

Resolution Test

Pass

Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	6.92
As (188.980 nm)	≤ 8.20	6.12
C (193.027 nm)	≤ 11.50	8.31
Mo (202.032 nm)	≤ 8.20	6.35
Cr (206.158 nm)	≤ 13.40	8.99
Zn (213.857 nm)	≤ 8.70	6.64
Pb (220.353 nm)	≤ 9.50	7.06
Co (228.615 nm)	≤ 17.20	11.68
Ba (230.424 nm)	≤ 9.40	7.27
Mn (257.610 nm)	≤ 13.30	9.46
Mn (260.568 nm)	≤ 20.30	14.18
Cr (267.716 nm)	≤ 11.00	8.01
Cu (324.754 nm)	≤ 25.00	18.89
Cu (327.395 nm)	≤ 14.20	11.29
Sr (338.071 nm)	≤ 33.50	24.46
Ba (455.403 nm)	≤ 44.00	33.62
Sr (460.733 nm)	≤ 36.00	17.37
Ba (493.408 nm)	≤ 36.00	25.47
Ba (614.171 nm)	≤ 42.00	25.43
Ar (675.283 nm)	≤ 74.00	60.50
K (766.491 nm)	≤ 80.00	65.33

เอกสารไม่ควบคุม

Sensitivity Test

Fail

Radial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	142.0	958.5	41.7
Se (196.026 nm)	≥ 41.0	SRBR	105.9	937.4	67.5
Zn (213.857 nm)	≥ 1421.0	SRBR	4190.3	44372.5	111.6
Pb (220.353 nm)	≥ 46.0	SRBR	213.9	2521.3	125.4
Mn (257.610 nm)	≥ 3518.0	SRBR	13681.0	279651.7	416.6
Al (396.152 nm)	≥ 3.4	SBR	12.1	52269.7	3994.3
Ba (493.408 nm)	≥ 34.0	SBR	185.8	2294372.8	12280.0
K (766.491 nm)	≥ 1.8	SBR	8.0	107401.4	11876.7
Axial					
Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	189.4	2285.0	129.5
Se (196.026 nm)	≥ 159.0	SRBR	168.7	2813.7	233.8
Zn (206.200 nm)	≥ 234.0	SRBR	905.0	10158.4	123.0
Zn (213.857 nm)	≥ 1743.0	SRBR	6849.9	135760.6	390.5
Cd (214.439 nm)	≥ 4227.0	SRBR	5597.6	92921.3	273.9
Pb (220.353 nm)	≥ 320.0	SRBR	454.8	10111.2	451.1
Mn (257.610 nm)	≥ 10625.0	SRBR	27295.3	1126118.1	1697.0
Cr (267.716 nm)	≥ 1048.0	SRBR	3948.2	144875.3	1322.0
Cu (324.754 nm)	≥ 19.0	SBR	49.2	341489.7	6798.2
Al (396.152 nm)	≥ 6.0	SBR	14.6	235321.6	15043.9
Ba (493.408 nm)	≥ 60.0	SBR	183.3	8393101.3	45538.3
K (766.491 nm)	≥ 24.0	SBR	31.2	1447045.2	44917.1

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 (206.200 nm)	≤ 1.50	0.59	
Zn (213.857 nm)	≤ 1.50	0.46	
Cd (214.439 nm)	≤ 1.50	0.70	
Pb (220.353 nm)	≤ 1.50	0.36	
Mn (257.610 nm)	≤ 1.50	0.95	
Cr (267.716 nm)	≤ 1.50	0.56	
Cu (324.754 nm)	≤ 1.50	0.69	
Al (396.152 nm)	≤ 1.50	0.63	
Ba (493.408 nm)	≤ 1.50	0.86	
K (766.491 nm)	≤ 1.50	1.13	

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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	
	Pass
Intensity	Radial 3522064 Axial 4003312
Wavelength	Radial 737.212 Axial 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 (614.171 nm)	≤ 42.00	25.27	
Ar (675.283 nm)	≤ 74.00	56.87	
K (766.491 nm)	≤ 80.00	65.88	

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เอกสารไม่ควบคุม

Sensitivity Test						Pass
Radial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 46.0	SRBR	168.6	1284.6	53.3	
Se (196.026 nm)	≥ 41.0	SRBR	122.4	1256.0	90.7	
Zn (213.857 nm)	≥ 1421.0	SRBR	4700.8	53870.1	130.7	
Pb (220.353 nm)	≥ 46.0	SRBR	236.0	3100.6	155.7	
Mn (257.610 nm)	≥ 3518.0	SRBR	14569.1	318398.1	476.2	
Al (396.152 nm)	≥ 3.4	SBR	11.5	59510.5	4761.6	
Ba (493.408 nm)	≥ 34.0	SBR	170.6	2490835.6	14514.2	
K (766.491 nm)	≥ 1.8	SBR	7.4	117698.7	14024.1	
Axial						
Element Wavelength	Specification	Method	Ratio	Standard	Blank	
As (188.980 nm)	≥ 208.0	SRBR	214.5	2706.2	142.8	
Se (196.026 nm)	≥ 159.0	SRBR	188.0	3262.8	255.9	
Zn (206.200 nm)	≥ 234.0	SRBR	1088.2	12794.8	135.3	
Zn (213.857 nm)	≥ 1743.0	SRBR	7564.2	156883.9	427.8	
Cd (214.439 nm)	≥ 4227.0	SRBR	6647.3	116281.7	304.4	
Pb (220.353 nm)	≥ 320.0	SRBR	519.3	12490.2	530.3	
Mn (257.610 nm)	≥ 10625.0	SRBR	29992.5	1305852.5	1890.2	
Cr (267.716 nm)	≥ 1048.0	SRBR	4366.6	173343.4	1547.9	
Cu (324.754 nm)	≥ 19.0	SBR	46.8	361093.0	7560.5	
Al (396.152 nm)	≥ 6.0	SBR	15.6	274029.5	16498.6	
Ba (493.408 nm)	≥ 60.0	SBR	203.6	9028914.5	44122.1	
K (766.491 nm)	≥ 24.0	SBR	39.7	1701521.4	41771.8	

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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		

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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.0-2719-9484




Certificate of Calibration

Cert. No.: 24TM648
Page : 1 of 3

Equipment : Incubator

Manufacturer : Memmert

Model : IPP 260

Serial No. : V615.0187

ID No. : UAE.MIC.003/2559

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

Location : Microbiology Laboratory

Received Order : 01 April 2024
Calibration Date : 01 April 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by : 
() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 7 April 2024

The Uncertainties are for a confidence probability of approximately 95%

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เอกสารไม่ควบคุม



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2404-0003OC-1

Cert. No.: 24TM648
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 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	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY49023932	23LM122	TPA	26 Jul 2024

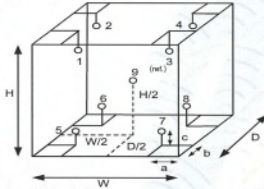
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

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

Dimension of Chamber :

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

Environment during calibration		
	Beginning	Finished
Temp. (°C)	24	24
REL.Humid. (%)	54	57
AC Supply (Volt)	221	223

Position :	Ref. Std. ID No.:
1	19-16RTD-01
2	19-16RTD-02
3	19-16RTD-03
4	19-16RTD-04
5	19-16RTD-05
6	19-16RTD-06
7	21-16RTD-07
8	19-16RTD-08
9 (ref.)	19-16RTD-09



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2404-0003OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM648
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
35.0	35.0	35.0	0.028	0.13	0.24	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
35.0	34.908	35.004	34.989	35.099	35.069	35.095	34.921	34.936	35.002	0.30

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

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

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

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

UUC* : Unit Under Calibration

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

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
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TEL.0-2717-3000-29 FAX.0-2719-9484



Certificate of Calibration

Cert. No.: 24TM650
Page : 1 of 3

Equipment : Incubator
Manufacturer : Memmert
Model : IPP 260
Serial No. : V616.0066
ID No. : UAE.MIC.032/2559
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory (302)
Received Order : 01 April 2024
Calibration Date : 02 - 03 April 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Man Pattanapongpaiboon

Approved by :

() Ponpan Paipim
(✓) Suwit Imjai
() Kunchit Promprat

Issue Date : 7 April 2024

The Uncertainties are for a confidence probability of approximately 95%

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Equipment : Incubator
Condition As-Received : Used Item
Reference : 2404-0003OC-2

Cert. No.: 24TM650
Page : 2 of 3

Procedure Used :-

Calibration were conducted using calibration procedure CP-OT02 based on TLAS G-20 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	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY49023932	23LM122	TPA	26 Jul 2024

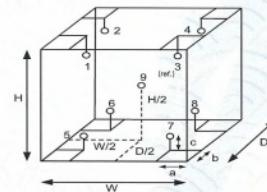
2. This certificate is valid only to the item calibrated on date and place of calibration.
3. This certification is traceable to the International System of Unit.

Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Close



Probe Installation Details :

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

Dimension of Chamber :

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

Environment during calibration		
	Beginning	Finished
Temp. (°C)	25	25
REL.Humid. (%)	57	54
AC Supply (Volt)	221	222

Position :	Ref. Std. ID No.:
1	19-16RTD-01
2	19-16RTD-02
3	19-16RTD-03
4	19-16RTD-04
5	19-16RTD-05
6	19-16RTD-06
7	21-16RTD-07
8	19-16RTD-08
9 (ref.)	19-16RTD-09

เอกสารไม่ควบคุม



Equipment : Incubator
Condition As-Received : Used Item
Reference : 2404-0003OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 24TM650
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
25.0	25.0	25.0	0.053	0.78	1.3	2
36.0	36.0	36.0	0.14	0.57	0.93	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
25.0	25.596	25.310	25.439	25.412	24.347	24.332	24.313	24.414	24.875	0.30
36.0	35.843	35.965	35.618	35.701	36.239	36.260	36.343	36.357	36.063	0.31

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

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

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

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

UUC* : Unit Under Calibration

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

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

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



Cert. No.: 24TM29
Page : 1 of 3

Certificate of Calibration

Equipment : Water Bath
Manufacturer : Memmert
Model : WNE 14
Serial No. : L416.0606
ID No. : UAE.MIC.002/2560
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory
Received Order : 10 February 2024
Calibration Date : 10 February 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Krisda Malee

Approved by : 
Approved Signatory

() Pornthippa Tameyakul
(✓) Unnopphol Harachai
() Suwit Imjai

Issue Date : 19 February 2024

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.



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2402-0232OC-2

Cert. No.: 24TM29
Page : 2 of 3

Procedure Used :-

Calibration were conducted using in-house calibration procedure CP-OT04 Based on ASTM E715 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPRT).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY49001451	23LM27	TPA	25 Feb 2024

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

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

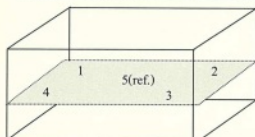
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply (Volt)
	(°C)	(%R.H.)	
Beginning of Calibration	26	51	220
Finished of Calibration	25	50	221



Front

Position :	Ref. Std. ID No.:
1	N37P301419
2	N37P300732
3	N37P301420
4	N37P301421
S(ref.)	N37P301425



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2402-0232OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 24TM29
Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)					Uncertainty (± °C)
			1	2	3	4	5 (ref.)	
44.5	44.4	44.4	44.508	44.469	44.502	44.521	44.527	0.15

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
44.5	0.15	0.074	2

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

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

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

UUC* : Unit Under Calibration

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

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

-o0o-



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



Cert. No.: 24TM30
Page: 1 of 3

Certificate of Calibration

Equipment : Water Bath
Manufacturer : Memmert
Model : WNE 14
Serial No. : L416.0612
ID No. : UAE.MIC.003/2560
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udumsuk 41, Sukhumvit Road,
Bangchak, Phrakhanong,
Bangkok 10260
Location : Microbiology Laboratory
Received Order : 10 February 2024
Calibration Date : 10 February 2024
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %
Calibrated by : Krisda Malee
Approved by :
() Pornthippa Tameyakul
(✓) Unnopphol Harachai
() Suwit Imjai
Issue Date : 19 February 2024

The Uncertainties are for a confidence probability of approximately 95%

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



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2402-0232OC-3
Procedure Used :-

Cert. No.: 24TM30
Page : 2 of 3

Calibration were conducted using in-house calibration procedure CP-OT04 Based on ASTM E715 according to direct measurement method with Data Acquisition which connected with Industrial Platinum Resistance Thermometer (IPRT).

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

Instrument	Serial No.	Cert. No.	Traceable	Due Date
1) Data Acquisition	MY49001451	23LM27	TPA	25 Feb 2024

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

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

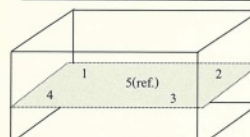
Remark : TPA : Technology Promotion Association (Thailand - Japan)

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Heat transfer medium used : Water

	Environmental		AC Voltage Supply
	(°C)	(%R.H.)	(Volt)
Beginning of Calibration	24	54	221
Finished of Calibration	26	55	220



Front

Position :	Ref. Std. ID No.:
1	N37P301419
2	N37P300732
3	N37P301420
4	N37P301421
S(ref.)	N37P301425



Equipment : Water Bath
Condition As-Received : Used Item
Reference : 2402-0232OC-3
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source

Cert. No.: 24TM30
Page : 3 of 3

Calibration point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Average* Standard Reading (°C)					Uncertainty (± °C)
			1	2	3	4	5 (ref.)	
44.5	44.6	44.6	44.491	44.463	44.496	44.518	44.528	0.15

Calibration point (°C)	Uniformity (°C)	Stability (± °C)	Coverage Factor k
44.5	0.12	0.059	2

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

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

Stability : One-half of the greatest maximum difference of measured temperature at any one probe.

UUC* : Unit Under Calibration

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

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

-o0o-



Certificate of Calibration

Equipment : Balance
Model : PX623
Serial No. (or ID.): C236754745 (UAE.MIC.055/2565)
Manufacturer : Ohaus
Condition : In condition

Certificate No.: C01234158
Issued Date: 08 December 2023
Job No.: WO-00011251
Page: 1 of 3

Customer : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udumsuk 41, Sukhumvit Road, Bangchak Sub-District,
Phrakhanong District, Bangkok, THAILAND 10260

Environment Condition : Temperature 25 °C ± 0.5 °C
Humidity 54 %RH ± 1.7 %RH

Calibration Place : United Analyst and Engineering Consultant Co., Ltd. (301 Microbiology Room)
3 Soi Udumsuk 41, Sukhumvit Road, Bangchak Sub-District,
Phrakhanong District, Bangkok, THAILAND 10260

Calibration By : Mr. Adisai Maknoi

Calibration Date : 07 December 2023

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

Traceability : This certificate is traceable to the SI Units maintained by National Institute of Metrology (NIMT), Thailand through DKSH Technology Co., Ltd. Certificate No. C02222534

(Mr. Adisai Maknoi)

Person in charge

(Mr. Rungrod Jenkitrakulchai)

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.

บริษัท เทคโนโลยีการบริการ จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองตัน เขตคลองเตย กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/certification-thailand

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เอกสารไม่ควบคุม

CAL-FM-C01-14: 12 Sep 2022

Calibration Results:

Before Adjustment

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

			Nominal Test Value	200	(g)
Reference Points (g)					
A	B	C	D	E	
-	0.000	-0.003	0.000	0.001	

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.001 (g)




Nominal test value (g)	Standard Deviation
50	0.0006
500	0.0008

Error of Indication from nominal or conventional mass value., Readability 0.001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.0000	1.000	0.000	0.0013	2.10
5	5.0001	5.000	0.000	0.0013	2.10
10	10.0001	10.001	0.001	0.0013	2.10
20	20.0000	20.000	0.000	0.0013	2.09
50	50.0001	50.000	0.000	0.0013	2.09
100	100.0001	100.001	0.001	0.0013	2.09
200	200.0004	200.002	0.002	0.0014	2.07
300	300.0005	300.002	0.002	0.0015	2.05
400	400.0006	400.004	0.003	0.0016	2.03
500	500.0006	500.008	0.007	0.0019	2.02
600	600.0007	600.009	0.008	0.0021	2.01

After Adjustment

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

			Nominal Test Value	200 (g)					
Reference Points (g)									
A	B	C	D	E					
-	0.001	-0.002	-0.002	0.001					

Repeatability: Determination of the standard deviation of weighing balance., Readability 0.001 (g)

Nominal test value (g)	Standard Deviation
50	0.0006
500	0.0008

Error of Indication from nominal or conventional mass value., Readability 0.001 (g)

Nominal Value (g)	Conventional Mass (g)	Displayed Value (g)	Error of Indication (g)	Uncertainty (g)	k
1	1.0000	1.000	0.000	0.0013	2.10
5	5.0001	5.000	0.000	0.0013	2.10
10	10.0001	10.000	0.000	0.0013	2.10
20	20.0000	20.000	0.000	0.0013	2.10
50	50.0001	50.000	0.000	0.0013	2.10
100	100.0001	100.000	0.000	0.0014	2.09
200	200.0004	200.000	0.000	0.0014	2.07
300	300.0005	300.001	0.001	0.0015	2.05
400	400.0006	400.002	0.001	0.0017	2.04
500	500.0006	500.001	0.000	0.0019	2.02
600	600.0007	600.002	0.001	0.0021	2.01

The End of Certificate

Statements of conformity:

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

The error of indication determined during calibration are under given measurement and environmental conditions and considering the expanded measurement uncertainty (coverage probability 95%) within the specification. The given measurement uncertainty already includes other all effects by according to the standard method, UKAS Lab14. Therefore, those parameters have not been assessed separately.

Tolerance and Decision rules:

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

- Decision rule :** ☐ Choice A Binary Statement for Simple Acceptance Rule ($w = 0$), Specific Risk < 50% PFA.
☒ Choice B Non-binary statement with guard band ($w = 1 U$), Pass or Fail Specific Risk < 2.5% PFA and Condition Pass or Condition Fail Specific Risk < 50% PFA.
☐ Choice C Customer defined, Customers may define arbitrary multiple of r to have applied as guard band ($w = r U$).
; PFA - Probability of False Accept

(Mr. Rungrod Jenkitrakulchai)

Authorized signatory

Statements of conformity:

Before Adjustment

Readability: 0.001 g

Nominal Value (g)	Error of indication (g)	Guard band (w) (g)	Tolerance (±) (g)	Conformity
1	0.000	0.0013	0.002	Pass
5	0.000	0.0013	0.010	Pass
10	0.001	0.0013	0.020	Pass
20	0.000	0.0013	0.040	Pass
50	0.000	0.0013	0.100	Pass
100	0.001	0.0013	0.200	Pass
200	0.002	0.0014	0.400	Pass
300	0.002	0.0015	0.600	Pass
400	0.003	0.0016	0.800	Pass
500	0.007	0.0019	1.000	Pass
600	0.008	0.0021	1.200	Pass

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

Statements of conformity:

After Adjustment

Readability: 0.001 g

Nominal Value g	Error of indication g	Guard band (w) g	Tolerance (±) g	Conformity
1	0.000	0.0013	0.002	Pass
5	0.000	0.0013	0.010	Pass
10	0.000	0.0013	0.020	Pass
20	0.000	0.0013	0.040	Pass
50	0.000	0.0013	0.100	Pass
100	0.000	0.0014	0.200	Pass
200	0.000	0.0014	0.400	Pass
300	0.001	0.0015	0.600	Pass
400	0.001	0.0017	0.800	Pass
500	0.000	0.0019	1.000	Pass
600	0.001	0.0021	1.200	Pass

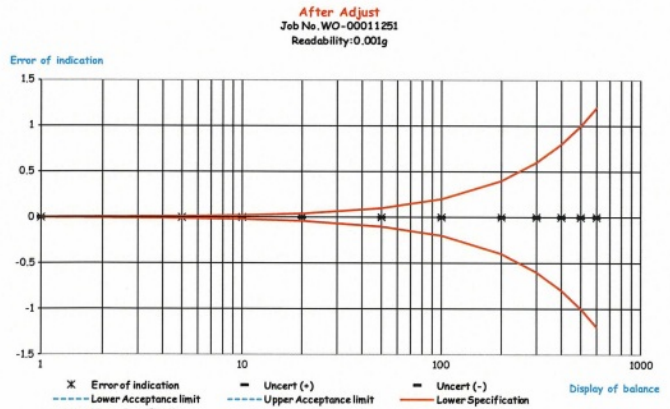
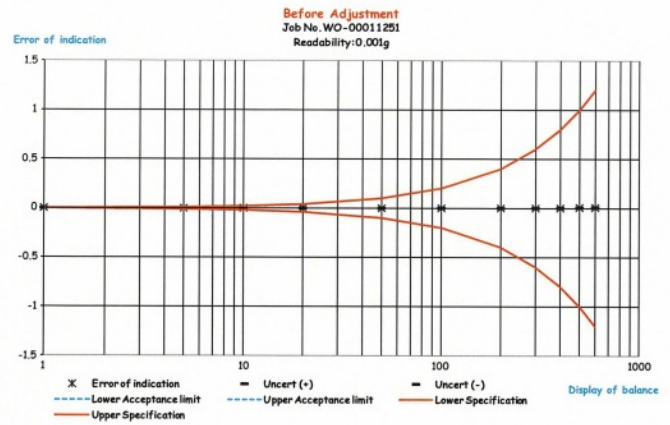
The validity of the statements of conformity cannot be guaranteed for different places of use, environmental conditions or improper use.

The End of Statements of conformity

บริษัท ดีเคเอส อีซี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
Phone: +66 2039 7000 Email: info.asia@dksh.com Website: www.dksh.com/identifio-thailand
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เอกสารไม่ควบคุม

CAL-FM-C01-14: 12 Sep 2022



เอกสารไม่ควบคุม

ใบตรวจสอบสภาพเครื่องชั่ง

เลขที่ใบงาน: WO-00011251

ชนิดเครื่องมือ: Balance

รุ่น: PX623

หมายเลขเครื่อง: C236754745

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
07 Dec 2023			07 Dec 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. สายไฟ/Adapter, power supply 220/110V	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสมบูรณ์ชุดกระดกกันลม (Cover)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. ความสมบูรณ์ชุดของระดับน้ำ	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. การปรับระดับของขาตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. การตอบสนองของปุ่มกด	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	6. ความสมบูรณ์ของ Display	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	7. การแสดงผลของ Display หลังวางน้ำหนัก	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ชุดรองจานชั่ง (Stopper) / pan support	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	9. การทำงานของ Function Internal / External	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. ความสะอาดตัวเครื่องภายในและนอก load cell	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. สภาวะแวดล้อม ณ สถานที่ตั้งเครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	

หมายเหตุเพิ่มเติม/ข้อแนะนำ:

Mr. Adisai Maknoi
Service Engineer

บริษัท ดีเคเอส อีซี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10260
Phone: +66 2039 7000 Email: info.asia@dksh.com Website: www.dksh.com/identifio-thailand
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เอกสารไม่ควบคุม

Calibration Certificate

Certificate No.: 2402281-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhonong, Bangkok 10260

Page 1 of 3

Equipment: Autoclave
Manufacturer: ALP
Model: CL-40L
Serial No.: 808763
ID No.: UAE.MIC.026/2563
Order No.: 2402281
Operation No.: 2402281-001
Date of Receipt: 2 April 2024
Date of Calibration: 2 April 2024

Calibrated by Mr.Jerawut Prapawuttipong Scientist Approved by (Mr.Pheraphat Tuanjit) Manager, Division of Calibration Laboratory Responsible for the Technical Management Team
Date of Issue: 9 April 2024

The uncertainties are for a confidence probability of approximately 95 %.
This Certificate is issued in accordance with the conditions of accreditation granted by the Thai Laboratory Accreditation scheme which has assessed the measurement capability of the laboratory and its traceability to recognized national standards and to the units of measurement realized at the corresponding national standards laboratory. This certificate may not be reproduced other than in full except with the prior written approval of the National Food Institute.
F-CS-009 Revision: 01 Date: 20-04-65

เอกสารไม่ควบคุม

nfiorth

Calibration Report

Certificate No.: 2402281-001-01
Equipment: Autoclave
Model: CL-40L Serial No.: 808763
Resolution: 0.1 °C ID No.: UAE.MIC.026/2563
Manufacturer: ALP
Date of Calibration: 2 April 2024

Page 2 of 3

Location: LABORATORY, UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.
Environment Condition: Ambient Temperature (25 ± 1) °C
Relative Humidity (55 ± 7) %
Line Voltage (225 ± 5) Volt

Condition of this results of Calibration:

- This instrument was calibrated by insert 3 standard temperature recorder with RTD into its autoclave and calibration according to W-TE-018 based on BS 2646-1(2021) : Autoclaves for sterilization in laboratories Design, construction, safety and performance Specification.
- The temperature scale used was based on ITS - 90 .
- All data show below were final values and the initial data may be obtained upon request.

2. Reference Standard Instrument :

Instrument	Model	Serial No.	Certificate No.	Due Date	Through
Digital Thermometer with RTD (Data Logger)	HiTemp140-2	R54918	TE 660383-01	8 April 2024	NATIONAL FOOD INSTITUTE
	HiTemp140-2	S25601	TE 670033-01	9 November 2024	MADGETECH INC.
	HiTemp140-2	S25602	TE 670034-01	9 November 2024	MADGETECH INC.

- This certificate is traceable to International System of Units (SI Units).
- This certificate was certified only for the instrument we calibrated.
- This result of calibration was found accurate as shown on date and place of calibration only.
- This standard does not apply to sterilizers or disinfectors used for medical, dental, pharmaceutical.
- Condition of Calibrated item : Good

UUC Description : Setting program function sterilization : STERILIZE/NORMAL
Time of sterilization 15 Minute At 115.0 aand 121.0 °C

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

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

Calibration Report

Certificate No.: 2402281-001-01
Equipment: Autoclave
Model: CL-40L Serial No.: 808763
Resolution: 0.1 °C ID No.: UAE.MIC.026/2563
Manufacturer: ALP
Date of Calibration: 2 April 2024

Page 3 of 3

Calibration point: 115.0 aand 121.0 °C

Calibration result:

Calibration Condition	Temperature (°C)	Relative Humidity (%)	Line Voltage (Volt)
Min	24.4	48.6	220
Max	25.5	62.1	230

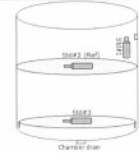


Table1 : Reporting of Temperature

Calibration Point (°C)	Measured Temperature (°C) @ Sensor No. (Sensor No.2 is REF)			Uncertainty ± (°C)
	Std.# 1	Std.# 2 (Ref)	Std.# 3	
115.0	115.28	115.35	115.38	0.64
121.0	121.28	121.36	121.37	0.64

Table 2 : Reporting of Characterization Result

UUC* Setting (°C)	UUC* Reading				Stability ± (°C)	Uniformity (°C)	Overall Variation (°C)
	Min (°C)	Max (°C)	Average (°C)	MPa			
115.0	115.0	115.1	115.0	0.08	0.19	0.13	0.48
121.0	121.0	121.1	121.0	0.12	0.17	0.10	0.38

Note

The quoted uncertainty include * Stability * and * Loading effect (20% of Uniformity)"

UUC* = Unit Under Calibration

Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors, for at least half an hour after reaching steady state.

Uniformity = The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.

Overall Variation = The difference of the maximum and minimum measured temperatures throughout observation time.

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

***** End *****

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