ภาคผนวก ฏ
เอกสารสอบเทียบเครื่องมือ



List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM_{10})	Thermo Scientific	G25A 1270	Jiranatee Associates Co., Ltd.	CO-004-66	12 Jun 23	11 Jun 24	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM_{10})	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	23P1401	9 May 23	8 May 24	-
3	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM_{10})	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	23P1855	2 Jun 23	1 Jun 24	-
4	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	-
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1201778106	UAE Consultant Co.,Ltd.	24012023	24 Jan 23	23 Jan 24	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM22387035	UAE Consultant Co.,Ltd.	09012023	9 Jan 23	8 Jan 24	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i CM22387036	UAE Consultant Co.,Ltd.	22032023	22 Mar 23	21 Mar 24	-
8	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
9	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1201778112	UAE Consultant Co.,Ltd.	07032023	4 Apr 23	3 Apr 24	-
10	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1201778115	UAE Consultant Co.,Ltd.	09022023	9 Feb 23	8 Feb 24	-
11	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1201778114	UAE Consultant Co.,Ltd.	03052023	3 May 23	2 May 24	-
12	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
13	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201778117	UAE Consultant Co.,Ltd.	21022023	21 Feb 23	20 Feb 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									
14	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201778118	UAE Consultant Co.,Ltd.	20032023	20 Mar 23	19 Mar 24	-
15	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1201497730	UAE Consultant Co.,Ltd.	03042023	3 Apr 23	2 Apr 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 2111DR0052	Thai Meteorological Department	178/23	10 Apr 23	9 Apr 24	-
18	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2111DT0058	Thai Meteorological Department	162/23	11 Apr 23	10 Apr 24	-
19	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2205DT0114	Thai Meteorological Department	163/23	17 Apr 23	16 Apr 24	-
20	Carbon Dioxide Analyzer	Carbon Dioxide	Teledyne API	360E 145	UAE Consultant Co.,Ltd.	04072023	14 Jul 23	13 Jul 24	-
21	Carbon Dioxide Analyzer	Carbon Dioxide	Teledyne API	410i 1162850027	UAE Consultant Co.,Ltd.	04072023	14 Jul 23	13 Jul 24	-
22	Carbon Dioxide Analyzer	Carbon Dioxide	Teledyne API	410i 1191543060	UAE Consultant Co.,Ltd.	28072523	28 Jul 23	27 Jul 24	-
23	Standard Gas	Carbon Dioxide	Linde	3805/21 90167449	Linde	145168	1 Sep 21	31 Aug 25	-
24	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV35 44783	Innovative Instrument Co.,Ltd.	23-ACT-114	4 Aug 23	3 Aug 24	-
25	Sound Level Meter	$L_{Aeq\ 24\ hours}$, L_{Amax}, L_{A90}, L_{Adn} Annoyance Noise	Larson Davis	LxT1 0007311	Larson Davis-A PCB Piezotronics Div.	2023003675	24 Mar 23	23 Mar 25	-
26	Sound Level Meter	$L_{Aeq\ 24\ hours}$, L_{Amax}, L_{A90}, L_{Adn} Annoyance Noise	Larson Davis	LxT1 0007312	Larson Davis-A PCB Piezotronics Div.	2023003676	24 Mar 23	23 Mar 25	-

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
27	Sound Level Meter	$L_{Aeq\ 24\ hours}$, L_{Amax}, L_{A90}, L_{Adn} Annoyance Noise	Larson Davis	LxT1 0007313	Larson Davis-A PCB Piezotronics Div.	2023002738	24 Mar 23	23 Mar 25	-

JIRANATEE ASSOCIATES CO.,LTD.

Jiranatee Associates Co.,Ltd
63/14-15, 67/35-36
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Bangkok 10600(Thailand)
Tel: +6608680812
Mobile: +66863999453
E-mail: jnac-calibration@jiranatee.com
Web site: www.jiranatee.com

Accredited calibration laboratory
ISO/IEC 17025:2017
NSC-TISI-TIS 17025
CALIBRATION 0367

Flow measurement laboratory
Calibration services department.

NSC – TISI – TIS 17025
CALIBRATION 0367

CERTIFICATE OF CALIBRATION

Certificate No. : CO-004-66

MEASUREMENT ITEM : Top Load Orifice
MANUFACTURER : Andersen Instruments
MODEL/TYPE : G25A
SERIAL NUMBER : 1270
ID NUMBER : UAE.ANV.009/2542
CONDITION AS-RECEIVED : Used item
CUSTOMER : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong,
Bangkok 10260

RECEIVED DATE : 02 Jun 2023
MEASUREMENT DATE : 12 Jun 2023
ISSUE DATE : 12 Jun 2023

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 23.3 °C and 55.0%RH.

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

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

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

Traceability:
This certificate provides a traceability of The measurement to recognized the national standards, and to realization of the international system of units (SI) through the VSL (National Metrology Institute of Netherlands) via Certificate number: G2211901

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. Sorawit Thachalad
☑ Miss Jittraporn Lertsomphol

Approved signatory:
Mr. Parinya Booncharoen
Calibration Department Manager

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

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JIRANATEE ASSOCIATES CO.,LTD.

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 m³/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_meter mmHg	Δp_Orifice inH₂O	y	Standard Flow [Q_s] m³/min
1	0.705	755.787	24.17	23.48	47.401	1.708	1.305	0.661
2	0.999	755.849	23.95	23.54	51.522	3.383	1.837	0.930
3	1.119	755.810	23.39	22.98	35.502	4.448	2.109	1.068
4	1.170	755.752	23.42	23.02	26.462	4.999	2.235	1.131
5	1.425	755.681	23.52	23.12	26.582	7.431	2.725	1.376

Slope (m): 1.98581
Intercept (b): -0.00879
Correlation coefficient (r): 0.99984
Uncertainty ($k=2$): 0.015 m³/min

Table 2: The results of Q actual calibration data

Plate	Flow rate m³/min	Pressure [Pa] mmHg	Temperature [Ta] °C	Temperature [Tm] °C	Δp_meter mmHg	Δp_Orifice inH₂O	y	Standard Flow [Q_a] m³/min
1	0.705	755.787	24.17	23.48	47.401	1.708	0.820	0.663
2	0.999	755.849	23.95	23.54	51.522	3.383	1.153	0.932
3	1.119	755.810	23.39	22.98	35.502	4.448	1.321	1.068
4	1.170	755.752	23.42	23.02	26.462	4.999	1.401	1.131
5	1.425	755.681	23.52	23.12	26.582	7.431	1.708	1.377

Slope (m): 1.24382
Intercept (b): -0.00554
Correlation coefficient (r): 0.99984
Uncertainty ($k=2$): 0.015 m³/min

End of Certificate of Calibration

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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. : 23P1401

Equipment : U-Tube Manometer
Manufacturer: Dwyer
Model : 1221-36-W/M
Serial No.: -
ID No.: UAE.EFM.022/2560
Condition As-Received: Used Item
Received Date: 26 April 2023
Calibration Date: 09 May 2023

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

Reference: 2304-0703WSC
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1010 mbar

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

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

Condition of this result of calibration

1.Reference standards instuments :

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 and oil 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 : Attapol P.
[ ] Phalinee Prabpaipal
[ ] Sura Suwannasri
[✓] Attapol Panurach

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Result of calibration:- Without adjustment Range : 0 inH₂O to 36 inH₂O
Function:- Pressure Measurement Scale Interval : 0.1 inH₂O(The Fifth Estimate)
Increasing Pressure

Applied Pressure (inH₂O)	UUC Indication High-port side (inH₂O)	UUC Indication Low-port side (inH₂O)	ΔP (inH₂O)	Error (inH₂O)
0.00	0.00	0.00	0.00	0.00
2.00	1.00	-0.98	1.98	-0.02
4.00	2.00	-1.98	3.98	-0.02
6.00	3.00	-2.98	5.98	-0.02
8.00	4.00	-3.98	7.98	-0.02
10.00	5.00	-4.98	9.98	-0.02
12.00	6.00	-6.00	12.00	0.00
14.00	7.00	-7.00	14.00	0.00
16.00	8.00	-8.00	16.00	0.00
18.00	9.00	-9.00	18.00	0.00
20.00	10.00	-10.00	20.00	0.00
22.00	11.00	-11.00	22.00	0.00
24.00	12.02	-12.00	24.02	0.02
26.00	13.02	-13.00	26.02	0.02
28.00	14.02	-14.00	28.02	0.02
30.00	15.04	-15.00	30.04	0.04
32.00	16.04	-16.00	32.04	0.04
34.00	17.02	-17.00	34.02	0.02
35.80	18.00	-17.96	35.96	0.16

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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Attapol P.

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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. : 23P1855
Page : 1 of 2

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

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

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

Procedure used: 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 : Attapol P.
[ ] Phalinee Prabpaipal
[ ] Sura Suwannasri
[✓] Attapol Panurach

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Cert.No.: 23P1855
Page: 2 of 2

Result of calibration:- Without adjustment **Range :** 960 hPa to 1030 hPa
Function:- Absolute Pressure Measurement **Scale Interval :** 1 hPa (The Fifth Estimate)

Increasing Pressure

Applied Pressure (hPa)	958.50	969.59	980.35	990.39	1001.01	1011.15	1020.94	1031.45
UUC* Indication (hPa)	960.0	970.0	980.0	990.0	1000.0	1010.0	1020.0	1030.0
Error (hPa)	1.50	0.41	-0.35	-0.39	-1.01	-1.15	-0.94	-1.45

Decreasing Pressure

Applied Pressure (hPa)	1031.45	1021.61	1012.16	1002.38	992.17	982.20	970.69	959.32
UUC* Indication (hPa)	1030.0	1020.0	1010.0	1000.0	990.0	980.0	970.0	960.0
Error (hPa)	-1.45	-1.61	-2.16	-2.38	-2.17	-2.20	-0.69	0.68

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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Attapol P.
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a 1165504

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. : 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 to 06 June 2023
Reference: 2305-0919WSC
Ambient Temperature: (25 ± 3) °C
Relative Humidity: (50 ± 20) %

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

Submitted by: United Analyst and Engineering Consultant Co.,Ltd.
81 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, 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	23I305	15 Mar 2024

2.The certificate is valid only to the item calibrated on date and place of calibration.
3.This Certification is traceable to the International System of Unit maintained through:-
-National Institute of Standards and Technology (NIST) , The United States of America
-Technology Promotion Association (Thailand-Japan), NSC-ONSC Accredited No. Calibration 0008

Calibrated by : Somchai Dumwor
Issue Date : 07 June 2023

Approved Signatory :
[✓] Chakrit Waewwanjua
[ ] Pornthippa Tameyakul
[ ] Viporn Tantiyawutti

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

Result of Calibration:- Before Adjustment
Function: Humidity Measurement

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

Result of Calibration:- After Adjustment
Function: Humidity Measurement

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

Result of Calibration:- Without Adjustment
Function: Temperature Measurement

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (±°C)
19.987	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

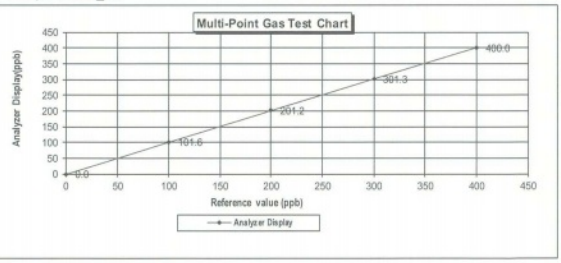
Test Date : Jan 24,2023

Equipment :	Gas Analyzer (NO_2)	**Model :**	42i
Manufacturer :	Thermo Scientific	**Serial Number :**	1201778106

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.68 PPM		Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.94 PPM		Model :	146i
Methane (CH_4)	- PPM		Serial Number :	1180540071
Carbon Monoxide (CO)	984.8			
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	101.6	1.60	1.57	1.57
Level 3	40.00%	200.0	201.2	1.20	0.60	0.60
Level 4	60.00%	300.0	301.3	1.30	0.43	0.43
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb :Acceptable Limit ± 5%				Average Difference (%)		0.52



Calculate by
Siriphan Pongsai
24 / 1 / 66

Approve by
Pattara N.
24 / Jan / 2023

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United Analyst and Engineering Consultant Co., Ltd.
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Tel. 0 2763 2828 Fax 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com

MULTI-POINT GAS TEST REPORT

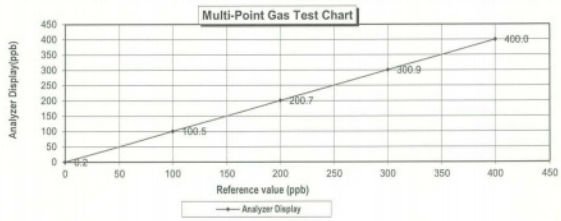
Test Date : Jan 9,2023

Equipment :	Gas Analyzer (NO_2)	**Model :**	42i
Manufacturer :	Thermo Scientific	**Serial Number :**	CM22387035

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.68 PPM		Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.94 PPM		Model :	146i
Methane (CH_4)	- PPM		Serial Number :	1180540071
Carbon Monoxide (CO)	984.8			
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	0.2	0.20	0.20	0.20
Level 2	20.00%	100.0	100.5	0.50	0.50	0.50
Level 3	40.00%	200.0	200.7	0.70	0.35	0.35
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 :Acceptable Limit ± 5%				Average Difference (%)		0.27



Calculate by
Apinat K.
9 / 1 / 66

Approve by
Pattara N.
10 / Jan / 2023

เอกสารไม่ควบคุม

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

MULTI-POINT GAS TEST REPORT

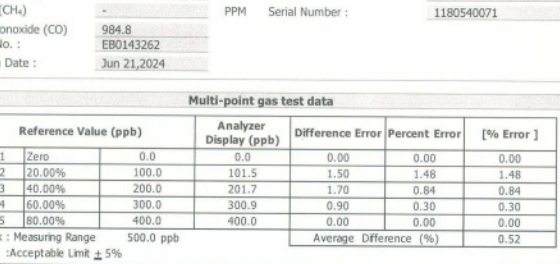
Test Date : Mar 22,2023

Equipment :	Gas Analyzer (NO_2)	**Model :**	42i
Manufacturer :	Thermo Scientific	**Serial Number :**	CM22387036

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.68 PPM		Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.94 PPM		Model :	146i
Methane (CH_4)	- PPM		Serial Number :	1180540071
Carbon Monoxide (CO)	984.8			
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	201.7	1.70	0.84	0.84
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 :Acceptable Limit ± 5%				Average Difference (%)		0.52



Calculate by
Aphiwat K.
22 / 3 / 66

Approve by
Pattara N.
22 / Mar / 2023

เอกสารไม่ควบคุม

Airgas
An Air Liquide company

Airgas Specialty Gases
Airgas USA, LLC
6522 United Drive
Durham, NC 27713
airgas.com

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

Part Number:	S04NI99E15A01D3	Reference Number:	122-402136187-1
Cylinder Number:	EB0143262	Cylinder Volume:	144.4 CF
Laboratory:	124 - Durham (SAP) - NC	Cylinder Pressure:	2015 PSIG
PGVP Number	B22027	Valve Outlet	660
Gas Code:	CO,NO,NOX,SO2,BALN	Certification Date:	Jun 21, 2021
	Expiration Date:	Jun 21, 2024	

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. Data are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise specified.

Do Not Use This Cylinder Below 100 psig, i.e. 27 megapascals

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.56 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.68 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	2008*120	CC708388	49.02 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 07, 2025
PRM	12339	DE65325	5.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 20, 2020
GMIS	4U-1425388132	CC315681	4.349 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 18, 2023
NTRM	15011043	CC479277	45.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTRM	14062119	CC434977	865.9 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Nov 15, 2025

The SRM, PRM or RGM listed above is only in reference to the GMIS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
Nicolet 6700 AHR3E01333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR3B01333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR3B01333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0B01333 SO2	FTIR	Jun 03, 2021

Triad Data Available Upon Request

NOTES:PO #5621002527
GROSS WT: 28.40kg
NET WT: 4.73kg

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

Approved for Release

ACCREDITED
CERT 3092.01

เอกสารไม่ควบคุม

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

MULTI-POINT GAS TEST REPORT

Test Date : Apr 4,2023

Equipment :	Gas Analyzer (SO_2)	**Model :**	43i
Manufacturer :	Thermo SCIENTIFIC	**Serial Number :**	1201778112

Standard Gas Concentration

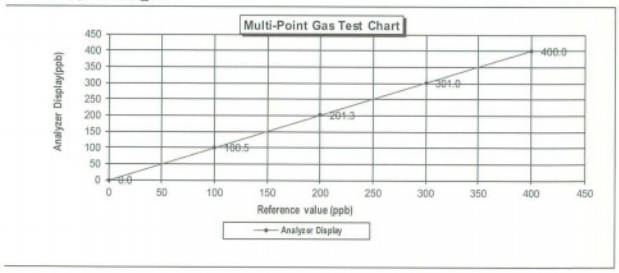
Sulphur Dioxide (SO_2)	44.68	PPM
Nitric Oxide (NO)	45.94	PPM
Methane (CH_4)	-	PPM
Carbon Monoxide (CO)	984.8	
Cylinder No. :	EB0143262	
Expiration Date :	Jun 24,2024	

Dilutor Detail

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

Multi-point gas test data

	Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.5	0.50	0.50	0.50
Level 3	40.00%	200.0	201.3	1.30	0.65	0.65
Level 4	60.00%	300.0	301.0	1.00	0.33	0.33
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb :Acceptable Limit ± 5%				Average Difference (%)		0.30



Calculate by: Aphiwat K. 4 / 4 / 66

Approve by: 4 / Apr / 2023

เอกสารไม่ควบคุม

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

MULTI-POINT GAS TEST REPORT

Test Date : Feb 9,2023

Equipment :	Gas Analyzer (SO_2)	**Model :**	43i
Manufacturer :	Thermo SCIENTIFIC	**Serial Number :**	1201778115

Standard Gas Concentration

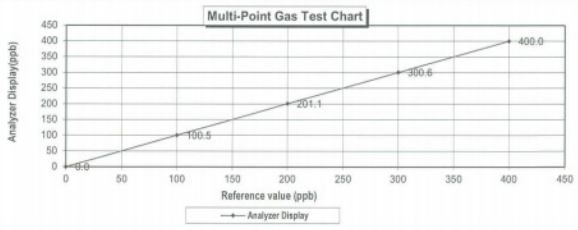
Sulphur Dioxide (SO_2)	44.68	PPM
Nitric Oxide (NO)	45.94	PPM
Methane (CH_4)	-	PPM
Carbon Monoxide (CO)	984.8	
Cylinder No. :	EB0143262	
Expiration Date :	Jun 24,2024	

Dilutor Detail

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

Multi-point gas test data

	Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.5	0.50	0.50	0.50
Level 3	40.00%	200.0	201.1	1.10	0.55	0.55
Level 4	60.00%	300.0	300.6	0.60	0.20	0.20
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb :Acceptable Limit ± 5%				Average Difference (%)		0.25



Calculate by: Sirichan Samsai 9 / 2 / 66

Approve by: Pakwan 9 / Feb / 2023

เอกสารไม่ควบคุม

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

MULTI-POINT GAS TEST REPORT

Test Date : May 3,2023

Equipment :	Gas Analyzer (SO_2)	**Model :**	43i
Manufacturer :	Thermo SCIENTIFIC	**Serial Number :**	1201778114

Standard Gas Concentration

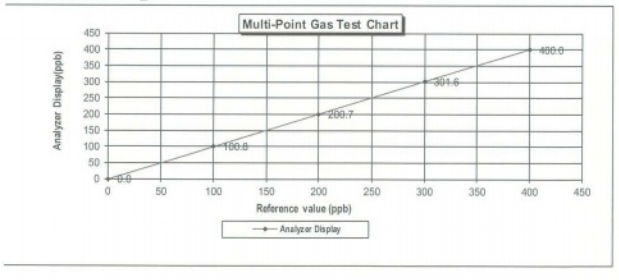
Sulphur Dioxide (SO_2)	44.68	PPM
Nitric Oxide (NO)	45.94	PPM
Methane (CH_4)	-	PPM
Carbon Monoxide (CO)	984.8	
Cylinder No. :	EB0143262	
Expiration Date :	Jun 24,2024	

Dilutor Detail

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

Multi-point gas test data

	Reference Value (ppb)		Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.8	0.80	0.79	0.79
Level 3	40.00%	200.0	200.7	0.70	0.35	0.35
Level 4	60.00%	300.0	301.6	1.60	0.53	0.53
Level 5	80.00%	400.0	400.0	0.00	0.00	0.00
Remark : Measuring Range 500.0 ppb :Acceptable Limit ± 5%				Average Difference (%)		0.33



Calculate by: Aphiwat K. 3 / 5 / 66

Approve by: Pakwan 3 / May / 2023

เอกสารไม่ควบคุม

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

MULTI-POINT GAS TEST REPORT

Test Date : Feb 21,2023

Equipment :	Gas Analyzer (CO)	**Model :**	48i
Manufacturer :	Thermo Scientific	**Serial Number :**	1201778117

Standard Gas Concentration

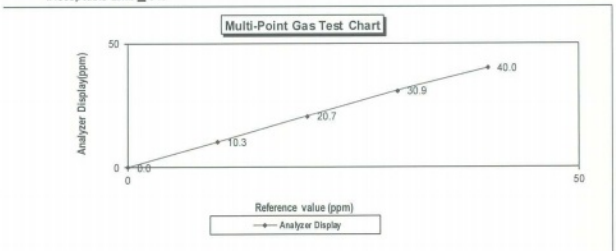
Sulphur Dioxide (SO_2)	44.68	PPM
Nitric Oxide (NO)	45.94	PPM
Methane (CH_4)	-	PPM
Carbon Monoxide (CO)	984.8	PPM
Cylinder No. :	EB0143262	
Expiration Date :	Jun 20,2024	

Dilutor Detail

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

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	10.3	0.3	2.9	2.9
Level 3	40.00%	20.0	20.7	0.7	3.4	3.4
Level 4	60.00%	30.0	30.9	0.9	2.9	2.9
Level 5	80.00%	40.0	40.0	0.0	0.0	0.0
Remark : Measuring Range 50.0 ppm :Acceptable Limit ± 5%				Average Difference (%)		1.84



Calculate by: Aphiwat 21 / 02 / 66

Approve by: Pakwan 22 / Feb / 2023

เอกสารไม่ควบคุม

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

MULTI-POINT GAS TEST REPORT

Test Date : Mar 20,2023

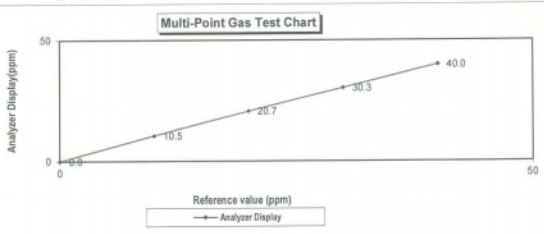
Equipment :	Gas Analyzer (CO)	**Model :**	48i
Manufacturer :	Thermo Scientific	**Serial Number :**	1201778118

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.68 PPM	Manufacturer :	Thermo Scientific	
Nitric Oxide (NO)	45.94 PPM	Model :	146i	
Methane (CH_4)	- PPM	Serial Number :	1180540071	
Carbon Monoxide (CO)	984.8 PPM			
Cylinder No. :	EB0143262			
Expiration Date :	Jun 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	10.5	0.5	4.8	4.8
Level 3	40.00%	20.0	20.7	0.7	3.4	3.4
Level 4	60.00%	30.0	30.3	0.3	1.0	1.0
Level 5	80.00%	40.0	40.0	0.0	0.0	0.0
				Average Difference (%)		1.83

Remark : Measuring Range 50.0 ppm
:Acceptable Limit ± 5%



Calculate by Aphiwat 30 / 03 / 66

Approve by Pakorn U. 29 / Mar / 2023

เอกสารไม่ควบคุม

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

MULTI-POINT GAS TEST REPORT

Test Date : Apr 3,2023

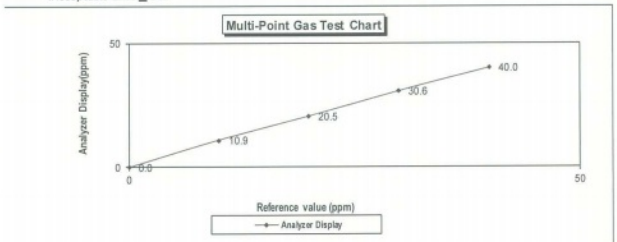
Equipment :	Gas Analyzer (CO)	**Model :**	48i
Manufacturer :	Thermo Scientific	**Serial Number :**	1201497730

Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	44.68 PPM	Manufacturer :	Thermo Scientific	
Nitric Oxide (NO)	45.94 PPM	Model :	146i	
Methane (CH_4)	- PPM	Serial Number :	1180540071	
Carbon Monoxide (CO)	984.8 PPM			
Cylinder No. :	EB0143262			
Expiration Date :	Jun 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	10.9	0.9	8.3	8.3
Level 3	40.00%	20.0	20.5	0.5	2.4	2.4
Level 4	60.00%	30.0	30.6	0.6	2.0	2.0
Level 5	80.00%	40.0	40.0	0.0	0.0	0.0
				Average Difference (%)		2.53

Remark : Measuring Range 50.0 ppm
:Acceptable Limit ± 5%



Calculate by Aphiwat 3 / 04 / 66

Approve by Pakorn U. 4 / Apr / 2023

เอกสารไม่ควบคุม

THAI METEOROLOGICAL DEPARTMENT

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 10 April, 2023 Certification No. 178/23

Page : 1 of 5

Object : WIRELESS ANEMOMETER

Manufacturer : SCARLET

Type : WIRELESS RECEIVER : WL-21
WIND SENSOR : WL-21

Mfg Code : WIRELESS RECEIVER : 2111DR0052
WIND SENSOR : 2111DT0052

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

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1006.9 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563
: HOOK GAGE NO 1425 : Wind Aloft Plotting Board
N.I.S.T. Test Reference Number 731/241460
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)
JAPAN QUALITY ASSURANCE ORGANIZATION
STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94
: testo, testo 645 Serial No. 02848057 : Thermoschneider No.918802
STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. K1320015
: Digital Barometer Vaisala Type PTB330 No. K1320101

Calibrated by : Watcharapol Subwat
Mr. Watcharapol Subwat
Mechanical Engineer

Signed : Pisood Pronsut
Mr. Pisood Pronsut
(Authorised Signatory)
for the Chief
Sub-Standard Instrument

เอกสารไม่ควบคุม

THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 178/23

10 April, 2023 Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.0	0.02
11.02	-	-	-	10.9	0.12
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.1	-0.08

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

Calibrated by : Watcharapol Subwat
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

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

The Result of Calibration

Certification No. 178/23

10 April, 2023 Page : 3 of 5

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1013.17	1013	0.17
1013.43	1014	-0.57
1014.15	1014	0.15
1014.22	1014	0.22
1009.63	1009	0.63
1009.71	1010	-0.29
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	1012	0.40
1008.64	1009	-0.36
1008.80	1009	-0.20
1009.25	1009	0.25
1009.45	1009	0.45
Average		0.06

Calibrated by : Watcharapol
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

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

The Result of Calibration

Certification No. 178/23

10 April, 2023 Page : 4 of 5

Standard Barometer Pressure	Tested Barometer Pressure	Correction
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	758	-0.48
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	758	0.56
758.75	759	-0.25
758.98	759	-0.02
759.36	759	0.36
756.54	757	-0.46
756.66	757	-0.34
757.00	757	0.00
757.15	757	0.15
Average		0.03

Calibrated by : Watcharapol
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

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

The Result of Calibration

Certification No. 178/23

10 April, 2023 Page : 5 of 5

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.15	45.3	-0.15
31.05	31.1	-0.05
15.32	15.5	-0.18

Calibrated by : Watcharapol
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 11 April, 2023 Certification No. 162/23

Page : 1 of 5

Object : WIRELESS ANEMOMETER

Manufacturer : SCARLET

Type : WIRELESS RECEIVER : WL-21
WIND SENSOR : WL-21

Mfg Code : WIRELESS RECEIVER : 2111DR0058
WIND SENSOR : 2111DT0058

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 1008.7 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 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec
STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94
: testo. testo 645 Serial No. 02848057 : Thermoschneider No.918802
STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. J1220015
: Digital Barometer Vaisala Type PTB330 No. K3320001

Calibrated by : Watcharapol
Mr. Watcharapol Subwat
Mechanical Engineer

Signed : Pisood Promsut
Mr. Pisood Promsut
(Authorised Signatory)
for the Chief
Sub-Standard Instrument

เอกสารไม่ควบคุม

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

The Result of Calibration

Certification No. 162/23

11 April, 2023 Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	6.9	0.14
9.02	-	-	-	9.0	0.02
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. US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRETION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

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

The Result of Calibration

Certification No. 162/23

11 April, 2023 Page : 3 of 5

Standard Barometer Pressure (mbar)	Tested Barometer Pressure (mbar)	Correction (mbar)
1010.39	1010	0.39
1011.13	1011	0.13
1011.31	1011	0.31
1011.57	1011	0.57
1008.42	1009	-0.58
1008.86	1009	-0.14
1008.99	1009	-0.01
1009.36	1009	0.36
1009.94	1010	-0.06
1010.36	1010	0.36
1009.53	1010	-0.47
1009.85	1010	-0.15
1010.06	1010	0.06
1010.23	1010	0.23
1009.06	1009	0.06
1009.21	1009	0.21
1009.71	1010	-0.29
1010.32	1010	0.32
1011.21	1011	0.21
1011.50	1011	0.50
	Average	0.14

Calibrated by :
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

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

The Result of Calibration

Certification No. 162/23

11 April, 2023 Page : 4 of 5

Standard Barometer Pressure (mmHg)	Tested Barometer Pressure (mmHg)	Correction (mmHg)
757.85	758	-0.15
758.41	758	0.41
758.54	758	0.54
758.74	759	-0.26
756.38	756	0.38
756.71	756	0.71
756.80	757	-0.20
757.08	757	0.08
757.52	757	0.52
757.83	758	-0.17
757.21	757	0.21
757.45	758	-0.55
757.61	758	-0.39
757.73	758	-0.27
756.86	757	-0.14
756.97	757	-0.03
757.34	757	0.34
757.80	758	-0.20
758.47	759	-0.53
758.69	759	-0.31
	Average	0.00

Calibrated by :
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

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

The Result of Calibration

Certification No. 162/23

11 April, 2023 Page : 5 of 5

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.12	45.1	0.02
31.24	31.3	-0.06
15.82	15.9	-0.08

Calibrated by :
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 17 April, 2023 Certification No. 163/23

Object : WIRELESS ANEMOMETER

Manufacturer : SCARLET

Type : WIRELESS RECEIVER : WL-21
WIND SENSOR : WL-21

Mfg Code : WIRELESS RECEIVER : 2205DR0114
WIND SENSOR : 2205DT0114

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 1008.5 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 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec
STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94
: testo, testo 645 Serial No. 02848057 : Thermoschneider No.918802
STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. K1220015
: Digital Barometer Vaisala Type PTB330 No. K1220001

Calibrated by : Watcharapol Subwat
Mr. Watcharapol Subwat
Mechanical Engineer

Signed : Pisood Promsut
Mr. Pisood Promsut
(Authorised Signatory)
for the Chief
Sub-Standard Instrument

เอกสารไม่ควบคุม

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

The Result of Calibration

Certification No. 163/23

17 April, 2023

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H20	inches H20	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	-	-	-	12.9	0.11
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

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

Calibrated by : Watcharapol Subwat
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

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

The Result of Calibration

Certification No. 163/23

17 April, 2023

Standard Barometer Pressure (mbar)	Tested Barometer Pressure (mbar)	Correction (mbar)
1011.56	1011	0.56
1011.31	1011	0.31
1010.68	1011	-0.32
1010.29	1010	0.29
1007.21	1007	0.21
1007.60	1007	0.60
1008.36	1008	0.36
1007.98	1008	-0.02
1008.32	1008	0.32
1007.88	1008	-0.12
1008.07	1008	0.07
1008.42	1008	0.42
1008.61	1009	-0.39
1009.33	1009	0.33
1009.68	1010	-0.32
1009.84	1010	-0.16
1009.90	1010	-0.10
1010.19	1010	0.19
1010.34	1010	0.34
1007.25	1007	0.25
Average		0.14

Calibrated by : Watcharapol Subwat
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. 163/23

17 April, 2023

Standard Barometer Pressure (mmHg)	Tested Barometer Pressure (mmHg)	Correction (mmHg)
758.73	759	-0.27
758.54	759	-0.46
758.07	758	0.07
757.78	758	-0.22
755.47	755	0.47
755.76	756	-0.24
756.33	756	0.33
756.05	756	0.05
756.30	756	0.30
755.97	756	-0.03
756.11	756	0.11
756.38	756	0.38
756.52	757	-0.48
757.06	757	0.06
757.32	757	0.32
757.44	757	0.44
757.49	758	-0.51
757.70	758	-0.30
757.82	758	-0.18
755.50	756	-0.50
Average		-0.03

Calibrated by : Watcharapol Subwat
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 163/23

17 April, 2023 Page : 5 of 5

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.26	45.3	-0.04
30.18	30.2	-0.02
16.32	16.4	-0.08

Calibrated by : Watcharapol

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

เอกสารไม่ควบคุม

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

GAS TEST REPORT

Test Date : July 14, 2022

Equipment :	Gas Analyzer (CO_2)	**Model :**	360E
Manufacturer :	Teledyne API	**Serial Number :**	145

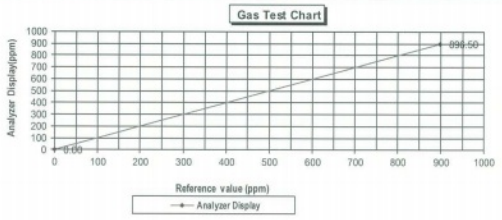
Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	- PPM	Manufacturer :	Thermo Scientific	
Nitric Oxide (NO)	- PPM	Model :	146i	
Carbon Dioxide (CO_2)	897 PPM	Serial Number :	1180120037	
Cylinder No. :	145168			
Expiration Date :	Aug 31,2025			

gas test data

Reference Value (ppm)			Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.00	0.00	0.00	0.00	0.00
Level 2	Span	897.00	896.50	-0.50	-0.06	0.06
Remark : Measuring Range 4000.00 ppm				Average Difference (%)		0.03

:Acceptable Limit ± 5%

Gas Test Chart



Calculate by Aphiwat u. 14 / 7 / 65

Approve by Petsuwan u. 14 / July / 2022

Page 1 of 1

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

GAS TEST REPORT

Test Date : July 14, 2022

Equipment :	Gas Analyzer (CO_2)	**Model :**	410i
Manufacturer :	Thermo SCIENTIFIC	**Serial Number :**	1162850027

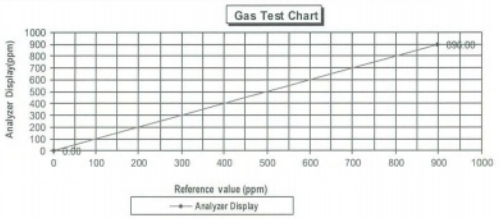
Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	- PPM	Manufacturer :	Thermo Scientific	
Nitric Oxide (NO)	- PPM	Model :	146i	
Carbon Dioxide (CO_2)	897 PPM	Serial Number :	1180120037	
Cylinder No. :	145168			
Expiration Date :	Aug 31,2025			

gas test data

Reference Value (ppm)			Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.00	0.00	0.00	0.00	0.00
Level 2	Span	897.00	896.00	-1.00	-0.11	0.11
Remark : Measuring Range 5000.00 ppm				Average Difference (%)		0.06

:Acceptable Limit ± 5%

Gas Test Chart



Calculate by Aphiwat u. 14 / 7 / 65

Approve by Petsuwan u. 14 / July / 2022

Page 1 of 1

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

GAS TEST REPORT

Test Date : July 28, 2022

Equipment :	Gas Analyzer (CO_2)	**Model :**	410i
Manufacturer :	Thermo SCIENTIFIC	**Serial Number :**	1191543060

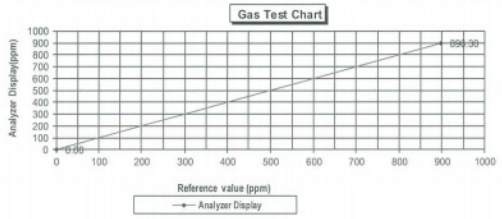
Standard Gas Concentration			**Dilutor Detail**	
Sulphur Dioxide (SO_2)	- PPM	Manufacturer :	Thermo Scientific	
Nitric Oxide (NO)	- PPM	Model :	146i	
Carbon Dioxide (CO_2)	897 PPM	Serial Number :	1180120037	
Cylinder No. :	145168			
Expiration Date :	Aug 31,2025			

gas test data

Reference Value (ppm)			Analyzer Display (ppm)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.00	0.00	0.00	0.00	0.00
Level 2	Span	897.00	896.30	-0.70	-0.08	0.08
Remark : Measuring Range 5000.00 ppm				Average Difference (%)		0.04

:Acceptable Limit ± 5%

Gas Test Chart



Calculate by Aphiwat u. 25 / 7 / 65

Approve by Petsuwan u. 28 / July / 2022

Page 1 of 1

เอกสารไม่ควบคุม

THE LINDE GROUP

Linde

Certificate Of Analysis

Special Gases Mixture

Customer Details

Name: United Analyst& Engineering Co., Ltd.

Address: 81, Soi Udom Suk 41, Sukhumvit Rd., Bang Chak, Khet Phra khanong, Bangkok, 10260

Customer Tag No.:

Certificate Details

Number:	3805/21	Date of Issue:	1-Sep-2021	Expiry date:	31-Aug-2025
Material Details					
Production Order:	90167449	Material Code:	P545700-V-62	Cylinder No.:	145168
Gas content:	1.40 M^3 (nominal)	Filling pressure:	145.0 bar (g)	Valve:	CGA 590 BRASS
Cylinder Owner:	Customer cylinder	Cylinder Material:	STEEL	Cylinder Size:	10 L

Laboratory Report

Component	Nominal Concentration	Analysis Result[1]	Uncertainty[2]	Method of Analysis[3]
Carbon Dioxide In Air	850 ppm	897 ppm	± 2% relative	(1) SG-CO-04

Recommend usage condition

Minimum utilization: 5% of actual content or before expire date whichever comes first.

Storage condition: Keep in well ventilation and secure area.

Comments

Note:

1. All results expressed in this report are on mole/mole basis, unless otherwise specified.
2. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor k=2, providing a level of confidence of approximately 95%. The measurement of this material is traceable to the SI through the reference gas standard which is traceable to Swiss National Standard of Mass or other recognised national metrology institutes.
3. (1) Gas Chromatography, (2) Paramagnetic Oxygen Analyzer, (3) Electrochemical Oxygen Analyzer, (4) Electrochemical Moisture Analyzer, (5) Total Hydrocarbon Analyzer, (6) Other - specified

Sukanya Parinyasoontorn
Signatory for and on behalf of Linde (Thailand) Co., Ltd.

Page 1 of 1
This report shall not be reproduced except in full

PB-002/F004
Iss.J/2 , 01 April 2021

บริษัท ลินเด้ (ประเทศไทย) จำกัด (มหาชน)
ชั้น 15 ทาวเวอร์เอ เอ 2/3 หมู่ 14 ถนนบางนา-ตราด กม. 6.5 ตำบลบางโฉลง อำเภอบางพลี จังหวัดสมุทรปราการ 10540 โทรศัพท์ (66) 2338-6100 โทรสาร (66) 2338-6333
โรงงานแสงจันทร์ : 105 หมู่ 5 ตำบลบ่อวิน อำเภอศรีราชา จังหวัดชลบุรี 24180
โทรศัพท์ (66) 38.570-479-93 โทรสาร (66) 38.570-323

Linde (Thailand) Public Company Limited
15th Floor, Bangna Tower A, 2/3 Moo 14, Bangna Trad KM. 6.5 Road, Bangkaew Bangplee, Samutprakarn 10540, Tel (66) 2338-6100 Fax (66) 2338-6333
Wellgrow Plant : 105 Moo 5, T.Bangsamak, A.Bangpakong, Chachoengsao 24180 Thailand, Tel (66) 38.570-479-93 Fax (66) 38.570-323

เอกสารไม่ควบคุม

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAEO,
AMPHOE BANG PHLI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: (6610-2116-5860-1 FAX: (6610-2116-7140

INNOVATIVE INSTRUMENT

ANAB ANSI National Accreditation Board ACCREDITED CALIBRATION LABORATORY AC-2961

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-114

Request No : Req-2023-1543

Unit Under Calibration Details

Measurement item : Acoustic Calibrator

Manufacturer : SVANTEK

Model : SV 35

Serial Number : 44783

ID : UAE.EFM.019/2559

Class : 1

Range : 94 , 114 dB / 1000 Hz

Intrument Status : Used

Calibration Environment and Details

Temperature : (23 ±2 °C)

Humidity : (50 ± 20 %RH)

Barometric Pressure : (1013 ±10.0 hPa)

Received Date : 21 July 2023

Calibration Date : 4 August 2023

Location of Calibration : LAB 1 Acoustic

Calibration Procedure : In-house method CP-ACT-02 based on IEC 60942:2017 Electroacoustics - Sound calibrators

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

Traceability : This certificate providoes 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 : 4 August 2023

The results related only to the item calibrated. The certificate shall not be reproduced except in full, without written approval of the Innovative Instrument Co., Ltd.
FM-708-ACT-02 Rev.00 Issue date: 08/07/23

เอกสารไม่ควบคุม

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7/139 MOO 13, SOI SUNTINAKORN 11 TAMBON BANG KAEO,
AMPHOE BANG PHLI SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: (6610-2116-5860-1 FAX: (6610-2116-7140

Certificate No : 23-ACT-114

Request No : Req-2023-1543

Sound pressure level — **Calibration Results :** Without Adjustment

Calibration Range (dB)	Without Adjustment (dB) Measured	Without Adjustment (dB) Error	Adjustment (dB) Measured	Adjustment (dB) Error	Uncertainty (± dB)	Acceptance limit Class 1 (± dB)
94 dB / 1000 Hz	94.25	0.25	-	-	0.13	0.25
114 dB / 1000 Hz	114.19	0.19	-	-	0.13	0.25

Frequency of Sound pressure level

Calibration Range (Hz)	Without Adjustment Measured (Hz)	Without Adjustment Error (%)	Adjustment Measured (Hz)	Adjustment Error (%)	Uncertainty (± %)	Acceptance limit Class 1 (± %)
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 Measured (%)	Adjustment Measured (%)	Uncertainty (± %)	Acceptance limit Class 1 (± %)
94 dB / 1000 Hz	0.04	-	0.40	2.5
114 dB / 1000 Hz	0.02	-	0.40	2.5

Note :

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

End of Calibration

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.
FM-708-ACT-02 Rev.00 Issue date: 08/07/23

เอกสารไม่ควบคุม

Calibration Certificate

Certificate Number 2023003675

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

Model Number	LxT1		***Procedure Number***	D0001.8384	
Serial Number	0007311		***Technician***	Jacob Cannon	
Test Results	Pass		***Calibration Date***	24 Mar 2023	
Initial Condition	As Manufactured		***Calibration Due***		
Description	SoundTrack LxT Class 1 Class 1 Sound Level Meter Firmware Revision: 2.404		***Temperature***	23.56 °C	± 0.25 °C
			Humidity	49.9 %RH	± 2.0 %RH
			Static Pressure	85.69 kPa	± 0.13 kPa

Evaluation Method — ***Tested with:*** — ***Data reported in dB re 20 µPa.***

Larson Davis CAL291. S/N 0108
Larson Davis CAL200. S/N 9079
PCB 377B02. S/N 345817
Larson Davis PRMLxT1. S/N 077646

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

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

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

The quality system is registered to ISO 9001:2015.

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

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

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

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

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716-684-0001

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1/2" adaptor is used with the preamplifier.

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

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part3.

Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 successfully completed by Physikalisch-Technische Bundesanstalt (PTB) on 2007-10-09 reference number PTB-1.72-4034218.

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

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2022-09-09	2023-09-09	001250
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
Larson Davis CAL200 Acoustic Calibrator	2022-07-21	2023-07-21	007027
Larson Davis Model 831	2023-02-22	2024-02-22	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2023-03-06	2024-03-06	007185
SRS DS360 Ultra Low Distortion Generator	2022-03-29	2023-03-29	007635
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2022-09-28	2023-09-28	PCB0004783

Acoustic Calibration

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

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

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-49.73	-52.44	-48.33	0.14	Pass

-- End of measurement results--

Acoustic Signal Tests, C-weighting

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

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.19	-0.20	-1.20	0.80	0.23	Pass
1000	0.15	0.00	-0.70	0.70	0.23	Pass
8000	-3.69	-3.00	-5.50	-1.50	0.32	Pass

-- End of measurement results--

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Self-generated Noise

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

Measurement	Test Result [dB]
A-weighted	40.32

-- End of measurement results--

-- End of Report--

Signatory: Jacob Cannon

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Calibration Certificate

Certificate Number 2023003651
Customer:
United Analyst and Engineering Consultant Co Ltd
No. 81 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phra Khanong,
Bangkok, 10260, Thailand

Model Number	LxT1	**Procedure Number**	D0001.8378
Serial Number	0007311	**Technician**	Jacob Cannon
Test Results	Pass	**Calibration Date**	23 Mar 2023
Initial Condition	As Manufactured	**Calibration Due**	
Description	SoundTrack LxT Class 1 Class 1 Sound Level Meter Firmware Revision: 2.404	**Temperature**	23.6 °C ± 0.25 °C
		Humidity	50.3 %RH ± 2.0 %RH
		Static Pressure	86.08 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1 S/N 077646 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

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

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

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

The quality system is registered to ISO 9001:2015.

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

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

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

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

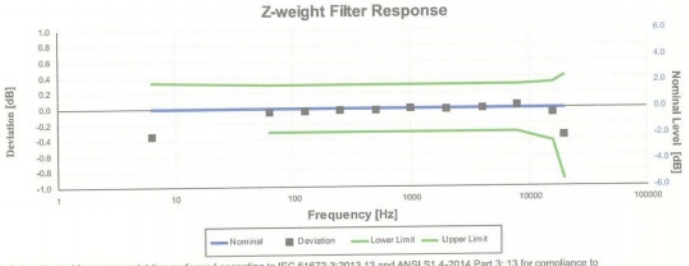
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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
SRS DS360 Ultra Low Distortion Generator	2022-03-30	2023-03-30	007174

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Z-weight Filter Response



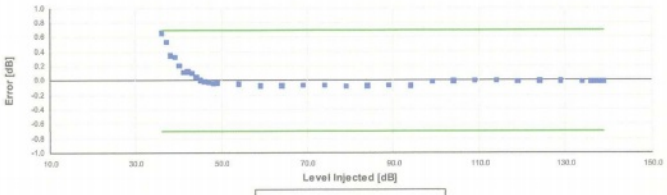
Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1983 (R2006) 5.1 and 8.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.36	-0.35	-1.11	0.33	0.15	Pass
63.10	-0.05	-0.05	-0.30	0.30	0.15	Pass
125.89	-0.03	-0.03	-0.30	0.30	0.15	Pass
251.19	-0.03	-0.03	-0.30	0.30	0.15	Pass
501.19	-0.03	-0.03	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.02	-0.01	-0.30	0.30	0.15	Pass
3,981.07	0.00	0.00	-0.30	0.30	0.15	Pass
7,943.28	0.04	0.04	-0.30	0.30	0.15	Pass
15,848.93	-0.06	-0.06	-0.42	0.32	0.15	Pass
19,952.62	-0.35	-0.35	-0.91	0.41	0.15	Pass

-- End of measurement results--

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A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
36.00	0.66	-0.70	0.70	0.16	Pass
37.00	0.53	-0.70	0.70	0.16	Pass
38.00	0.35	-0.70	0.70	0.16	Pass
39.00	0.32	-0.70	0.70	0.16	Pass
40.00	0.21	-0.70	0.70	0.16	Pass
41.00	0.12	-0.70	0.70	0.16	Pass
42.00	0.12	-0.70	0.70	0.16	Pass
43.00	0.10	-0.70	0.70	0.17	Pass
44.00	0.05	-0.70	0.70	0.17	Pass
45.00	0.00	-0.70	0.70	0.16	Pass
46.00	-0.01	-0.70	0.70	0.16	Pass
47.00	-0.03	-0.70	0.70	0.16	Pass
48.00	-0.04	-0.70	0.70	0.16	Pass
49.00	-0.04	-0.70	0.70	0.16	Pass
54.00	-0.05	-0.70	0.70	0.16	Pass
59.00	-0.07	-0.70	0.70	0.16	Pass
64.00	-0.07	-0.70	0.70	0.16	Pass
69.00	-0.07	-0.70	0.70	0.16	Pass
74.00	-0.06	-0.70	0.70	0.16	Pass
79.00	-0.08	-0.70	0.70	0.16	Pass
84.00	-0.07	-0.70	0.70	0.16	Pass
89.00	-0.07	-0.70	0.70	0.16	Pass
94.00	-0.07	-0.70	0.70	0.16	Pass
99.00	-0.01	-0.70	0.70	0.15	Pass
104.00	-0.01	-0.70	0.70	0.15	Pass
109.00	0.00	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
119.00	-0.02	-0.70	0.70	0.15	Pass
124.00	-0.01	-0.70	0.70	0.15	Pass
129.00	-0.01	-0.70	0.70	0.15	Pass
134.00	-0.01	-0.70	0.70	0.15	Pass
136.00	-0.01	-0.70	0.70	0.15	Pass
137.00	-0.01	-0.70	0.70	0.15	Pass
138.00	-0.01	-0.70	0.70	0.15	Pass
139.00	-0.02	-0.70	0.70	0.15	Pass

-- End of measurement results--

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Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.4

Amplitude [dB]	Duration [µs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
137.85	40	Negative Pulse	135.26	133.80	135.80	0.15	Pass
		Positive Pulse	135.25	133.80	135.80	0.15	Pass
	30	Negative Pulse	134.32	133.80	135.80	0.15	Pass
		Positive Pulse	134.32	133.80	135.80	0.15	Pass

-- End of measurement results--

Positive Pulse Crest Factor

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

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
126.85	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.11	± 1.00	0.16 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
116.85	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.15 ‡	Pass
	10	-0.26	± 1.50	0.15 ‡	Pass
106.85	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.12	± 1.00	0.15 ‡	Pass
	10	0.01	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Negative Pulse Crest Factor

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

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
126.85	3	-0.11	± 0.50	0.15 ‡	Pass
	5	-0.10	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
116.85	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.11	± 1.00	0.15 ‡	Pass
	10	-0.25	± 1.50	0.15 ‡	Pass
106.85	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.11	± 1.00	0.15 ‡	Pass
	10	0.01	± 1.50	0.15 ‡	Pass

-- End of measurement results--

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Gain

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

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.94	93.90	94.10	0.15	Pass
0 dB Gain, Linearity	41.14	40.30	41.70	0.16	Pass
OBA Low Range	94.00	93.90	94.10	0.15	Pass
OBA Normal Range	94.00	93.20	94.80	0.15	Pass

-- End of measurement results--

Broadband Noise Floor

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

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	27.01	36.00	Pass
C-weight Noise Floor	27.02	35.00	Pass
Z-weight Noise Floor	33.41	39.00	Pass

-- End of measurement results--

Total Harmonic Distortion

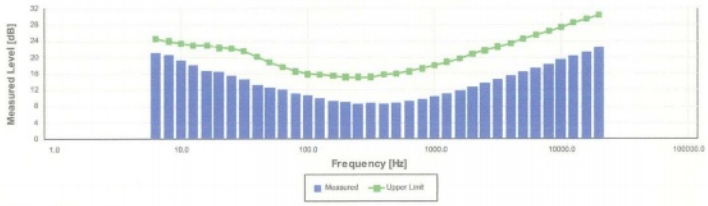
Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.84	135.05	136.65	0.15	Pass
THD	-67.26		-58.00	0.01 ‡	Pass
THD+N	-63.27		-58.00	0.01 ‡	Pass

-- End of measurement results--

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1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	21.01	24.60	Pass
8.00	20.60	24.00	Pass
10.00	19.19	23.50	Pass
12.50	18.13	23.00	Pass
16.00	16.66	22.90	Pass
20.00	16.47	22.40	Pass
25.00	15.54	22.30	Pass
31.50	14.59	21.50	Pass
40.00	13.14	20.20	Pass
50.00	12.53	18.80	Pass
63.00	12.05	17.60	Pass
80.00	11.24	16.60	Pass
100.00	10.61	15.90	Pass
125.00	10.01	15.70	Pass
160.00	9.34	15.50	Pass
200.00	9.01	15.20	Pass
250.00	8.52	15.20	Pass
315.00	8.71	15.20	Pass
400.00	8.61	15.70	Pass
500.00	8.80	16.00	Pass
630.00	9.26	16.60	Pass
800.00	9.76	17.30	Pass
1,000.00	10.40	18.10	Pass
1,250.00	11.15	18.90	Pass
1,600.00	11.94	19.80	Pass
2,000.00	12.75	20.80	Pass
2,500.00	13.68	21.70	Pass
3,150.00	14.64	22.60	Pass
4,000.00	15.55	23.50	Pass
5,000.00	16.47	24.50	Pass
6,300.00	17.47	25.50	Pass
8,000.00	18.44	26.50	Pass
10,000.00	19.44	27.40	Pass
12,500.00	20.45	28.50	Pass
16,000.00	21.42	29.50	Pass
20,000.00	22.41	30.40	Pass

-- End of measurement results--

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-- End of Report--

Signatory: Jacob Cannon

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Provo, UT 84601, United States
716-684-0001

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Calibration Certificate

Certificate Number 2023003676

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

Model Number	LxT1	**Procedure Number**	D0001.8384
Serial Number	0007312	**Technician**	Jacob Cannon
Test Results	Pass	**Calibration Date**	24 Mar 2023
Initial Condition	As Manufactured	**Calibration Due**	
Description	SoundTrack LxT Class 1 Class 1 Sound Level Meter Firmware Revision: 2.404	**Temperature**	23.58 °C ± 0.25 °C
		Humidity	49.3 %RH ± 2.0 %RH
		Static Pressure	85.71 kPa ± 0.13 kPa

Evaluation Method — **Tested with:** — **Data reported in dB re 20 µPa.**

Larson Davis CAL200. S/N 9079
PCB 377B02. S/N 345818
Larson Davis PRMLxT1. S/N 077647
Larson Davis CAL291. S/N 0108

Compliance Standards

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

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

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

The quality system is registered to ISO 9001:2015.

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

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

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

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

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Provo, UT 84601, United States
716-684-0001

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1/2" adaptor is used with the preamplifier.

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

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part3.

Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 successfully completed by Physikalisch-Technische Bundesanstalt (PTB) on 2007-10-09 reference number PTB-1.72-4034218.

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

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2022-09-09	2023-09-09	001250
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
Larson Davis CAL200 Acoustic Calibrator	2022-07-21	2023-07-21	007027
Larson Davis Model 831	2023-02-22	2024-02-22	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2023-03-06	2024-03-06	007185
SRS DS360 Ultra Low Distortion Generator	2022-03-29	2023-03-29	007635
Larson Davis 1/2" Preamplifier for Model 831 Type I	2022-09-28	2023-09-28	PCB0004783

Acoustic Calibration

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

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

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-49.85	-52.44	-48.33	0.14	Pass

-- End of measurement results--

Acoustic Signal Tests, C-weighting

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

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.20	-0.20	-1.20	0.80	0.23	Pass
1000	0.14	0.00	-0.70	0.70	0.23	Pass
8000	-3.72	-3.00	-5.50	-1.50	0.32	Pass

-- End of measurement results--

LARSON DAVIS – A PCB DIVISION
1681 West 820 North
Provo, UT 84601, United States
716-684-0001

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Self-generated Noise

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

Measurement	Test Result [dB]
A-weighted	40.51

-- End of measurement results--

-- End of Report--

Signatory: *Jacob Cannon*

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Calibration Certificate

Certificate Number 2023003652
Customer:
United Analyst and Engineering Consultant Co Ltd
No. 81 Soi Udonsuk 41, Sukhumvit Road,
Bangchak, Phra Khanong,
Bangkok, 10260, Thailand

Model Number	LxT1	***Procedure Number***	D0001.8378
Serial Number	0007312	***Technician***	Jacob Cannon
Test Results	Pass	***Calibration Date***	23 Mar 2023
Initial Condition	As Manufactured	***Calibration Due***	
Description	SoundTrack LxT Class 1 Class 1 Sound Level Meter Firmware Revision: 2.404	***Temperature***	23.62 °C ± 0.25 °C
		Humidity	49.6 %RH ± 2.0 %RH
		Static Pressure	86.08 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT1 S/N 077647 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

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

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

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

The quality system is registered to ISO 9001:2015.

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

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

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

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

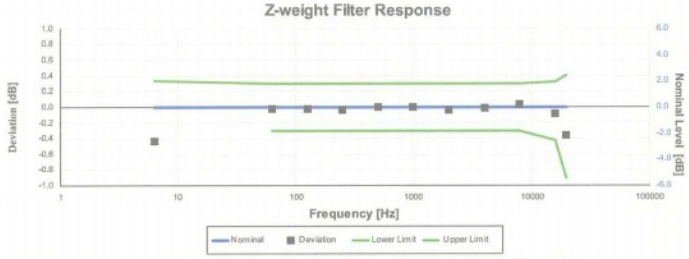
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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
SRS DS360 Ultra Low Distortion Generator	2022-05-04	2023-05-04	007117

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Z-weight Filter Response



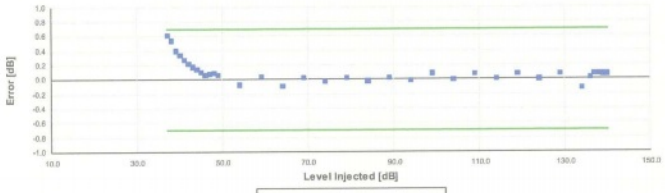
Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1983 (R2006) 5.1 and 8.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.44	-0.44	-1.11	0.33	0.15	Pass
63.10	-0.03	-0.03	-0.30	0.30	0.15	Pass
125.89	-0.03	-0.03	-0.30	0.30	0.15	Pass
251.19	-0.04	-0.04	-0.30	0.30	0.15	Pass
501.19	-0.01	-0.01	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.03	-0.03	-0.30	0.30	0.15	Pass
3,981.07	-0.01	-0.01	-0.30	0.30	0.15	Pass
7,943.28	0.04	0.04	-0.30	0.30	0.15	Pass
15,848.93	-0.08	-0.08	-0.42	0.32	0.15	Pass
19,952.62	-0.37	-0.37	-0.91	0.41	0.15	Pass

-- End of measurement results--

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A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
37.00	0.61	-0.70	0.70	0.16	Pass
38.00	0.54	-0.70	0.70	0.16	Pass
39.00	0.40	-0.70	0.70	0.16	Pass
40.00	0.33	-0.70	0.70	0.16	Pass
41.00	0.27	-0.70	0.70	0.16	Pass
42.00	0.22	-0.70	0.70	0.16	Pass
43.00	0.18	-0.70	0.70	0.17	Pass
44.00	0.15	-0.70	0.70	0.17	Pass
45.00	0.10	-0.70	0.70	0.16	Pass
46.00	0.07	-0.70	0.70	0.16	Pass
47.00	0.07	-0.70	0.70	0.16	Pass
48.00	0.09	-0.70	0.70	0.16	Pass
49.00	0.06	-0.70	0.70	0.16	Pass
54.00	-0.07	-0.70	0.70	0.16	Pass
59.00	0.03	-0.70	0.70	0.16	Pass
64.00	-0.09	-0.70	0.70	0.16	Pass
69.00	0.03	-0.70	0.70	0.16	Pass
74.00	-0.03	-0.70	0.70	0.16	Pass
79.00	0.02	-0.70	0.70	0.16	Pass
84.00	-0.02	-0.70	0.70	0.16	Pass
89.00	0.03	-0.70	0.70	0.16	Pass
94.00	-0.02	-0.70	0.70	0.16	Pass
99.00	0.08	-0.70	0.70	0.15	Pass
104.00	0.00	-0.70	0.70	0.15	Pass
109.00	0.08	-0.70	0.70	0.15	Pass
114.00	0.01	-0.70	0.70	0.15	Pass
119.00	0.07	-0.70	0.70	0.15	Pass
124.00	0.01	-0.70	0.70	0.15	Pass
129.00	0.08	-0.70	0.70	0.15	Pass
134.00	-0.12	-0.70	0.70	0.15	Pass
136.00	0.02	-0.70	0.70	0.15	Pass
137.00	0.07	-0.70	0.70	0.15	Pass
138.00	0.07	-0.70	0.70	0.15	Pass
139.00	0.07	-0.70	0.70	0.15	Pass
140.00	0.07	-0.70	0.70	0.15	Pass

-- End of measurement results--

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Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.4

Amplitude [dB]	Duration [µs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
137.85	40	Negative Pulse	134.73	133.30	135.30	0.15	Pass
		Positive Pulse	134.72	133.28	135.28	0.15	Pass
	30	Negative Pulse	133.79	133.30	135.30	0.15	Pass
		Positive Pulse	133.78	133.28	135.28	0.15	Pass

-- End of measurement results--

Positive Pulse Crest Factor

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

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
126.85	3	-0.12	± 0.50	0.15 ‡	Pass
	5	-0.07	± 1.00	0.16 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
116.85	3	-0.16	± 0.50	0.15 ‡	Pass
	5	-0.05	± 1.00	0.15 ‡	Pass
	10	-0.24	± 1.50	0.15 ‡	Pass
106.85	3	-0.19	± 0.50	0.15 ‡	Pass
	5	-0.09	± 1.00	0.15 ‡	Pass
	10	-0.30	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Negative Pulse Crest Factor

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

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
126.85	3	-0.11	± 0.50	0.15 ‡	Pass
	5	-0.08	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
116.85	3	-0.10	± 0.50	0.15 ‡	Pass
	5	-0.06	± 1.00	0.15 ‡	Pass
	10	-0.23	± 1.50	0.15 ‡	Pass
106.85	3	-0.18	± 0.50	0.15 ‡	Pass
	5	-0.11	± 1.00	0.15 ‡	Pass
	10	-0.28	± 1.50	0.15 ‡	Pass

-- End of measurement results--

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Gain

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

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.92	93.86	94.06	0.15	Pass
0 dB Gain, Linearity	41.16	40.26	41.66	0.16	Pass
OBA Low Range	93.97	93.86	94.06	0.15	Pass
OBA Normal Range	93.96	93.20	94.80	0.15	Pass

-- End of measurement results--

Broadband Noise Floor

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

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	26.86	36.00	Pass
C-weight Noise Floor	26.56	35.00	Pass
Z-weight Noise Floor	32.28	39.00	Pass

-- End of measurement results--

Total Harmonic Distortion

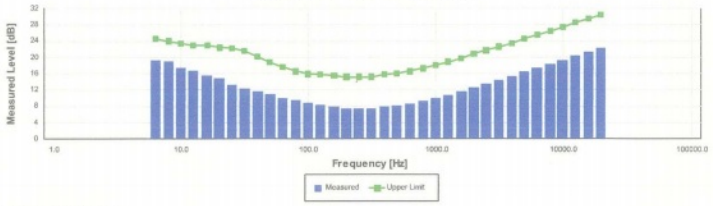
Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.35	135.05	136.65	0.15	Pass
THD	-64.53		-58.00	0.01 ‡	Pass
THD+N	-61.30		-58.00	0.01 ‡	Pass

-- End of measurement results--

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1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	19.36	24.60	Pass
8.00	18.96	24.00	Pass
10.00	17.32	23.50	Pass
12.50	16.60	23.00	Pass
16.00	15.47	22.90	Pass
20.00	14.87	22.40	Pass
25.00	13.12	22.30	Pass
31.50	12.38	21.50	Pass
40.00	11.67	20.20	Pass
50.00	10.95	18.80	Pass
63.00	10.08	17.60	Pass
80.00	9.46	16.60	Pass
100.00	8.73	15.90	Pass
125.00	8.30	15.70	Pass
160.00	7.83	15.50	Pass
200.00	7.53	15.20	Pass
250.00	7.40	15.20	Pass
315.00	7.44	15.20	Pass
400.00	7.80	15.70	Pass
500.00	8.11	16.00	Pass
630.00	8.69	16.60	Pass
800.00	9.34	17.30	Pass
1,000.00	10.05	18.10	Pass
1,250.00	10.74	18.90	Pass
1,600.00	11.61	19.80	Pass
2,000.00	12.58	20.80	Pass
2,500.00	13.49	21.70	Pass
3,150.00	14.42	22.60	Pass
4,000.00	15.39	23.50	Pass
5,000.00	16.38	24.50	Pass
6,300.00	17.34	25.50	Pass
8,000.00	18.33	26.50	Pass
10,000.00	19.35	27.40	Pass
12,500.00	20.35	28.50	Pass
16,000.00	21.34	29.50	Pass
20,000.00	22.35	30.40	Pass

-- End of measurement results--

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-- End of Report--

Signatory: Jacob Cannon

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Calibration Certificate

Certificate Number 2023002738
Customer:
United Analyst and Engineering Consultant Co Ltd
No. 81 Soi Udonsuk 41,Sukhumvit Road,
Bangchak, Phra Khanong,
Bangkok, 10260, Thailand

Model Number	LxT1	**Procedure Number**	D0001.8384
Serial Number	0007313	**Technician**	Jacob Cannon
Test Results	Pass	**Calibration Date**	24 Mar 2023
Initial Condition	As Manufactured	**Calibration Due**	
Description	SoundTrack LxT Class 1 Class 1 Sound Level Meter Firmware Revision: 2.404	**Temperature**	23.62 °C ± 0.25 °C
		Humidity	49.3 %RH ± 2.0 %RH
		Static Pressure	85.7 kPa ± 0.13 kPa

Evaluation Method — **Tested with:**
PCB 377B02. S/N 345819
Larson Davis CAL291. S/N 0108
Larson Davis PRMLxT1. S/N 077648
Larson Davis CAL200. S/N 9079

Data reported in dB re 20 µPa.

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

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

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

The quality system is registered to ISO 9001:2015.

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

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

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

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

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1/2" adaptor is used with the preamplifier.

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

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part3.

Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 successfully completed by Physikalisch-Technische Bundesanstalt (PTB) on 2007-10-09 reference number PTB-1.72-4034218.

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

Standards Used

Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	2022-09-09	2023-09-09	001250
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
Larson Davis CAL200 Acoustic Calibrator	2022-07-21	2023-07-21	007027
Larson Davis Model 831	2023-02-22	2024-02-22	007182
PCB 377A13 1/2 inch Prepolarized Pressure Microphone	2023-03-06	2024-03-06	007185
SRS DS360 Ultra Low Distortion Generator	2022-03-29	2023-03-29	007635
Larson Davis 1/2" Preamplifier for Model 831 Type 1	2022-09-28	2023-09-28	PCB0004783

Acoustic Calibration

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

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

Loaded Circuit Sensitivity

Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-49.76	-52.44	-48.33	0.14	Pass

-- End of measurement results--

Acoustic Signal Tests, C-weighting

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

Frequency [Hz]	Test Result [dB]	Expected [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
125	-0.20	-0.20	-1.20	0.80	0.23	Pass
1000	0.13	0.00	-0.70	0.70	0.23	Pass
8000	-3.30	-3.00	-5.50	-1.50	0.32	Pass

-- End of measurement results--

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Self-generated Noise

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

Measurement	Test Result [dB]
A-weighted	44.29

-- End of measurement results--

-- End of Report--

Signatory: Jacob Cannon

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Calibration Certificate

Certificate Number 2023002738

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

Model Number	LxT1	***Procedure Number***	D0001.8378		
Serial Number	0007313	***Technician***	Jacob Cannon		
Test Results	**Pass**	***Calibration Date***	23 Mar 2023		
Initial Condition	As Manufactured	***Calibration Due***			
		Temperature	23.66 °C	± 0.25 °C	
Description	SoundTrack LxT Class 1	***Humidity***	49.3 %RH	± 2.0 %RH	
	Class 1 Sound Level Meter	***Static Pressure***	85.98 kPa	± 0.13 kPa	
	Firmware Revision: 2.404				

Evaluation Method Tested electrically using Larson Davis PRMLxT1 S/N 077648 and a 12.0 pF capacitor to simulate microphone capacitance. Data reported in dB re 20 µPa assuming a microphone sensitivity of 50.0 mV/Pa.

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

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

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

The quality system is registered to ISO 9001:2015.

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

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

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

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

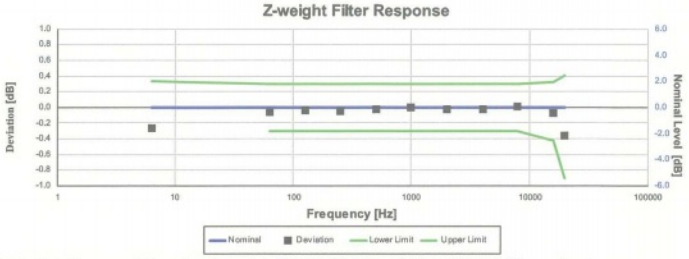
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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Hart Scientific 2626-H Temperature Probe	2021-08-25	2023-05-25	006798
SRS DS360 Ultra Low Distortion Generator	2022-12-29	2023-12-29	007118

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Z-weight Filter Response



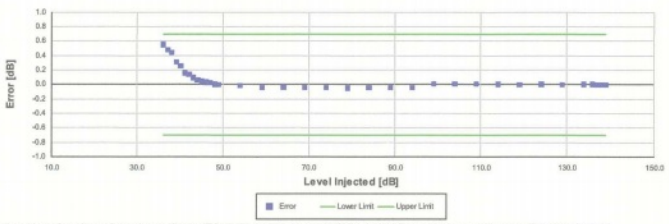
Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1983 (R2006) 5.1 and 8.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.27	-0.27	-1.11	0.33	0.15	Pass
63.10	-0.06	-0.06	-0.30	0.30	0.15	Pass
125.89	-0.04	-0.04	-0.30	0.30	0.15	Pass
251.19	-0.05	-0.05	-0.30	0.30	0.15	Pass
501.19	-0.03	-0.03	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.03	-0.03	-0.30	0.30	0.15	Pass
3,981.07	-0.02	-0.02	-0.30	0.30	0.15	Pass
7,943.28	0.01	0.01	-0.30	0.30	0.15	Pass
15,848.93	-0.08	-0.08	-0.42	0.32	0.15	Pass
19,952.62	-0.37	-0.37	-0.91	0.41	0.15	Pass

-- End of measurement results--

เอกสารไม่ควบคุม

A-weighted Broadband Log Linearity: 8,000.00 Hz



Broadband level linearity performed according to IEC 61672-3:2013 16 and ANSI S1.4-2014 Part 3: 16 for compliance to IEC 61672-1:2013 5.6, IEC 60804:2000 6.2, IEC 61252:2002 8, ANSI S1.4 (R2006) 6.9, ANSI S1.4-2014 Part 1: 5.6, ANSI S1.43 (R2007) 6.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
36.00	0.55	-0.70	0.70	0.16	Pass
37.00	0.48	-0.70	0.70	0.16	Pass
38.00	0.44	-0.70	0.70	0.16	Pass
39.00	0.31	-0.70	0.70	0.16	Pass
40.00	0.26	-0.70	0.70	0.16	Pass
41.00	0.16	-0.70	0.70	0.16	Pass
42.00	0.15	-0.70	0.70	0.16	Pass
43.00	0.10	-0.70	0.70	0.17	Pass
44.00	0.06	-0.70	0.70	0.17	Pass
45.00	0.04	-0.70	0.70	0.16	Pass
46.00	0.03	-0.70	0.70	0.16	Pass
47.00	0.03	-0.70	0.70	0.16	Pass
48.00	0.00	-0.70	0.70	0.16	Pass
49.00	0.00	-0.70	0.70	0.16	Pass
54.00	-0.02	-0.70	0.70	0.16	Pass
59.00	-0.04	-0.70	0.70	0.16	Pass
64.00	-0.04	-0.70	0.70	0.16	Pass
69.00	-0.04	-0.70	0.70	0.16	Pass
74.00	-0.04	-0.70	0.70	0.16	Pass
79.00	-0.05	-0.70	0.70	0.16	Pass
84.00	-0.04	-0.70	0.70	0.16	Pass
89.00	-0.04	-0.70	0.70	0.16	Pass
94.00	-0.04	-0.70	0.70	0.16	Pass
99.00	0.01	-0.70	0.70	0.15	Pass
104.00	0.02	-0.70	0.70	0.15	Pass
109.00	0.01	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
119.00	0.00	-0.70	0.70	0.15	Pass
124.00	0.01	-0.70	0.70	0.15	Pass
129.00	0.00	-0.70	0.70	0.15	Pass
134.00	0.00	-0.70	0.70	0.15	Pass
136.00	0.01	-0.70	0.70	0.15	Pass
137.00	0.00	-0.70	0.70	0.15	Pass
138.00	0.00	-0.70	0.70	0.15	Pass
139.00	0.00	-0.70	0.70	0.15	Pass

-- End of measurement results--

เอกสารไม่ควบคุม

Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.4

Amplitude [dB]	Duration [µs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
137.85	40	Negative Pulse	135.12	133.65	135.65	0.15	Pass
		Positive Pulse	135.12	133.64	135.64	0.15	Pass
	30	Negative Pulse	134.19	133.65	135.65	0.15	Pass
		Positive Pulse	134.19	133.64	135.64	0.15	Pass

-- End of measurement results--

Positive Pulse Crest Factor

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

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
126.85	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.16 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
116.85	3	-0.14	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.15 ‡	Pass
	10	-0.02	± 1.50	0.15 ‡	Pass
106.85	3	-0.15	± 0.50	0.15 ‡	Pass
	5	-0.13	± 1.00	0.15 ‡	Pass
	10	-0.26	± 1.50	0.15 ‡	Pass

-- End of measurement results--

Negative Pulse Crest Factor

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

Crest Factor measured according to IEC 60651:2001 9.4.2 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Crest Factor	Test Result [dB]	Limits [dB]	Expanded Uncertainty [dB]	Result
136.85	3	OVLD	± 0.50	0.15 ‡	Pass
	5	OVLD	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
126.85	3	-0.13	± 0.50	0.15 ‡	Pass
	5	-0.14	± 1.00	0.15 ‡	Pass
	10	OVLD	± 1.50	0.15 ‡	Pass
116.85	3	-0.14	± 0.50	0.15 ‡	Pass
	5	-0.12	± 1.00	0.15 ‡	Pass
	10	0.00	± 1.50	0.15 ‡	Pass
106.85	3	-0.15	± 0.50	0.15 ‡	Pass
	5	-0.12	± 1.00	0.15 ‡	Pass
	10	-0.26	± 1.50	0.15 ‡	Pass

-- End of measurement results--

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Gain

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

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.95	93.90	94.10	0.15	Pass
0 dB Gain, Linearity	41.09	40.30	41.70	0.16	Pass
OBA Low Range	94.00	93.90	94.10	0.15	Pass
OBA Normal Range	94.00	93.20	94.80	0.15	Pass

-- End of measurement results--

Broadband Noise Floor

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

Measurement	Test Result [dB]	Upper limit [dB]	Result
A-weight Noise Floor	26.97	36.00	Pass
C-weight Noise Floor	26.58	35.00	Pass
Z-weight Noise Floor	32.49	39.00	Pass

-- End of measurement results--

Total Harmonic Distortion

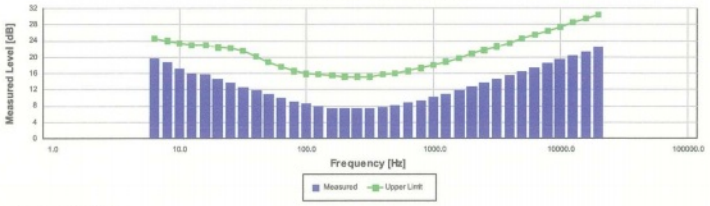
Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.70	135.05	136.65	0.15	Pass
THD	-66.61		-58.00	0.01 ‡	Pass
THD+N	-62.64		-58.00	0.01 ‡	Pass

-- End of measurement results--

เอกสารไม่ควบคุม

1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	19.80	24.60	Pass
8.00	18.80	24.00	Pass
10.00	17.19	23.50	Pass
12.50	15.99	23.00	Pass
16.00	15.86	22.90	Pass
20.00	14.51	22.40	Pass
25.00	13.66	22.30	Pass
31.50	12.51	21.50	Pass
40.00	11.77	20.20	Pass
50.00	10.95	18.80	Pass
63.00	10.01	17.60	Pass
80.00	9.05	16.60	Pass
100.00	8.51	15.90	Pass
125.00	7.92	15.70	Pass
160.00	7.54	15.50	Pass
200.00	7.46	15.20	Pass
250.00	7.39	15.20	Pass
315.00	7.47	15.20	Pass
400.00	7.66	15.70	Pass
500.00	8.16	16.00	Pass
630.00	8.75	16.60	Pass
800.00	9.37	17.30	Pass
1,000.00	10.15	18.10	Pass
1,250.00	10.99	18.90	Pass
1,600.00	11.82	19.80	Pass
2,000.00	12.70	20.80	Pass
2,500.00	13.72	21.70	Pass
3,150.00	14.57	22.60	Pass
4,000.00	15.53	23.50	Pass
5,000.00	16.46	24.50	Pass
6,300.00	17.44	25.50	Pass
8,000.00	18.45	26.50	Pass
10,000.00	19.43	27.40	Pass
12,500.00	20.42	28.50	Pass
16,000.00	21.39	29.50	Pass
20,000.00	22.40	30.40	Pass

-- End of measurement results--

เอกสารไม่ควบคุม

-- End of Report--

Signatory: Jacob Cannon

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

NSC-TISI-TIS17025 CALIBRATION 0008

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

Certificate of Calibration

Equipment :	Electronic Balance
Manufacturer :	Mettler Toledo
Model :	AB204-S
Serial No. :	1128312528
ID No. :	UAE.AIR.019/2550
Submitted by :	United Analyst and Engineering Consultant Co.,Ltd. 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Location :	Balance Room 2
Received order :	07 April 2023
Calibration Date :	07 April 2023
Ambient Temperature :	15 °C to 40 °C
Relative Humidity :	30 % to 90 %
Calibrated by :	Suwit Imjai
Approved by :	Approved Signatory

( ) Pornthippa Tameyakul
(/) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

Result of calibration ( ) Without Adjustment (*) After Adjustment by Internal Calibration
Range capacity : 0 g to 220 g **Resolution** 0.0001 g
Before Adjustment :

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

After Adjustment :

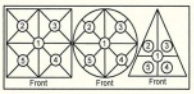
1. Determination of the standard deviation of weighing machine (n = 10)

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

เอกสารไม่ควบคุม

Result of calibration

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



Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	Maximum difference between off-center and central loading (g)
-0.0001	-0.0002	+0.0004	-0.0001	-0.0006	0.0005

3. Departure from nominal value

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

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

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เอกสารไม่ควบคุม

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

NSC-TISI-TIS17025 CALIBRATION 0008

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

Certificate of Calibration

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

( ) Pornthippa Tameyakul
(/) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

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

Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
100	100.0002	-0.0002	0.21	2.06
200	200.0003	-0.0003	0.29	2.00

After Adjustment :

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

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

เอกสารไม่ควบคุม

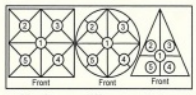
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-2

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

Result of calibration

2. Effect of off center loading

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



Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	Maximum difference between off-center and central loading (g)
+0.0001	-0.0003	+0.0003	+0.0006	+0.0002	0.0005

3. Departure from nominal value

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

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

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

NSC-TIBI-TIS17025
CALIBRATION 0009

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

Certificate of Calibration

Equipment : Electronic Balance

Manufacturer : Mettler Toledo

Model : XP6

Serial No. : B322373893

ID No. : UAE.AIR.019/2556

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

Location : Balance Room 2

Received order : 07 April 2023
Calibration Date : 07 April 2023
Ambient Temperature : 15 °C to 40 °C
Relative Humidity : 30 % to 90 %

Calibrated by : Suwit Imjai

Approved by : Approved Signatory

( ) Pornthippa Tameyakul
( ) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

Range capacity : 0 g to 6.1 g **Resolution** 0.000001 g

Before Adjustment :

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
3	2.999987	+0.000013	0.026	2.00
6	6.000003	-0.000003	0.036	2.00

After Adjustment :

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

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

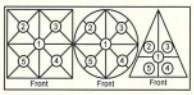
เอกสารไม่ควบคุม

Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-3
Cert.No.: 23MM333
Page: 3 of 3

Result of calibration

2. Effect of off center loading

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



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

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.000000	0.000000	0.0060	2.37
0.01	0.009998	+0.000002	0.0060	2.13
0.05	0.050003	-0.000003	0.0070	2.05
0.1	0.100007	-0.000007	0.0090	2.03
0.15	0.150000	0.000000	0.011	2.00
0.17	0.169998	+0.000002	0.014	2.00
0.2	0.200002	-0.000002	0.014	2.00
1.5	1.500001	-0.000001	0.020	2.00
3	2.999990	+0.000010	0.026	2.00
4.5	4.499994	+0.000006	0.036	2.00
6	5.999982	+0.000018	0.036	2.00

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

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เอกสารไม่ควบคุม

สุดสาครรมพัฒนาอุตสาหกรรมอาหาร
ศูนย์บริการห้องปฏิบัติการอุตสาหกรรมอาหาร
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Certificate

Certificate No.: 2301846-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsuk 41, Sukhumvit Road, Bangchack, Prakhanong, Bangkok 10260

Equipment: pH Meter
Manufacturer: Mettler Toledo
Model: SevenEasy TM S20 pH
Serial No.: 1231155210
ID No.: UAE.WAT.010/2553
Order No.: 2301846
Operation No.: 2301846-001
Date of Receipt: 17 February 2023
Date of Calibration: 24 February 2023

Calibrated by Mr.Worapob Sooktong, Scientist
Approved by (Mr.Nuttapol Niyomchart), Specialist, Division of Calibration Laboratory, Responsible for the Technical Management Team
Date of Issue: 24 February 2023

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

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

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

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2301846-001-01
Equipment: pH Meter — **Resolution:** 0.01 pH ; 1 mV
Manufacturer: Mettler Toledo — **Model:** SevenEasy TM S20 pH
Serial No.: 1231155210 — **Type:** Bench top
ID No.: UAE.WAT.010/2553

Date of Calibration: 24 February 2023

Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: Ambient Temperature: (25.1 ± 1.5) °C Relative Humidity: (50 ± 5) %
Condition of Equipment: Good Condition
Condition of this Results of Calibration

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

2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	22E1959	17 June 2023
2.2 Digital Thermometer	2709007	Fluke	CC 650577-01	30 October 2023
2.3 Thermo-Hygro Meter	NFI.BTH 007/18	PONPE 490	QR22-0886	26 April 2023
Certified Reference Material	**Lot. No.**	**Manufacturer**	**Ref N**	**Expire Date**
2.4 pH buffer 4.008 (Primary pH buffer Solution)	832606	CPAchem	PH216.L5	8 August 2024
2.5 pH buffer 6.865 (Primary pH buffer Solution)	832607	CPAchem	PH217.L5	8 August 2024
2.6 pH buffer 10.01 (Primary pH buffer Solution)	832609	CPAchem	PH220.L5	8 August 2023
2.7 pH buffer 7.00 (Standard pH buffer Solution)	832610	CPAchem	PH107.L5	8 August 2023

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

3.1 Instruments No.2.1	through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0008
3.2 Instruments No.2.2	through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0061
3.3 Instruments No.2.3	through	NSC-TISI-TIS 17025 Laboratory Accredition of Calibration No.0292
3.4 Certified Reference Material No. 2.4 to 2.6	traceable to	Primary measurement method- Harned cell using calibrated thermometer, barometer, and nanovoltmeter.The Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025
3.5 Certified Reference Material No.2.7	traceable to	BIM RefN HI-27 LotN 04.06.2021; BIM RefN HI-28 LotN 28.05.2021; BIM RefN HI-27 LotN 04.06.2021; BIM RefN HI-28 LotN 28.05.2021, the Standard Solution preparation and certified by CPAchem Ltd is accredited to ISO 17034 and ISO/IEC 17025

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

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

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

NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2301846-001-01
Equipment: pH Meter — **Resolution:** 0.01 pH ; 1 mV
Manufacturer: Mettler Toledo — **Model:** SevenEasy TM S20 pH
Serial No.: 1231155210 — **Type:** Bench top
ID No.: UAE.WAT.010/2553

Date of Calibration: 24 February 2023

Calibration Results:

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

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

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

Equipment: pH Electrode — **Type:** Combined Electrode
Manufacturer: Mettler Toledo — **Model:** InLab Solids
Serial No.: 9018311 — **ID.No.** N/A
Performance of Electrode system (Three-Point Calibration at pH 4, pH 7 and pH 10)

Certified Value @25 °C (pH)	Average Indicator Reading pH	Average Indicator Reading mV	Relative Slope (%)	Uncertainty (± pH)	Coverage Factor (k)
4.008	4.01	186	-	0.0071	2.00
6.865	6.90	19	97.68	0.0075	2.00
10.008	10.01	-160	97.29	0.0095	2.00
6.985	6.99	15	-	0.0092	2.00

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Calibration Report

Certificate No.: 2301846-001-01

Equipment: Digital Thermometer with RTD

Resolution: 0.1 ℃ Model: SevenEasy TM S20 pH

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

Manufacturer: Mettler Toledo

Date of Calibration: 24 February 2023

Location: Chemical Calibration Laboratory, National Food Institute

Environment Condition: Ambient Temperature 25 ℃ ± 1 ℃

Relative Humidity 48 % ± 3 %

Condition of this results of Calibration:

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

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

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

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

N. niyomchart

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Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2301846-001-01

Equipment: Digital Thermometer with RTD

Resolution: 0.1 ℃ Model: SevenEasy TM S20 pH

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

Manufacturer: Mettler Toledo

Date of Calibration: 24 February 2023

Calibration point: 15.0, 25.0 and 35.0 ℃

Calibration result:

- The probe was immersed in liquid bath or dry bath to a minimum depth of 120 mm.
- Description of probe, model : - S/N : -

Dimension of probe : Diameter 9 mm., Length 120 mm.,

Sheath material : Stainless Steel

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

Note

- UUC* : Unit Under Calibration

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

--------- End ---------

N. niyomchart

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Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Certificate

Certificate No.: 2302181-001-01

Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.

Address: 3 Soi Udomsuk 41, Sukhumvit Road,
Bangchack, Prakhanong, Bangkok 10260

Equipment: pH Meter

Manufacturer: METTLER TOLEDO

Model: SevenEasy pH

Serial No.: 1230525212

ID No.: UAE.WAS.003/2553

Order No.: 2302181

Operation No.: 2302181-001

Date of Receipt: 14 March 2023

Date of Calibration: 24 March 2023

Calibrated by Mr.Pheraphat Tuanjit
Scientist

Approved by N. niyomchart
(Mr.Nuttapol Niyomchart)
Specialist, Division of Calibration Laboratory
Responsible for the Technical Management Team

Date of Issue: 24 March 2023

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

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

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Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center
NSC-TISI-TIS 17025 CALIBRATION 0061

Calibration Report

Certificate No.: 2302181-001-01

Equipment: pH Meter Resolution: 0.01 pH ; 1 mV

Manufacturer: METTLER TOLEDO Model: SevenEasy pH

Serial No.: 1230525212 Type: Bench top

ID No.: UAE.WAS.003/2553

Date of Calibration: 24 March 2023

Location: Chemical Calibration Laboratory, National Food Institute

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

Condition of Equipment: Good Condition

Condition of this Results of Calibration

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

2. Reference Standards / Certified Reference Material

Instruments	Serial / ID No.	Manufacturer	Certificate No.	Due Date
2.1 DC Voltage Calibrator	2709007	Fluke	22E1959	17 June 2023
2.2 Digital Thermometer	2709007	Fluke	CC-650557-01	30 October 2023
2.3 Thermo-Hygro Meter	NFI.BTH003/17	PONPE	TE 650555-01	21 September 2023
Certified Reference Material	**Lot. No.**	**Manufacturer**	**Ref N**	**Expire Date**
2.4 pH buffer 4.006 (Primary pH buffer Solution)	873608	CPAchem	PH216.L5	16 February 2025
2.5 pH buffer 6.865 (Primary pH buffer Solution)	873609	CPAchem	PH217.L5	16 February 2025
2.6 pH buffer 10.01 (Primary pH buffer Solution)	873611	CPAchem	PH220.L5	16 February 2024
2.7 pH buffer 7.00 (Standard pH buffer Solution)	873612	CPAchem	PH107.L5	16 February 2024

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

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

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

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

N. niyomchart

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

NSC-TISI-TIS 17025
CALIBRATION 0061

Calibration Report

Certificate No.: 2302181-001-01

Equipment: pH Meter **Resolution:** 0.01 pH : 1 mV

Manufacturer: METTLER TOLEDO **Model:** SevenEasy pH

Serial No.: 1230525212 **Type:** Bench top

ID No.: UAE.WAS.003/2553

Date of Calibration: 24 March 2023

Calibration Results:

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

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

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

Equipment: pH Electrode **Type:** Combined Electrode

Manufacturer: METTLER TOLEDO **Model:** InLab Solids

Serial No.: 1156883 **ID.No.** N/A

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

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

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Food Industrial Laboratory Service Center

NSC-TISI-TIS 17025
CALIBRATION 0061

Calibration Report

Certificate No.: 2302181-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C Model: SevenEasy pH

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

Manufacturer: METTLER TOLEDO

Date of Calibration: 24 March 2023

Location: Chemical Calibration Laboratory, National Food Institute

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

Relative Humidity 55 % ± 5 %

Condition of this results of Calibration:

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

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

Support Equipment : - Low Temperature Bath (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 : [X] Without adjustment [ ] After adjustment

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national food institute ministry of industry
Foundation for Industrial Development National Food Institute
Food Industrial Laboratory Service Center

NSC-TISI-TIS 17025
CALIBRATION 0061

Calibration Report

Certificate No.: 2302181-001-01

Equipment: Digital Thermometer with RTD (pH Meter)

Resolution: 0.1 °C Model: SevenEasy pH

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

Manufacturer: METTLER TOLEDO

Date of Calibration: 24 March 2023

Calibration point: 15.0, 25.0 and 30.0 °C

Calibration result:

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

Dimension of probe : Diameter 3 mm., Length 120 mm.,

Sheath material : N/A

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

Note

- UUC* : Unit Under Calibration

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

--------- End ---------

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เอกสารไม่ควบคุม

DKSH

NSC-TISI-TIS 17025

Certificate of Calibration

Equipment:	CONDUCTIVITY METER	Certificate No.:	C24230059
Model:	Lab 955	Issued Date:	16 March 2023
Serial No. (or ID.):	16300356	Job No.:	KSPR2304472
Manufacturer:	SI Analytics	Page:	1 of 2
Electrode Serial No.	16070067	Model : LF413T	Brand : SI Analytics
Condition:	In Condition		

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

Calibration By: Mr.Atachai Ngamchanat

Calibration Date: 16 March 2023

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. 838312, 838313, 838316

(Mr. Atachai Ngamchanat)
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 ดีเคเอสเอช เทคโนโลยี จำกัด
DKSH Technology Limited
2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260
2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Delivering Growth – in Asia and Beyond.

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Calibration Results:

Before Adjustment

Standard Conductivity Solution		Unit Under Calibration Reading		Correction		Coverage Factor (k)	Uncertainty (±)	
25.000	µS/cm	24.5	µS/cm	0.500	µS/cm	2.00	0.21	µS/cm
1413.0	µS/cm	1403	µS/cm	10.0	µS/cm	2.00	9.0	µS/cm
111.3	mS/cm	108.5	mS/cm	2.80	mS/cm	2.00	0.67	mS/cm

After Adjustment ; at 1413 µS/cm

Standard Conductivity Solution		Unit Under Calibration Reading		Correction		Coverage Factor (k)	Uncertainty (±)	
25.000	µS/cm	24.8	µS/cm	0.200	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	108.8	mS/cm	2.50	mS/cm	2.00	0.67	mS/cm

The End of Certificate

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ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: KSPR2304472

ชนิดเครื่องมือ: CONDUCTIVITY METER รุ่น: Lab 955 หมายเลขเครื่อง: 16300356

ตรวจสอบ (รับ) 16 Mar 2023		รายการตรวจเช็ค	ตรวจสอบ (ส่ง) 16 Mar 2023		หมายเหตุ
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
☑	☐	1. ความสมบูรณ์เครื่อง	☑	☐	
☑	☐	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	☑	☐	
☑	☐	3. สวิทช์ ปิด – เปิด เครื่อง (On-Off Swicth)	☑	☐	
☑	☐	4. ปุ่มกด (Keypad)	☑	☐	
☑	☐	5. หน้าจอ (Display, Screen Contrast)	☑	☐	
		Spectrophotometer			
☐	☐	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	☐	☐	
☐	☐	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	☐	☐	
☐	☐	8. ความยาวคลื่น (Wavelength Check)	☐	☐	
☐	☐	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	☐	☐	
☐	☐	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	☐	☐	
☐	☐	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	☐	☐	
		pH Meter and Conductivity Meter			
☑	☐	12. อิเล็คโทรด (Electrode and Connection Cable)	☑	☐	
☐	☐	13. ระดับสารละลายใน Electrode (Level KCl)	☐	☐	
☐	☐	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	☐	☐	
☐	☐	15. ขาจับอิเล็คโทรด (Stand)	☐	☐	
		Turbidimeter			
☐	☐	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	☐	☐	
☐	☐	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่เกิน 3.0)	☐	☐	
		Automatic titrator			
☐	☐	18. สภาพ Piston Burettes	☐	☐	
☐	☐	19. Function Rinsing and Dosing	☐	☐	
☐	☐	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	☐	☐	

ข้อแนะนำ : Electrode วัดอุณหภูมิได้ 25.1°C โดย Control Waterbath ที่ 25.0 ±0.1°C

Mr.Atachai Ngamchanat
Service Engineer

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด
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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

NSC-TISI-TIS17025 CALIBRATION 0506

Certificate of Calibration

Equipment :	Electronic Balance
Manufacturer :	Mettler Toledo
Model :	XSR205
Serial No. :	C210685394
ID No. :	UAE.WAO.010/2565
Submitted by :	United Analyst and Engineering Consulant Co.,Ltd. 3 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phakhanong, Bangkok 10260
Location :	Balance Room
Received order :	26 April 2023
Calibration Date :	26 April 2023
Ambient Temperature :	15 °C to 40 °C
Relative Humidity :	30 % to 90 %
Calibrated by :	Man Pattanapongpaiboon
Approved by :	Approved Signatory

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

Issue Date : 2 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

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

Before Adjustment :

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

After Adjustment :

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

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

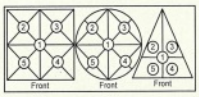
เอกสารไม่ควบคุม

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

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

2. Effect of off center loading

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



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

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.00000	0.00000	0.014	2.11
0.05	0.04999	+0.00001	0.015	2.09
0.1	0.09999	+0.00001	0.015	2.07
1	1.00000	0.00000	0.018	2.04
5	5.00000	0.00000	0.026	2.00
20	20.00002	-0.00002	0.045	2.00
50	50.00002	-0.00002	0.080	2.00
80	80.00002	-0.00002	0.15	2.00
100	100.0000	0.0000	0.17	2.00
150	150.0000	0.0000	0.29	2.00
200	199.9999	+0.0001	0.29	2.00

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

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เอกสารไม่ควบคุม

a 1159271

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

ilac-MRA
NSC-TISI-TIS17025 CALIBRATION 0808

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

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UF 55
Serial No. : B212.0411
ID No. : UAE.WAO.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 : 11 April 2023
Calibration Date : 11 - 12 April 2023
Ambient Temperature : (26 ± 10) °C
Relative Humidity : (50 ± 30) %

Calibrated by : Krisda Malee

Approved by :
Approved Signatory

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

Issue Date : 24 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0053359

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2304-0156OC-1

Cert. No.: 23TM373
Page : 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

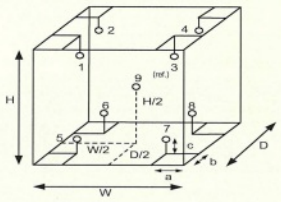
1. Reference standard instrument:-

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

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

Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

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



Probe Installation Details :
a = 5.0 cm
b = 5.0 cm
c = 5.0 cm

Dimension of Chamber :
D = 0.50 m
W = 0.80 m
H = 0.75 m
Capacity = 0.30 m³

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

เอกสารไม่ควบคุม

a 1158261

Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2304-0156OC-1
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

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

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

Calibration Point (°C)	Measured Temperature (°C) Position 1	2	3	4	5	6	7	8	9 (ref.)	Uncertainty (±°C)
104.0	104.512	104.016	104.542	104.407	103.704	103.729	104.167	104.158	104.001	0.42
120.0	120.317	119.768	120.524	120.232	119.363	119.209	119.888	119.797	119.735	1.1
180.0	180.878	179.819	181.357	180.871	179.303	179.139	180.230	180.055	179.960	1.1

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

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

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เอกสารไม่ควบคุม

a 1158260

LS 45/50B/55 - Preventive Maintenace report			
Company Name:	United analyst and Engineering Consultant Co.,Ltd.		
Address:	3 Soi Udomsuk 41, Sukumvit Road, Phrakhanong, Bangkok 10260		
User Name :	K. Primpun	**WO Number:**	WO-01624974
Telephone Number :	02-763-2828	**Certificate Number :**	FLR1001-2023
Customer Support Engineer :	Tanongsak	**P.M. Number**	1 of 1
PM Performed: (DD-MMM-YYYY)	2-Feb-2023	**Next PM Due Date: (DD-MMM-YYYY)**	2-Feb-2024

Scope

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

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting thePM. Always check with the customer before making any changes that may affect the customer's analysis should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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เอกสารไม่ควบคุม

Component List

Component Specific Model	Serial #	Software Version		Configuration Notes
LS55	81440	4.00.03		
-	-	-	-	-
-	-	-	-	-

Parts Lists

Test standard Used	
Part Number (if applicable)	**Description**
C 520-7440	Stanadard Fluorence Intensity Filter
B050 7805	Sealed Water Cell

Additional Tools Required for PM				
Part Number (if applicable)	**Description**	**Quantity**	**Serial #**	**Calibration Due Date (MM/YY)**

เอกสารไม่ควบคุม

Procedure Checklist

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

1. General:

☑ Review the instrument performance with the customer and document any recent problems.

☑ Perform general inspection of system for cleanliness.

2. Optical checks and Clean:

☑ Lamp Alignment/Intensity

☑ Sample Compartment and Windows

☑ Mirror and Grating Alignment

☑ Filter Wheel

☑ Cell Holder Alignment

3. Mechanical:

☑ Physical inspection – Please write any comments in the additional comments section.

☑ Grating Drive Mechanism.

☑ Slit Drive Mechanism.

☑ Sample Holder

4. Test:

☑ Emission Wavelength Accuracy.

Emission Wavelength Accuracy		Actual Value	Validation Criteria
Target Peak (nm)		(nm)	Accuracy Limit +/- (nm)
Target Peak # 1	253.7	254.0	± 1.0 nm
Target Peak # 2	507.3	507.4	± 1.0 nm
Target Peak # 3	626.0	625.8	± 1.0 nm

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☑ Excitation Wavelength Accuracy.

Excitation Wavelength Accuracy		Actual Value	Validation Criteria
Target Peak (nm)		(nm)	Accuracy Limit +/- (nm)
Target Peak # 1	253.7	253.2	± 1.0 nm
Target Peak # 2	365.0	365.4	± 1.0 nm
Target Peak # 3	507.3	508.0	± 1.0 nm

☑ Emission Slit calibration.

Emission Slit		Actual Value	Validation Criteria
Target Value (nm)		(nm)	Accuracy Limit +/- (nm)
Target Peak # 1	2.5	2.63	± 0.5 nm
Target Peak # 2	5.0	4.75	± 0.5 nm
Target Peak # 3	10.0	9.99	+ 1.0 / - 0.5 nm

☑ Excitation Wavelength Repeatability.

Emission Slit		Actual Value	Validation Criteria
Target Value (nm)		(nm)	Accuracy Limit +/- (nm)
Target Peak # 1	2.5	2.57	± 0.5 nm
Target Peak # 2	5.0	5.08	± 0.5 nm
Target Peak # 3	10.0	9.80	+ 1.0 / - 0.5 nm

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☑ Water Raman Sensitivity

	Actual Value
Signal to Noise	288 : 1
Drift	0.03

☑ Stray Light

	Actual Value
Stray Light at 290nm	2.64
Stray Light at 300nm	0.77

5. Accessory (where applicable):

☐ Micro Plate Reader
☐ Integrating Sphere
☐ Multi Cell Holder
☐ Water Jacketed Cell Holder
☐ etc. .....

6. Review:

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

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Additional Comments

Additional Comments Regarding the PM
Reference intensity low

Review

The PM checks and if applicable performance tests for LS 45/50B/55 have been completed.

This LS 45/50B/55 Passes ☑ *Fails* ☐ *the PM.*

Review of Preventive Maintenance:	
Authorized PerkinElmer Representative: Tanawat R.	Date: 2-Feb-23 (DD-MMM-YYYY)
Authorized Customer Representative:	Date: 2-Feb-23 (DD-MMM-YYYY)

เอกสารไม่ควบคุม

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

CERTIFICATE OF CALIBRATION

Certificate No. : SP23-021 Page 1 of 5

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

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

Location of calibration : Laboratory 315

Equipment : UV-Vis Spectrophotometer

Manufacturer : Agilent Technologies

Model : Cary 60

Serial No. : MY15410009

ID No. : N/A

Received Date : 20 May 2023

Calibration Date : 20 May 2023

Issue Date : 23 May 2023

Condition Instrument : Good

Calibrated by : (Mr.Tanawut Rittidach) Technical Manager

Approved by : (Ms. Chonthicha Sangngern) Quality Manager

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

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

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

REPORT OF CALIBRATION

Certificate No. : SP23-021 Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

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

Certified Reference Materials :

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

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

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

FM-708-02 R01 1/11/2021

เอกสารไม่ควบคุม

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Calibration Results : Without adjustment

Photometric Accuracy :

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

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REPORT OF CALIBRATION

Certificate No. : SP23-021

Photometric Accuracy :

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

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

REPORT OF CALIBRATION

Certificate No. : SP23-021

Wavelength Accuracy :

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

Remark : - UUC = Unit Under Calibration

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

- End of Certificate -

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

CALIBRATION CERTIFICATE

NOMENCLATURE : 1. Atomic Absorption Spectrophotometer "Agilent Technologies" Model AA240FS, Serial No. MY13160001
2. Working standard solution "Inorganic Ventures" Multi Analyte Custom Grade Solution, Lot No. S2-MEB708640

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

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

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

CALIBRATION DATE : 2 February 2023

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

AMBIENT CONDITIONS : Temperature 22 °C Relative humidity 58 %

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

Calibrated by 1. Danai Srithongkum
(Mr. Danai Srithongkum)

2. Atipat
(Mr. Atipat Ratana)

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

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CALIBRATION DATA

1. Noise Level

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

Continue 2 / 5

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Request No. 25-66 / 0323 2 / 5 MTC. ACL. No. 387 / 66

2. Precision

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

Continue 3 / 5

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Request No. 25-66 / 0323 3 / 5 MTC. ACL. No. 387 / 66

3. Trueness

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

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

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

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

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

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

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Request No. 25-66 / 0323 4 / 5 MTC. ACL. No. 387 / 66

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

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

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

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

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

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

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Request No. 25-66 / 0323 5 / 5 MTC. ACL. No. 387 / 66

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

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

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

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

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

Calibrated by 1. (Mr. Danai Srithongkum)

2. Atipat (Mr. Atipat Ratana)

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

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End of Certificate

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Agilent Technologies

Agilent 5110 and 5100 ICP-OES
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Customer Information

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

Service Engineer's Responsibilities

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

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Agilent 5110 and 5100 ICP-OES
Preventive Maintenance Checklist

System Information

Instrument system name and ID	ICP 5110 VDV
Instrument system site and location	UAE / 3rd Floor Laboratory

List system component product numbers	List the serial numbers of each component
1. G8015A	1. MY18030001
2. G8481A	2. 1801-01988
3.	3.
4.	4.
5.	5.
6.	6.
7.	7.
8.	8.
9.	9.
10.	10.

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

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Agilent 5110 and 5100 ICP-OES
Preventive Maintenance Checklist

General Preparation

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

Inspect and clean the system

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

G8481A Cooling water system

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

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SPS 3 Auto Sampler

- ☑ **Section NOT Applicable**
- ☐ Power cycle the autosampler and verify successful initialization.
- ☐ Inspect X and Z axis belts for wear. Replace 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

- ☑ **Section NOT Applicable**
- ☐ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☐ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner
- ☐ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☐ Check the X-axis, Theta-axis and Z-axis 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

AVS 4, 6, 7

- ☑ **Section NOT Applicable**
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

Instrument Adjustment

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

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

Instrument Performance Test Results Table

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

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	4105.6	8364.0	4375.0	8400.8
Mn 257.610 nm SRBR	11064.7	31842.1	12801.7	30846.2
Al 396.152 nm SBR	7.5	14.9	9.9	16.8
K 766.491 nm SBR	5.1	36.8	6.4	39.7

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

Instrument Test Results Table

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

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

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ICP-OES Status Results Table

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

Measurement	Standby Mode		Plasma On	
Mains Voltage	224.540	VAC	211.913	VAC
Mains Current	0.204	A	0.104	A
Instrument Temperature	28.8	°C	28.7	°C
RF Air Flow (sensor speed)	15.0	Hz	19.0	Hz
Plasma Exhaust Temperature	No measurement		26.7	°C
Water Flow Oscillator	No measurement		1.64	L/min
Water Flow Detector	1.06	L/min	1.06	L/min
Water Inlet Temperature	18.0	°C	18.0	°C
Polychromator Temperature	35.0	°C	35.0	°C
CCD Temperature	-39.8	°C	-39.8	°C
Thermal Stabilizer	35.0	°C	35.0	°C
Argon Supply Pressure	671.94	kPa	687.33	kPa
Purge Gas Supply Pressure*1	674.90	kPa	645.40	kPa
Option Gas Supply Pressure*1	N/A	kPa	N/A	kPa
Nebulizer Flow	No measurement		0.70	L/min
Nebulizer Back Pressure	No measurement		164.63	kPa
Plasma Gas Flow	No measurement		11.98	L/min
Auxiliary Gas Flow	No measurement		1.00	L/min
RF Power	No measurement		1200	W
RF Supply Current	No measurement		8.663	A
RF Supply Voltage	No measurement		184.660	V

*1 If option installed

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ICP-OES Parts List Table

Part description	Part Number	Product /Model # where used	Quantity Consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Polyclear Cooling Fluid	G3292-80010	G8481A	
Purge Gas Filter	G8010-60136	All	1
Air inlet filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	
PVC waste tubing.8mm od x 5mm id, 2m	G8410-80122	SPS 4	
Additional Parts may be required from engineers stock:			
X axis drive belt	5410047500	SPS 3	
Z axis drive belt	5410047400	SPS 3	
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	

Restore system

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

Leave system in an idle state: on and purging.

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

Service Review

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

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Agilent Technologies

Agilent 5110 and 5100 ICP-OES
Preventive Maintenance Checklist

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

Service Engineer Comments (optional)

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

Other Important Customer Web Links

How to get information on your product:

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

Service Completion

Service request number 6005625287 Date service completed 30 NOV 2022

Agilent signature Worawit T. Customer signature

Document part number: G8014-90075

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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	Test Before PM
Test Completed On	11/30/2022 9:35:32 AM

Result Summary

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

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Resolution Test Pass

Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	6.62
As (188.980 nm)	≤ 8.20	6.20
C (193.027 nm)	≤ 11.50	8.35
Mo (202.032 nm)	≤ 8.20	6.41
Cr (206.158 nm)	≤ 13.40	9.04
Zn (213.857 nm)	≤ 8.70	6.62
Pb (220.353 nm)	≤ 9.50	7.13
Co (228.615 nm)	≤ 17.20	11.71
Ba (230.424 nm)	≤ 9.40	7.21
Mn (257.610 nm)	≤ 13.30	9.50
Mn (260.568 nm)	≤ 20.30	14.33
Cr (267.716 nm)	≤ 11.00	8.14
Cu (324.754 nm)	≤ 25.00	18.98
Cu (327.395 nm)	≤ 14.20	11.24
Sr (338.071 nm)	≤ 33.50	24.47
Ba (455.403 nm)	≤ 44.00	33.88
Sr (460.733 nm)	≤ 36.00	17.22
Ba (493.408 nm)	≤ 36.00	25.48
Ba (614.171 nm)	≤ 42.00	25.47
Ar (675.283 nm)	≤ 74.00	59.82
K (766.491 nm)	≤ 80.00	64.94

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Sensitivity Test Pass

Radial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	147.7	1156.5	55.5
Se (196.026 nm)	≥ 41.0	SRBR	111.1	1195.3	97.7
Zn (213.857 nm)	≥ 1421.0	SRBR	4100.6	51959.5	159.6
Pb (220.353 nm)	≥ 46.0	SRBR	192.5	2808.6	185.7
Mn (257.610 nm)	≥ 3518.0	SRBR	11064.7	264165.0	567.6
Al (396.152 nm)	≥ 3.4	SBR	7.5	49047.9	5770.5
Ba (493.408 nm)	≥ 34.0	SBR	107.4	1887710.3	17407.5
K (766.491 nm)	≥ 1.8	SBR	5.1	100805.9	16626.4

Axial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	234.9	3056.4	152.9
Se (196.026 nm)	≥ 159.0	SRBR	218.1	3865.1	271.6
Zn (206.200 nm)	≥ 234.0	SRBR	1306.5	15850.4	144.5
Zn (213.857 nm)	≥ 1743.0	SRBR	8364.0	183037.8	476.4
Cd (214.439 nm)	≥ 4227.0	SRBR	7718.5	143240.2	342.8
Pb (220.353 nm)	≥ 320.0	SRBR	576.3	14465.2	580.4
Mn (257.610 nm)	≥ 10625.0	SRBR	31842.1	1411257.3	1958.9
Cr (267.716 nm)	≥ 1048.0	SRBR	4492.1	183110.6	1632.2
Cu (324.754 nm)	≥ 19.0	SBR	46.2	371487.5	7862.9
Al (396.152 nm)	≥ 6.0	SBR	14.9	278447.4	17552.6
Ba (493.408 nm)	≥ 60.0	SBR	190.6	10061527.3	52519.8
K (766.491 nm)	≥ 24.0	SBR	36.8	1922163.4	50858.1

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Precision Test **Pass**

Radial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	0.82
Se (196.026 nm)	≤ 2.60	0.71
Zn (213.857 nm)	≤ 1.50	0.43
Pb (220.353 nm)	≤ 2.60	0.76
Mn (257.610 nm)	≤ 1.50	0.60
Al (396.152 nm)	≤ 1.50	0.48
Ba (493.408 nm)	≤ 1.50	0.89
K (766.491 nm)	≤ 1.50	0.42

Axial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.57
Se (196.026 nm)	≤ 1.50	0.76
Zn (206.200 nm)	≤ 1.50	0.61
Zn (213.857 nm)	≤ 1.50	0.51
Cd (214.439 nm)	≤ 1.50	0.55
Pb (220.353 nm)	≤ 1.50	0.52
Mn (257.610 nm)	≤ 1.50	0.54
Cr (267.716 nm)	≤ 1.50	0.54
Cu (324.754 nm)	≤ 1.50	0.69
Al (396.152 nm)	≤ 1.50	0.91
Ba (493.408 nm)	≤ 1.50	0.85
K (766.491 nm)	≤ 1.50	1.22

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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	PM Functional test
Test Completed On	11/30/2022 11:43:36 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	19.00

Water Flow Test **Pass**

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

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Gas Flows Test **Pass**

Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.70	163.37	2.00	1.99	108.49

Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	2.00	112.85	18.00	17.91	23.46

RF Generator Test **Pass**

RF Power Supply Test	Passed
RF Power Supply (V)	147.437
RF Oscillator Test	Passed
RF Oscillator Frequency (MHz)	0.000
Work Coil Current (A)	45.069
RF Power Supply Current (A)	1.997

Camera Test **Pass**

	Integration Time (ms)	Standard Deviation	Status
Electronic Offset Test	1000	5.305	Passed
Dark Current Test	6000	0.578	Passed
Array Test	5	0.024	Passed
Linearity Test		0.118	Passed

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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	PM Performance test
Test Completed On	11/30/2022 12:10:42 PM

Result Summary

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

Optics Test **Pass**

	Radial	Axial
Intensity	5674608	5823476
Wavelength	737.212	737.212

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Resolution Test — **Pass**

Element Wavelength	Specification	Width
N (174.213 nm)	≤ 9.40	6.79
As (188.980 nm)	≤ 8.20	6.09
C (193.027 nm)	≤ 11.50	8.29
Mo (202.032 nm)	≤ 8.20	6.30
Cr (206.158 nm)	≤ 13.40	9.05
Zn (213.857 nm)	≤ 8.70	6.77
Pb (220.353 nm)	≤ 9.50	7.02
Co (228.615 nm)	≤ 17.20	11.67
Ba (230.424 nm)	≤ 9.40	7.39
Mn (257.610 nm)	≤ 13.30	9.48
Mn (260.568 nm)	≤ 20.30	14.25
Cr (267.716 nm)	≤ 11.00	7.94
Cu (324.754 nm)	≤ 25.00	18.99
Cu (327.395 nm)	≤ 14.20	11.33
Sr (338.071 nm)	≤ 33.50	24.44
Ba (455.403 nm)	≤ 44.00	33.86
Sr (460.733 nm)	≤ 36.00	17.51
Ba (493.408 nm)	≤ 36.00	25.56
Ba (614.171 nm)	≤ 42.00	24.96
Ar (675.283 nm)	≤ 74.00	59.38
K (766.491 nm)	≤ 80.00	65.63

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Sensitivity Test — **Pass**

Radial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	147.8	1149.3	54.8
Se (196.026 nm)	≥ 41.0	SRBR	111.6	1222.8	101.0
Zn (213.857 nm)	≥ 1421.0	SRBR	4375.0	52592.3	143.7
Pb (220.353 nm)	≥ 46.0	SRBR	199.8	2744.4	166.5
Mn (257.610 nm)	≥ 3518.0	SRBR	12801.7	285591.3	496.0
Al (396.152 nm)	≥ 3.4	SBR	9.9	52888.6	4873.6
Ba (493.408 nm)	≥ 34.0	SBR	154.6	2287291.6	14698.1
K (766.491 nm)	≥ 1.8	SBR	6.4	106701.6	14350.9

Axial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	242.4	3170.1	154.8
Se (196.026 nm)	≥ 159.0	SRBR	226.1	4134.5	289.3
Zn (206.200 nm)	≥ 234.0	SRBR	1126.6	13782.0	146.5
Zn (213.857 nm)	≥ 1743.0	SRBR	8400.8	177166.3	442.5
Cd (214.439 nm)	≥ 4227.0	SRBR	7001.9	125884.2	321.6
Pb (220.353 nm)	≥ 320.0	SRBR	536.3	12909.3	532.6
Mn (257.610 nm)	≥ 10625.0	SRBR	30846.2	1287989.0	1738.8
Cr (267.716 nm)	≥ 1048.0	SRBR	4396.0	167335.6	1424.4
Cu (324.754 nm)	≥ 19.0	SBR	52.1	373690.7	7033.1
Al (396.152 nm)	≥ 6.0	SBR	16.8	268357.7	15112.4
Ba (493.408 nm)	≥ 60.0	SBR	225.2	10173441.5	44971.7
K (766.491 nm)	≥ 24.0	SBR	39.7	1874136.2	46055.7

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Precision Test — **Pass**

Radial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	0.60
Se (196.026 nm)	≤ 2.60	0.84
Zn (213.857 nm)	≤ 1.50	0.29
Pb (220.353 nm)	≤ 2.60	0.59
Mn (257.610 nm)	≤ 1.50	0.28
Al (396.152 nm)	≤ 1.50	0.28
Ba (493.408 nm)	≤ 1.50	0.59
K (766.491 nm)	≤ 1.50	0.23

Axial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.71
Se (196.026 nm)	≤ 1.50	0.43
Zn (206.200 nm)	≤ 1.50	0.46
Zn (213.857 nm)	≤ 1.50	0.37
Cd (214.439 nm)	≤ 1.50	0.48
Pb (220.353 nm)	≤ 1.50	0.48
Mn (257.610 nm)	≤ 1.50	0.74
Cr (267.716 nm)	≤ 1.50	0.26
Cu (324.754 nm)	≤ 1.50	0.51
Al (396.152 nm)	≤ 1.50	0.45
Ba (493.408 nm)	≤ 1.50	0.81
K (766.491 nm)	≤ 1.50	0.84

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UNITED ANALYST AND ENGINEERING CONSULTANT COMPANY Ltd.

Automatic Mercury Analyzer

Model RA-4500

Preventive Maintenance Report

Serial No. : 17780278

Soft version : Ver 2.0.7

ROM version : Ver 2.0.1

Date : 11 July 2023

PM by : Pradit Mayong

(Pradit M.)

Approved by :

(Pathom S.)

Coax Group Corporation Ltd.
1131/62,64,325-331 Nakornchaisri road,
Kwang ThanonNakornchaisri, Dusit, Bangkok 10300 Thailand
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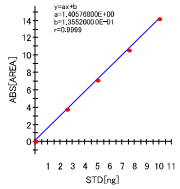
Inspection result

ITEM		STANDARD	RESULT	JUDGE
1. Self Check	1.1 Heating		PASS	OK
	1.2 Cooling		PASS	OK
	1.3 Leak		PASS	OK
	1.4 Optical system		PASS	OK
	1.5 Drift		PASS	OK
2. Analytical curve inspection(AREA)				
	2.1 No Pretreatment (Low Conc.)	Correlation coefficient (r) ≥ 0.9990	1.0000	OK
3. Repeatability(AREA)				
	3.1 No Pretreatment 100ppb, n=5		1. 99.12 ppb	
			2. 101.48 ppb	
			3. 101.24 ppb	
			4. 102.34 ppb	
			5. 101.92 ppb	
		C.V. ≤ 5%	1.23%	OK
4. Blank		Below 1.0 (AREA)	0.2062	OK

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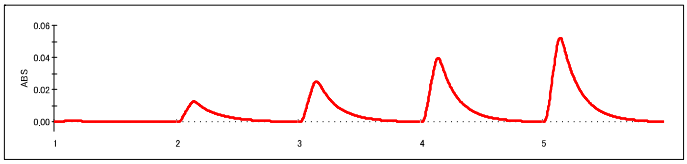
Title : Preventive Maintenance RA-4500 sn:17780278
Date : 7/11/2023
Name : Coax Group
Memo : Calibration Curve 0-10ng

Calib



STD

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



SMP

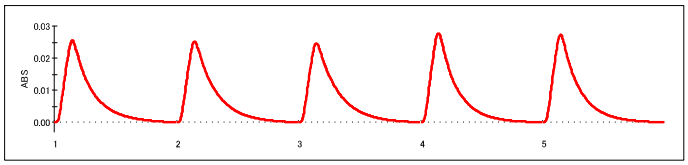
No.	NAME	SVOL [mL]	CVOL [mL]	DVOL [mL]	AREA [ON]	MEAS [ng]	CONC [ug/L]	Note
1	hg 100 ppb	0.050	5.000	5.000	7.1027	4.9561	99.122	
2	hg 100 ppb	0.050	5.000	5.000	7.2687	5.0742	101.484	
3	hg 100 ppb	0.050	5.000	5.000	7.2514	5.0619	101.238	
4	hg 100 ppb	0.050	5.000	5.000	7.3285	5.1168	102.336	
5	hg 100 ppb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

Statistics

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

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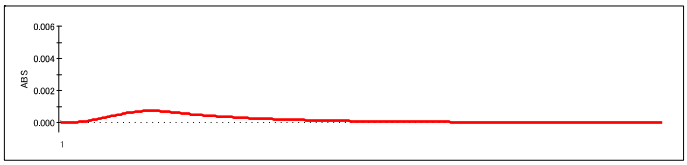
Self Check

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

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

SMP

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



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Agilent CrossLab
From Insight to Outcome

Agilent CrossLab Start Up Services

Agilent 8890 Gas Chromatograph Preventive Maintenance Checklist

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

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

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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.
- Any parts, not included in the Parts Lists section of this document, are not part of the recommended Preventive Maintenance service, nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.

Important Customer Web Links

- For more information about *Agilent Technologies services*, please visit our website using the following URL: http://www.agilent.com/en-us/products/crosslab-instrument-services/service-repair
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit https://community.agilent.com/welcome.
- To access **Agilent University**, visit http://www.agilent.com/crosslab/university/ to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- A useful **Agilent Resource Center** web page is available, which includes short videos on maintenance, quick lists of consumables for new instruments, and other valuable information. Check out the Resource Page here. https://www.agilent.com/en-us/agilentresources.
- Need technical support, FAQs, supplies? – visit our **Support Home page** http://www.agilent.com/search/support.
- Videos about specific preparation requirements for your instrument can be found by searching the *Agilent YouTube* channel at https://www.youtube.com/user/agilent.

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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 **"Section not applicable"** check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance service in the order of the tasks listed.
- Complete the Service Review section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Complete the total number of pages field in the Service Completion section
- ***Ask the customer to sign the Service Completion section including the customer's and your signature.***

Additional Instruction Notes

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

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System Information

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

Instrument System Name and ID	CN1945A066
Instrument System Site and Location	UAE GCMS (405)

List System Component Product Numbers	List the Serial Numbers of each Component
1. G3542A	CN 1945A066
2.	
3.	
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Preparation

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

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Preventive Maintenance Procedure

Clean and inspect GC

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

Inlet and detector consumable replacement

- [x] Replace the split vent trap cartridge filter using the Maintenance procedure from either the Browser User interfaces on units with these inlets: Split/Splitless Capillary (SSL), Multi-Mode Inlet (MMI), Programmed Temperature Vaporizer (PTV), Volatiles Interface (VI).
- [x] If the inlet system is used in Split Mode with viscous samples, inspect and clean the split vent tube on the inlet and flush or replace the tubing between the inlet and the split vent trap.
- [x] For the inlets installed, perform inlet maintenance using the Maintenance procedure from the Browser User interfaces. Record the results. (Leak and Restriction Test)
- [ ] If the GC includes a Flame Ionization Detector (FID), replace the jet. If the ignitor shows any buildup of sample or corrosion, replace the ignitor. Examine the FID collector and castle assemblies for contamination – clean as necessary.

Zero Sensors and Leak test

- [x] Zero all pressure sensors using the Browser interface.
- [x] Perform inlet pressure decay test(s) from the diagnostics screen on the Browser User interface. Record if test passed or failed in the results table.

Note: If the PM is done in preparation for an Operational Qualification, then the pressure decay test defined within that protocol can be used for the PM.

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ALS Maintenance

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

Restore Instrument

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

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

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Signature Page

Service Review

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

PM Test Results Table

Test description	Before PM Service	After PM Service
Front detector output	N/A	N/A
Back detector output	N/A	N/A
AUX 1 detector output	N/A	N/A
AUX 2 detector output	N/A	N/A
Test description	**Expected test result**	**Actual test result**
Leak and Restriction Test after front inlet maintenance	Pass	PASS
Leak and Restriction Test after back inlet maintenance	Pass N/A	N/A
Leak and Restriction Test after front inlet Split Vent Trap replacement	Pass	PASS
Leak and Restriction Test after back inlet Split Vent Trap replacement	Pass N/A	N/A
Front inlet pressure decay test	Pass	PASS
Back inlet pressure decay test	Pass N/A	N/A

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PM Parts List Table

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

Part description	Part number	Product or model# where used	Quantity consumed
SSL Capillary Inlet PM kit, Splitless	5190-6497	8890 GC	1
SSL Capillary Inlet PM kit, Split	5188-6496	8890 GC	1
SSL Capillary Ultra Inert Inlet Gold Seal with Washer	5190-6144	8890 GC	N/A
SSL Capillary Ultra Inert Inlet Splitless Liner, Single taper with Glass Wool	5190-2293	8890 GC	N/A
SSL Capillary Ultra Inert Inlet Low Pressure Drop Split Liner - with Glass Wool	5190-2295	8890 GC	N/A
PP Inlet PM kit	5188-6498	8890 GC	N/A
Split vent trap PM kit, single cartridge (for MMI, PTV & VI)	5188-6495	8890 GC	N/A
MMI Cleaning Kit	G3510-60820	8890 GC	N/A
PTV Septumless Head Rebuild Kit	5182-9747	8890 GC	N/A
PTV Septumless Head Teflon Guide	5182-9748	8890 GC	N/A
Ignitor (glow plug) assembly with O-ring	19231-60680	8890 GC	N/A
FID Collector Rebuild/Cleaning Kit	G1531-67000	8890 GC	N/A
FID Collector Replacement Kit	G1531-67001	8890 GC	N/A
Standard .011-inch FID Jet	5200-0176	8890 GC	N/A
Universal .018-inch FID Jet	5200-0177	8890 GC	N/A

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Service Engineer Comments

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

Service Completion

Service request number 6005975997 Date service completed 14 June 2023

Agilent signature [signature] Customer signature

Total number of pages in this document 9 Pages

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