

ภาคผนวก ค
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)	Tisch Environmental, Inc.	TE-5025A 3383	Jiranatee Associates Co., Ltd.	CL-003-65	26 Jul 22	25 Jul 24	-
2	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Electron	42C 42C-0508011076	UAE Consultant Co., Ltd.	18032023	18 Mar 23	17 Mar 24	-
3	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Fisher Scientific	42C 0517512000	UAE Consultant Co., Ltd.	16032023	16 Mar 23	15 Mar 24	-
4	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Electron	42C 0517512001	UAE Consultant Co., Ltd.	20042023	20 Apr 23	19 Apr 24	-
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Environmental Instrument	42C 42C-78933-390	UAE Consultant Co., Ltd.	09022023	9 Feb 23	8 Feb 24	-
6	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
7	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1201778116	UAE Consultant Co., Ltd.	04042023	4 Apr 23	3 Apr 24	-
8	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i JC1606001757	UAE Consultant Co., Ltd.	01042023	1 Mar 23	28 Feb 24	-
9	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i JC1606001758	UAE Consultant Co., Ltd.	09022023	9 Feb 23	8 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									
10	Sulphur Dioxide Analyzer	Sulphur Dioxide	Thermo Scientific	43i 1191503039	UAE Consultant Co.,Ltd.	01042023	1 Mar 23	28 Feb 24	-
11	Standard Gases (Mixture)	Sulphur Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
12	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2111DR0041	Thai Meteorological Department	143/23	31 Mar 23	30 Mar 24	-
13	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2111DR0052	Thai Meteorological Department	178/23	10 Apr 23	9 Apr 24	-
14	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2111DT0058	Thai Meteorological Department	162/23	11 Apr 23	10 Apr 24	-
15	Wind Speed/Wind Direction	WS/WD	Scarlet Tech Ltd.	WL-21 2205DT0105	Thai Meteorological Department	144/23	31 Mar 23	30 Mar 24	-
16	Sound Level Calibrator (Acoustic Calibrator)	Calibrate Sound Level Meter	Svantek	SV36 107224	Innovative Instrument Co.,Ltd.	23-ACT-117	4 Aug 23	3 Aug 24	-
17	Sound Level Meter	$L_{Aeq\ 24\ hours}$ L_{A90}	Larson Davis	LxT2 0006754	Larson Davis-A PCB Piezotronics Div.	2023003540	22 Mar 23	21 Mar 25	-
18	Sound Level Meter	$L_{Aeq\ 24\ hours}$ L_{A90}	Larson Davis	LxT2 0006755	Larson Davis-A PCB Piezotronics Div.	2023003594	23 Mar 23	22 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
Stack									
19	Pre-Test Console	Total Suspended Particulate Hydrogen Sulphide	Apex Instruments, USA.	XC-572-V 1701019	Envi Equipment Service Co., Ltd.	E23-04044	25 Apr 23	24 Apr 24	-
20	Pre-Test Console	Total Suspended Particulate Hydrogen Sulphide	Apex Instruments, USA.	XC-572-V 1904011	Envi Equipment Service Co., Ltd.	E23-08066	5 Aug 23	4 Aug 24	-
21	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide Carbon Monoxide	Testo AG	Testo 350 62289477	Entech Industrial Sulation Co., Ltd.	G 660220	20 Apr 23	19 Apr 24	-
22	Flue gas Analyzer	Sulphur Dioxide Oxide of Nitrogen as Nitrogen Dioxide Carbon Monoxide	Testo	Testo 350 60899698	Entech Industrial Sulation Co., Ltd.	G 660095	17 Feb 23	16 Feb 24	-

CERTIFICATE OF CALIBRATION

Certificate No. : CL-003-65

Page 1 of 2 Pages

MEASUREMENT ITEM
MANUFACTURER : Top Load Orifice
MODEL/TYPE : Tach Environmental, Inc.
SERIAL NUMBER : TE-5025A
ID NUMBER : 13383
CONDITION AS-RECEIVED : UAE EFM-063/2560
CUSTOMER : Used Item
United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsak 41, Sukhumvit Road, Bangkok, Phrakhanong,
Bangkok 10260

RECEIVED DATE : 15 Jul 2022
MEASUREMENT DATE : 25 Jul 2022
ISSUE DATE : 26 Jul 2022

ENVIRONMENTAL CONDITIONS:

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

CALIBRATION CONDITION:

Preconditioning : 24 hours at ambient conditions.
Measurement Condition : The average values during measurement are 24.8 °C and 55.1 %RH.

TABULATION OF RESULTS:

The table on next page give the measured values.

Calibration procedure:
The Orifice gas flow device was calibrated against the Standard Rotary Displacement Meter (Roos). Meter Model GSS/MAC/WA-2g. The W-100-dot 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: 02223301.

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. Satewit Thachalad
□ Miss Jittrapan Lertsongkhod



Approved signatory:

Mr. Parinya Booncharoen
Calibration Department Manager

Continuation of Certificate of Calibration Number CL-003-65

Page 2 of 2 Pages

MEASUREMENT RESULTS:

The Orifice gas flow device was calibrated by direct comparison method with the Standard Rotary Displacement Meter (Roos 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	Ap_meter mmHg	Ap_Orifice mmHg	γ	Standard Flow [Qs] m³/min
1	0.697	754.265	24.640	23.960	55.399	1.699	1.293	0.643
2	1.000	754.236	24.950	24.350	62.172	3.444	1.849	0.919
3	1.118	754.323	24.730	24.210	41.925	4.582	2.139	1.058
4	1.169	754.212	24.640	24.160	31.045	5.150	2.262	1.116
5	1.416	754.175	24.480	24.210	30.117	7.629	2.754	1.361

Slope (a): 2.04804

Intercept (b): -0.01939

Correlation coefficient (r): 0.99982

Uncertainty (k=2): 0.011 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	Ap_meter mmHg	Ap_Orifice mmHg	γ	Standard Flow [Qs] m³/min
1	0.697	754.265	24.640	23.960	55.399	1.699	0.819	0.647
2	1.000	754.236	24.950	24.350	62.172	3.444	1.167	0.919
3	1.118	754.323	24.730	24.210	41.925	4.582	1.345	1.058
4	1.169	754.212	24.640	24.160	31.045	5.150	1.426	1.123
5	1.416	754.175	24.480	24.210	30.117	7.629	1.735	1.361

Slope (a): 1.28277

Intercept (b): -0.01223

Correlation coefficient (r): 0.99982

Uncertainty (k=2): 0.012 m³/min

End of Certificate of Calibration



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

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม



United Analyst and Engineering Consultant Co., Ltd.

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

Tel: 0 2763 2828 Fax: 0 2763 2800 www.uaeconsultant.com E-mail: uae@uaeconsultant.com



United Analyst and Engineering Consultant Co., Ltd.

3 Soi Udomsak 41, Sukhumvit Road, Bangkok, 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 18, 2023

Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Electron Corporation Serial Number : 42C-0508011076

Standard Gas Concentration

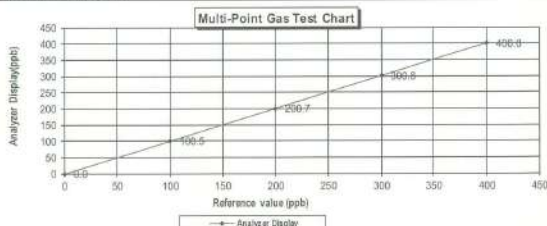
Sulphur Dioxide (SO₂) : 44.68 PPM
Nitric Oxide (NO) : 45.94 PPM
Methane (CH₄) : - PPM
Carbon Monoxide (CO) : 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 21, 2024

Dilutor Detail

Manufacturer : Thermo Scientific
Model : 1461
Serial Number : 1180540071

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	0.50	0.50	0.50
Level 3	40.00%	200.0	0.70	0.35	0.35
Level 4	60.00%	300.0	0.80	0.27	0.27
Level 5	80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range	500.0 ppb		Average Difference (%)	0.22	
Acceptable Limit ± 5%					



Calculated by:

18/3/23

Calculated by:

18/Mar/2023

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Mar 16, 2023

Equipment : Gas Analyzer (NO₂) Model : 42C
Manufacturer : Thermo Electron Corporation Serial Number : 0517512000

Standard Gas Concentration

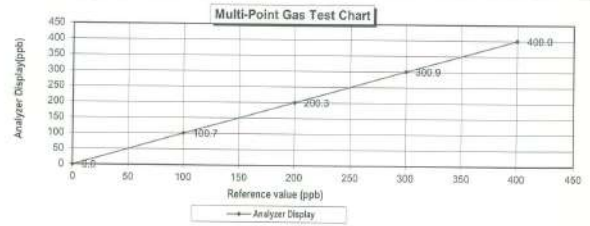
Sulphur Dioxide (SO₂) : 44.68 PPM
Nitric Oxide (NO) : 45.94 PPM
Methane (CH₄) : - PPM
Carbon Monoxide (CO) : 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 21, 2024

Dilutor Detail

Manufacturer : Thermo Scientific
Model : 1461
Serial Number : 1180540071

Multi-point gas test data

	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	0.70	0.70	0.70
Level 3	40.00%	200.0	0.30	0.15	0.15
Level 4	60.00%	300.0	0.90	0.30	0.30
Level 5	80.00%	400.0	0.00	0.00	0.00
Remark : Measuring Range	500.0 ppb		Average Difference (%)	0.23	
Acceptable Limit ± 5%					



Calculated by:

16/3/23

Calculated by:

16/Mar/2023

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Apr 20, 2023

Equipment : Gas Analyzer (NO_x) Model : 42C
Manufacturer : Thermo Electron Corporation Serial Number : 0517512001

Standard Gas Concentration

Sulphur Dioxide (SO ₂)	44.68	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.94	PPM	Model :	1461
Methane (CH ₄)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	984.8	PPM		
Cylinder No. :	EB0143262			
Expiration Date :	Jun 21, 2024			

Diluter Detail

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.2	1.20	1.19
Level 3	40.00%	200.0	200.7	0.70	0.35
Level 4	60.00%	300.0	301.1	1.10	0.37
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)	0.38
: Acceptable Limit \pm 5%					

Multi-Point Gas Test Chart

Page 1 of 1

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Feb 9, 2023

Equipment : Gas Analyzer (NO_x) Model : 42C
Manufacturer : Thermo Environmental Instruments Serial Number : 42C-78933-390

Standard Gas Concentration

Sulphur Dioxide (SO ₂)	44.68	PPM	Manufacturer :	Thermo Scientific
Nitric Oxide (NO)	45.94	PPM	Model :	1461
Methane (CH ₄)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	984.8	PPM		
Cylinder No. :	EB0143262			
Expiration Date :	Jun 21, 2024			

Diluter Detail

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.9	0.90	0.89
Level 3	40.00%	200.0	201.0	1.00	0.50
Level 4	60.00%	300.0	300.4	0.40	0.13
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)	0.30
: Acceptable Limit \pm 5%					

Multi-Point Gas Test Chart

Page 1 of 1

เอกสารไม่ควบคุม

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: ED4N100E-5A0100
Cylinder Number: EB0143262
Laboratory: 124 - Durham (SAF) - NC
PGVP Number: B2202
Gas Code: CO, NO, NO_x, SO₂, BALN

Reference Number: 122-402135167-1
Cylinder Volume: 144.4 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: S60
Certification Date: Jun 21, 2021

Expiration Date: Jun 21, 2024

Certificate performed in accordance with EPA Testability Protocol for Analytical Equipment of Gas and Calibration Standards (May 2012), approved EPA CGR-1548-01, using the assay procedures listed. Analytical Equipment does not require calibration for analytical performance. The cylinder has a social concept underlying its design below with a certificate level of 4.5%. There are no significant impurities noted without the use of this calibration certificate. All concentrations are in mg/L or ppm unless otherwise noted.
Do Not Use "as Labeled" below. Warning: 1.0 0.7 0.2 0.2 0.2 0.2

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NO _x	45.00 PPM	45.86 PPM	G1	+/- 1.4% NIST Traceable	08/14/2021, 06/12/2021
NITRIC OXIDE	45.00 PPM	45.86 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/12/2021
SULFUR DIOXIDE	45.00 PPM	44.50 PPM	G1	+/- 1.0% NIST Traceable	06/14/2021, 06/12/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	20201102	CC100008	45.92 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%	Feb 02, 2025
PRM	20186	CC600005	9.91 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.3%	Feb 20, 2020
GMC	40142302102	CC600001	4.345 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 16, 2023
NTRM	10011043	CC452277	45.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.2%	Jun 17, 2022
NTRM	14030118	CC452277	395.0 PPM CARBON MONOXIDE/NITROGEN	+/- 0.2%	Nov 15, 2025

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
N code: 9700 AHRB00-333 CO	FTIR	Jun 03, 2021
N code: 9700 AHRB00-333 NO	FTIR	Jun 03, 2021
N code: 9700 AHRB00-333 NO ₂	FTIR	Jun 03, 2021
N code: 9700 AHRB00-333 SO ₂	FTIR	Jun 03, 2021

Test Data Available Upon Request

NOTES: PO #322-007607

GROSS WT: 23.40kg

NET WT: 4.72kg



CERT 3002-01

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Apr 4, 2023

Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : 1201778116

Standard Gas Concentration

Sulphur Dioxide (SO ₂)	44.68	PPM	Manufacturer :	Thermo SCIENTIFIC
Nitric Oxide (NO)	45.94	PPM	Model :	1461
Methane (CH ₄)	-	PPM	Serial Number :	1180540071
Carbon Monoxide (CO)	984.8	PPM		
Cylinder No. :	EB0143262			
Expiration Date :	Jun 24, 2024			

Diluter Detail

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	100.7	0.70	0.70
Level 3	40.00%	200.0	201.5	1.50	0.74
Level 4	60.00%	300.0	301.3	1.30	0.43
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range			500.0 ppb	Average Difference (%)	0.37
: Acceptable Limit \pm 5%					

Multi-Point Gas Test Chart

Page 1 of 1

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Mar 1, 2023

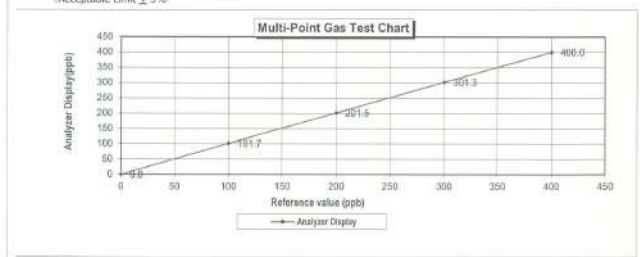
Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : JC1606001757

Standard Gas Concentration
Sulphur Dioxide (SO₂) : 44.68 PPM
Nitric Oxide (NO) : 45.94 PPM
Methane (CH₄) : - PPM
Carbon Monoxide (CO) : 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 24, 2024

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

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.7	1.70	1.67
Level 3	40.00%	200.0	201.5	1.50	0.74
Level 4	60.00%	300.0	301.3	1.30	0.43
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range : 500.0 ppb			Average Difference (%) : 0.57		



Calculate by :

1. Mar 2023

Page 1 of 1

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Feb 9, 2023

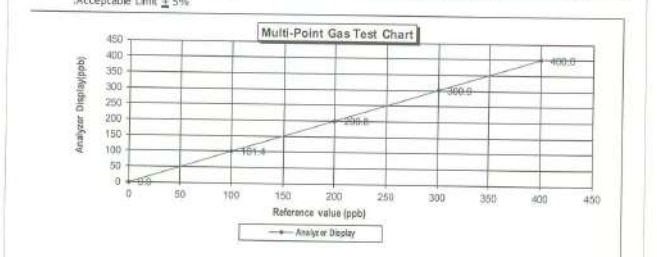
Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : JC1606001758

Standard Gas Concentration
Sulphur Dioxide (SO₂) : 44.68 PPM
Nitric Oxide (NO) : 45.94 PPM
Methane (CH₄) : - PPM
Carbon Monoxide (CO) : 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 24, 2024

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

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.00	0.00	0.00
Level 2	20.00%	100.0	101.4	1.40	1.38
Level 3	40.00%	200.0	200.8	0.80	0.40
Level 4	60.00%	300.0	300.9	0.90	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range : 500.0 ppb			Average Difference (%) : 0.42		



Calculate by :

9. Feb 2023

Page 1 of 1

เอกสารไม่ควบคุม

MULTI-POINT GAS TEST REPORT

Test Date : Mar 1, 2023

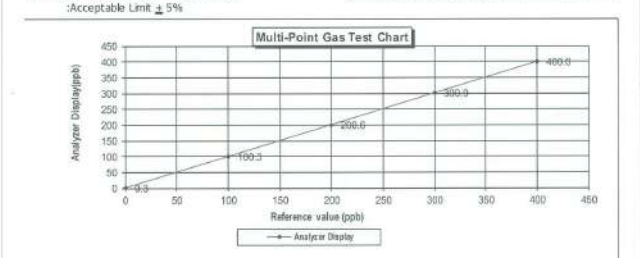
Equipment : Gas Analyzer (SO₂) Model : 43i
Manufacturer : Thermo SCIENTIFIC Serial Number : 1191503039

Standard Gas Concentration
Sulphur Dioxide (SO₂) : 44.68 PPM
Nitric Oxide (NO) : 45.94 PPM
Methane (CH₄) : - PPM
Carbon Monoxide (CO) : 984.8 PPM
Cylinder No. : EB0143262
Expiration Date : Jun 24, 2024

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

Multi-point gas test data

Level	Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1	Zero	0.0	0.30	0.30	0.30
Level 2	20.00%	100.0	100.3	0.30	0.30
Level 3	40.00%	200.0	200.6	0.60	0.30
Level 4	60.00%	300.0	300.9	0.90	0.30
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark : Measuring Range : 500.0 ppb			Average Difference (%) : 0.24		



Calculate by :

1. Mar 2023

Page 1 of 1

เอกสารไม่ควบคุม

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: ED4N190E-5A01D5 Reference Number: 122-402135167-1
Cylinder Number: EB0143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAF) - ILC Cylinder Pressure: 2015 PSI
PGVP Number: B2202 Valve Outlet: S60
Gas Code: CO, NO, NOX, SO₂, BALN Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024

Certificate prepared in accordance with EPA Testability Protocol for Airgas and Certification of Gas and Calibration Standards (May 2012) as revised EPA CG-161-1615. Using the assay procedure, Analytical Technology does not require a certificate for analysis. Therefore, the cylinder has a serial number and a date of manufacture for a certificate level of 4.5%. This also means that the cylinder is not subject to the use of this calibration certificate. All concentrations are in mg/m³ unless noted otherwise.

ANALYTICAL RESULTS

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.86 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/15/2021
NITRIC OXIDE	45.00 PPM	45.86 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/15/2021
SULFUR DIOXIDE	45.00 PPM	45.86 PPM	G1	+/- 1.4% NIST Traceable	06/14/2021, 06/15/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	+/- 0.7% NIST Traceable	06/14/2021, 06/15/2021
NITROGEN	Balance	Balance	G1	+/- 0.7% NIST Traceable	06/14/2021, 06/15/2021

CALIBRATION STANDARDS

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTM	20201112	CC03008	45.92 PPM NITRIC OXIDE/NITROGEN	+/- 1.3%	Feb 02, 2025
PRM	7286	CE05055	9.91 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.3%	Feb 20, 2020
GMG	40142028182	CC03081	4.345 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.1	Feb 16, 2023
NTM	16011043	CC043277	45.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Jun 17, 2022
NTM	14030118	CC043277	395.0 PPM CARBON MONOXIDE/NITROGEN	+/- 0.8%	Nov 15, 2025

ANALYTICAL EQUIPMENT

Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
N Code: 9700 AFR800-333 CO	FTIR	Jun 03, 2021
N Code: 9700 AFR800-333 NO	FTIR	Jun 03, 2021
N Code: 9700 AFR800-333 NO ₂	FTIR	Jun 03, 2021
N Code: 9700 AFR800-333 SO ₂	FTIR	Jun 03, 2021

Trid Data Available Upon Request
NOTES: PO #322-007607
GROSS WT: 23.40kg
NET WT: 4.72kg



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

Approved for Release



CERT 3002-01

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 : 31 March, 2023

Certification No. : 143/23

Page : 1 of 5

Object : WIRELESS ANEMOMETER

Manufacturer : SCARLET

Type : WIRELESS RECEIVER : WL-21

WIND SENSOR : WL-21

Mfg Code : WIRELESS RECEIVER : 2111DR0041

WIND SENSOR : 2111DT0041

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

81 Soi Udumuk 41, Sukhumvit Road,

Bangchak, Prakanong, Bangkok 10260.

Calibration Condition : Temperature : 25.1 °C Barometric Pressure : 1009.2 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91583

: 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 PTB3220 No. V1220015

meter Vaisala Type PTB330 No. 64320001

Calibrated by : [Redacted] Sig. [Redacted] (Authorized Signatory)

Mr. Watcharapol Subwat Mr. [Redacted] for the Chief

Mechanical Engineer

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

31 March, 2023

Certification No. 143/23

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer	m/sec	mm Hg	mm Hg	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	-	-	-	10.9	0.12
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

Wind Aloft Plotting Board	
US DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
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. 143/23

31 March, 2023

Page : 3 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1014.29	1014	0.29
1014.02	1014	0.02
1011.47	1012	-0.53
1011.25	1011	0.25
1011.11	1011	0.11
1011.36	1012	-0.62
1011.71	1012	-0.29
1013.46	1014	-0.52
1013.61	1014	-0.19
1014.02	1014	0.02
1013.73	1013	0.73
1013.32	1013	0.32
1014.92	1015	-0.08
1014.75	1015	-0.25
1014.36	1014	0.36
1014.21	1014	0.21
1013.57	1013	0.57
1013.01	1013	0.01
1011.26	1011	0.26
1011.59	1012	-0.41

Average

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

31 March, 2023

Certification No. 143/23

Page : 4 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
760.76	761	-0.22
760.56	761	-0.42
756.66	759	-0.34
758.50	756	0.50
758.39	756	0.39
758.60	759	-0.40
758.84	759	-0.16
760.17	760	0.17
760.42	760	0.42
760.58	761	-0.42
760.36	760	0.36
760.05	760	0.05
761.25	761	0.25
761.12	761	0.12
760.85	761	-0.15
760.72	761	-0.28
760.24	760	0.24
759.82	760	-0.18
758.51	759	-0.49
758.75	759	-0.25

Average

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

31 March, 2023

Certification No. 143/23

Page : 5 of 5

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.24	45.4	-0.16
32.16	32.3	-0.14
16.48	16.5	-0.02

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 : 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-850-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629566)

JAPAN QUALITY ASSURANCE ORGANIZATION

STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/B4 Wet No. 8389/94

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

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB3220 No. 1320015

: Vaisala Type PTB3320 No. 144200101

Calibrated by :

Mr. Watcharapol Subwat
Mechanical Engineer

(Authorized Signature)
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

10 April, 2023

Certification No. 178/23

Page : 2 of 5

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	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.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	

Calibrated by :

Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau



เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

10 April, 2023

Certification No. 178/23

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
1011.69	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 :

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	Tested Barometer	Correction
Pressure	Pressure	
759.94	760	-0.06
760.13	760	0.13
760.67	761	-0.33
760.73	761	-0.27
757.28	757	0.28
757.34	757	0.34
757.52	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
759.38	759	0.36
758.54	757	-0.46
758.66	757	-0.34
757.00	757	0.00
757.15	757	0.15

Average

0.01

Calibrated by :

Mr. Watcharapol Suwanat
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 :

Mr. Watcharapol Suwanat
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 120829586)

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. 11220015

: Barometer Vaisala Type PTB330 No. 1K2380001

Calibrated by :

Signature

(Authorized Signatory)

Mr. Watcharapol Suwanat
Mechanical Engineer

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 Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	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.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270

Calibrated by :

Mr. Watcharapol Suwanat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



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
1008.88	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

0.16

Calibrated by :

Mr. Wacharapol Sabwail
Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

เอกสารไม่ควบคุม



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	756	-0.55
757.61	756	-0.39
757.73	756	-0.27
756.86	757	-0.14
756.97	757	-0.03
757.34	757	0.34
757.60	756	-0.20
758.47	759	-0.53
758.69	759	-0.31

Average

0.00

Calibrated by :

Mr. Wacharapol Sabwail
Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

เอกสารไม่ควบคุม



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. Wacharapol Sabwail
Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

เอกสารไม่ควบคุม



Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 31 March, 2023

Certification No. 144/23

Page : 1 of 5

Object : WIRELESS ANEMOMETER

Manufacturer : SCARLET

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

Mfg Code : WIRELESS RECEIVER : 2205DR0105
WIND SENSOR : 2205DT0105

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 1008.9 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. 8399/94
: testo : testo 645 Serial No. 02648057 : ThermoSchneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala : Type PTB220-100 : 220015
: Barometer Vaisala : Type PTB330 No. K9320001

Calibrated by : [Redacted]
Mr. Wacharapol Sabwail
Mechanical Engineer

(Authorized Signatory)
for the Chief
Sub-Standard Instrument

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 144/23

31 March, 2023

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer	inches H2O	inches H2O	m/sec	m/sec	m/sec
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	-	-	-	10.9	0.12
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

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

Calibrated by :
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 144/23

Page : 3 of 5

31 March, 2023

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1014.29	1014	0.29
1014.02	1014	0.02
1011.47	1012	-0.53
1011.25	1011	0.25
1011.11	1011	0.11
1011.38	1011	0.38
1011.71	1012	-0.29
1013.48	1013	0.48
1013.81	1014	-0.19
1014.02	1014	0.02
1013.73	1014	-0.27
1013.32	1013	0.32
1014.82	1015	-0.08
1014.75	1015	-0.25
1014.38	1014	0.38
1014.21	1014	0.21
1013.57	1014	-0.43
1013.01	1013	0.01
1011.26	1011	0.26
1011.59	1012	-0.41

Average

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. 144/23

31 March, 2023

Page : 4 of 5

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
760.78	761	-0.22
760.58	761	-0.42
758.66	759	-0.34
758.50	759	-0.50
758.39	758	0.39
758.80	759	-0.40
758.84	759	-0.16
760.17	760	0.17
760.42	760	0.42
760.58	760	0.58
760.36	760	0.36
760.05	760	0.05
761.25	761	0.25
761.12	761	0.12
760.85	761	-0.15
760.72	761	-0.25
760.24	760	0.24
759.82	760	-0.18
758.51	759	-0.49
758.75	759	-0.25

Average

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. 144/23

31 March, 2023

Page : 5 of 5

Standard	Temperature Sensor Reading	
	Reading	Correction
Temp.	°C	°C
45.24	45.0	0.24
32.16	32.0	0.16
16.48	16.4	0.08

Calibrated by :
Mr. Watcharapol Subwat
Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau

เอกสารไม่ควบคุม

Calibration Certificate

Certificate Number 2023003540

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

Model Number LxT2
Serial Number 0006754
Test Results Pass
Initial Condition As Manufactured
Description SoundTrack LxT Class 2
Class 2 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8384
Technician Jacob Cannon
Calibration Date 22 Mar 2023
Calibration Due
Temperature 23.5 °C ± 0.25 °C
Humidity 48.8 %RH ± 2.0 %RH
Static Pressure 84.99 kPa ± 0.13 kPa

Evaluation Method Tested with:
Larson Davis CAL200, S/N 9079
Larson Davis PRMLxT2C, S/N 073882
PCB 375A04, S/N 346381
Larson Davis CAL291, S/N 0108
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 2
IEC 60804:2000 Type 2
IEC 61252:2002
IEC 61260:2001 Class 2
IEC 61672:2013 Class 2

ANSI S1.4-2014 Class 2
ANSI S1.4 (R2006) Type 2
ANSI S1.11 (R2009) Class 2
ANSI S1.25 (R2007)
ANSI S1.43 (R2007) Type 2

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.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

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

เอกสารไม่ควบคุม

Certificate Number 2023003540

1/2" adaptor is used with the preamplifier.

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

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

No Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 available.

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. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 2 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3 cover only a limited subset of the specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

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	2023-05-23	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 DS160 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	114.00	113.80	114.20	0.14	Pass

Loaded Circuit Sensitivity					
Measurement	Test Result [dB re 1 V / Pa]	Lower Limit [dB re 1 V / Pa]	Upper Limit [dB re 1 V / Pa]	Expanded Uncertainty [dB]	Result
1000 Hz	-50.08	-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	-1.70	1.30	0.23	Pass
1000	0.15	0.00	-1.00	1.00	0.23	Pass
8000	-3.36	-3.00	-8.00	2.00	0.32	Pass

– End of measurement results–

เอกสารไม่ควบคุม

Certificate Number 2023003540

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	40.49

– End of measurement results–

Model Number LxT2
Serial Number 0006754
Test Results Pass
Initial Condition As Manufactured
Description SoundTrack LxT Class 2
Class 2 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8378
Technician Jacob Cannon
Calibration Date 22 Mar 2023
Calibration Due
Temperature 23.42 °C ± 0.25 °C
Humidity 51 %RH ± 2.0 %RH
Static Pressure 84.94 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRMLxT2C S/N 073882 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 2
IEC 60804:2000 Type 2
IEC 61252:2002
IEC 61672:2013 Class 2
IEC 61260:2001 Class 2

ANSI S1.4-2014 Class 2
ANSI S1.4 (R2006) Type 2
ANSI S1.25 (R2007)
ANSI S1.43 (R2007) Type 2
ANSI S1.11 (R2009) Class 2

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.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

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

เอกสารไม่ควบคุม

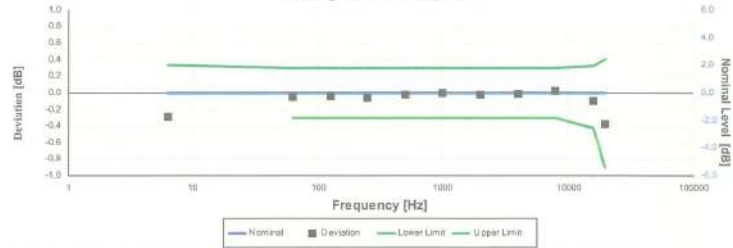
เอกสารไม่ควบคุม

Description
Hart Scientific 2626-H Temperature Probe
SRS DS360 Ultra Low Distortion Generator

Standards Used

Cal Date	Cal Due	Cal Standard
2021-08-25	2023-05-25	006798
2022-03-29	2023-03-29	007635

Z-weight Filter Response



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



LARSON DAVIS
A PCB DIVISION

Page 2 of 8

D0001.8407 Rev G

เอกสารไม่ควบคุม

2023-3-22T12:24:32

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



LARSON DAVIS
A PCB DIVISION

Page 3 of 8

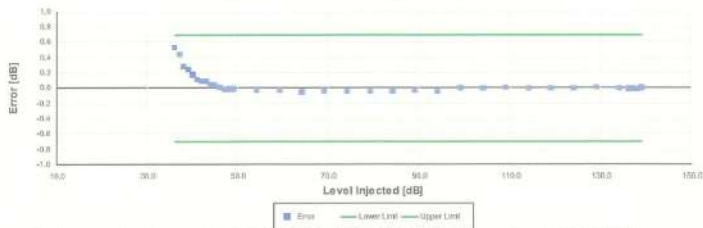
D0001.8407 Rev G

เอกสารไม่ควบคุม

2023-3-22T12:24:32

Certificate Number 2023003536

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) 6.8; ANSI S1.4-2014 Part 1: 5.6; ANSI S1.43 (R2007) 8.2

Level [dB]	Error [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
36.00	0.53	-0.70	0.70	0.16	Pass
37.00	0.45	-0.70	0.70	0.16	Pass
38.00	0.29	-0.70	0.70	0.16	Pass
39.00	0.25	-0.70	0.70	0.16	Pass
40.00	0.18	-0.70	0.70	0.16	Pass
41.00	0.12	-0.70	0.70	0.16	Pass
42.00	0.09	-0.70	0.70	0.16	Pass
43.00	0.09	-0.70	0.70	0.16	Pass
44.00	0.05	-0.70	0.70	0.17	Pass
45.00	0.03	-0.70	0.70	0.16	Pass
46.00	0.01	-0.70	0.70	0.16	Pass
47.00	-0.01	-0.70	0.70	0.16	Pass
48.00	-0.01	-0.70	0.70	0.16	Pass
49.00	-0.01	-0.70	0.70	0.16	Pass
54.00	-0.03	-0.70	0.70	0.16	Pass
59.00	-0.03	-0.70	0.70	0.16	Pass
64.00	-0.04	-0.70	0.70	0.16	Pass
69.00	-0.03	-0.70	0.70	0.16	Pass
74.00	-0.04	-0.70	0.70	0.16	Pass
79.00	-0.04	-0.70	0.70	0.16	Pass
84.00	-0.04	-0.70	0.70	0.16	Pass
89.00	-0.03	-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	0.00	-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	0.00	-0.70	0.70	0.15	Pass
129.00	0.01	-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	-0.01	-0.70	0.70	0.15	Pass
138.00	-0.01	-0.70	0.70	0.15	Pass
139.00	0.00	-0.70	0.70	0.15	Pass

— End of measurement results—

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



LARSON DAVIS
A PCB DIVISION

Page 4 of 8

D0001.8407 Rev G

เอกสารไม่ควบคุม

2023-3-22T12:24:32

Certificate Number 2023003536

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
136.95	40	Negative Pulse	134.86	133.42	135.42	0.15	Pass
		Positive Pulse	134.85	133.41	135.41	0.15	Pass
	30	Negative Pulse	133.90	133.42	135.42	0.15	Pass
		Positive Pulse	133.69	133.41	135.41	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
135.95	3	OVLD	± 1.00	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
125.95	3	-0.13	± 1.00	0.15 ±	Pass
	5	-0.13	± 1.00	0.16 ±	Pass
115.95	3	-0.14	± 1.00	0.15 ±	Pass
	5	-0.11	± 1.00	0.15 ±	Pass
105.95	3	-0.15	± 1.00	0.15 ±	Pass
	5	-0.12	± 1.00	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
135.95	3	OVLD	± 1.00	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
125.95	3	-0.12	± 1.00	0.15 ±	Pass
	5	-0.12	± 1.00	0.15 ±	Pass
115.95	3	-0.14	± 1.00	0.15 ±	Pass
	5	-0.12	± 1.00	0.15 ±	Pass
105.95	3	-0.15	± 1.00	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass

— End of measurement results—

Gain

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

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.96	93.90	94.10	0.15	Pass
0 dB Gain, Linearity	40.32	39.40	40.80	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—

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



LARSON DAVIS
A PCB DIVISION

Page 5 of 8

D0001.8407 Rev G

เอกสารไม่ควบคุม

2023-3-22T12:24:32

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	26.55	35.00	Pass
Z-weight Noise Floor	32.48	39.00	Pass

— End of measurement results—

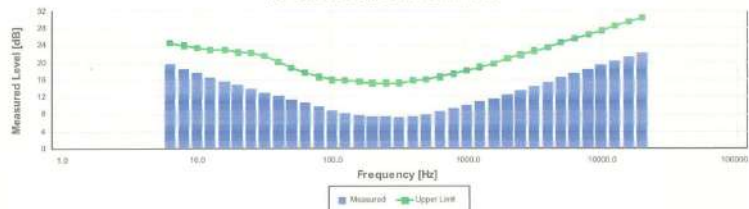
Total Harmonic Distortion

Measured using 1/3-Octave filters

Measurement	Test Result [dB]	Lower Limit [dB]	Upper Limit [dB]	Expanded Uncertainty [dB]	Result
10 Hz Signal	135.45	134.15	135.75	0.15	Pass
THD	-65.74		-58.00	0.00 ±	Pass
THD+N	-61.96		-58.00	0.00 ±	Pass

— End of measurement results—

1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	19.76	24.60	Pass
8.00	18.64	24.00	Pass
10.00	17.64	23.50	Pass
12.50	16.46	23.00	Pass
16.00	15.45	22.90	Pass
20.00	14.78	22.40	Pass
25.00	13.93	22.30	Pass
31.50	12.95	21.50	Pass
40.00	12.23	20.20	Pass
50.00	11.32	18.80	Pass
63.00	10.57	17.60	Pass
80.00	9.78	16.60	Pass
100.00	8.76	15.90	Pass
125.00	8.12	15.70	Pass
160.00	7.68	15.50	Pass
200.00	7.45	15.20	Pass
250.00	7.38	15.20	Pass
315.00	7.28	15.20	Pass
400.00	7.53	15.70	Pass
500.00	7.93	16.00	Pass
630.00	8.56	16.60	Pass
800.00	9.18	17.30	Pass
1,000.00	9.97	18.10	Pass
1,250.00	10.82	18.90	Pass
1,600.00	11.59	19.80	Pass
2,000.00	12.53	20.80	Pass
2,500.00	13.48	21.70	Pass
3,150.00	14.44	22.60	Pass
4,000.00	15.43	23.50	Pass
5,000.00	16.44	24.50	Pass
6,300.00	17.36	25.50	Pass
8,000.00	18.32	26.50	Pass
10,000.00	19.38	27.40	Pass
12,500.00	20.32	28.50	Pass
16,000.00	21.30	29.50	Pass
20,000.00	22.31	30.40	Pass

— End of measurement results—

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

Calibration Certificate

Certificate Number 2023003594

Customer:

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

Model Number

LxT2

Serial Number

0006755

Test Results

Pass

Initial Condition

As Manufactured

Description

SoundTrack LxT Class 2

Class 2 Sound Level Meter

Firmware Revision: 2.404

Procedure Number

D0001.8384

Technician

Jacob Cannon

Calibration Date

23 Mar 2023

Calibration Due

23.43 °C ± 0.25 °C

Temperature

50.7 %RH ± 2.0 %RH

Humidity

85.97 kPa ± 0.13 kPa

Static Pressure

Evaluation Method

Tested with:

Larson Davis CAL291, S/N 0108

Larson Davis PRLxT2C, S/N 073884

Larson Davis CAL200, S/N 9079

PCB 375A04, S/N 346383

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 2

IEC 60804:2000 Type 2

IEC 61252:2002

IEC 61260:2001 Class 2

IEC 61672:2013 Class 2

ANSI S1.4-2014 Class 2

ANSI S1.4 (R2006) Type 2

ANSI S1.11 (R2009) Class 2

ANSI S1.25 (R2007)

ANSI S1.43 (R2007) Type 2

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.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

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

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

1/2" adaptor is used with the preamplifier.

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

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

No Pattern approval for IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 available.

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. However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 because (a) evidence was not publicly available, from an independent testing organization responsible for pattern approvals, to demonstrate that the model of sound level meter fully conformed to the class 2 specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 / ANSI/ASA S1.4-2014/Part 3 cover only a limited subset of the specifications in IEC 61672-1:2013 / ANSI/ASA S1.4-2014/Part 1.

Standards Used			
Description	Cal Date	Cal Due	Cal Standard
Larson Davis CAL291 Residual Intensity Calibrator	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	007183
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	-50.23	-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	-0.22	-0.20	-1.70	1.30	0.23	Pass
1000	0.15	0.00	-1.00	1.00	0.23	Pass
8000	-2.97	-3.00	-6.00	2.00	0.32	Pass

— End of measurement results—

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



Page 2 of 3

LARSON DAVIS
A PCB DIVISION

D0001.8406 Rev G

เอกสารไม่ควบคุม

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	40.42

— End of measurement results—

— End of Report—

Signature

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



Page 3 of 3

LARSON DAVIS
A PCB DIVISION

D0001.8406 Rev G

เอกสารไม่ควบคุม

Calibration Certificate

Certificate Number 2023003578

Customer:

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

Model Number LxT2
Serial Number 0006755
Test Results Pass

Initial Condition As Manufactured

Description SoundTrack LxT Class 2
Class 2 Sound Level Meter
Firmware Revision: 2.404

Procedure Number D0001.8378
Technician Jacob Cannon
Calibration Date 22 Mar 2023
Calibration Due
Temperature 23.68 °C ± 0.25 °C
Humidity 50.3 %RH ± 2.0 %RH
Static Pressure 85.34 kPa ± 0.13 kPa

Evaluation Method Tested electrically using Larson Davis PRLXLT2C S/N 073884 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 2	ANSI S1.4-2014 Class 2
IEC 60804:2000 Type 2	ANSI S1.4 (R2006) Type 2
IEC 61252:2002	ANSI S1.26 (R2007)
IEC 61672:2013 Class 2	ANSI S1.43 (R2007) Type 2
IEC 61260:2001 Class 2	ANSI S1.11 (R2009) Class 2

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.

This report may not be reproduced, except in full, unless permission for the publication of an approved abstract is obtained in writing from the organization issuing this report.

Correction data from Larson Davis LxT Manual for SoundTrack LxT & SoundExpert Ltd, 1770.01 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

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



Page 1 of 8

LARSON DAVIS
A PCB DIVISION

D0001.8407 Rev G

เอกสารไม่ควบคุม

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	2023-12-29	2023-12-29	007118

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



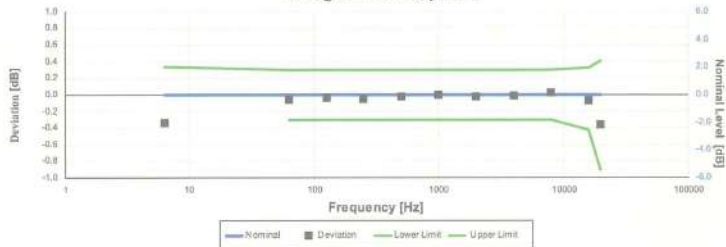
Page 2 of 8

LARSON DAVIS
A PCB DIVISION

D0001.8407 Rev G

เอกสารไม่ควบคุม

Z-weight Filter Response

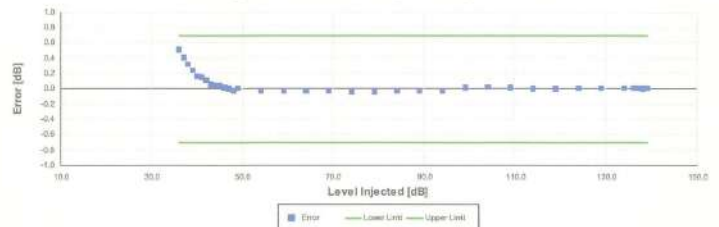


Electrical signal test of frequency weighting performed according to IEC 61672-3:2013 13 and ANSI S1.4-2014 Part 3: 13 for compliance to IEC 61672-1:2013 5.5; IEC 60651:2001 6.1 and 9.2.2; IEC 60804:2000 5; ANSI S1.4:1983 (R2006) 5.1 and 6.2.1; ANSI S1.4-2014 Part 1: 5.5

Frequency [Hz]	Test Result [dB]	Deviation [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
6.31	-0.34	-0.33	-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	-0.06	-0.06	-0.30	0.30	0.15	Pass
501.19	-0.02	-0.02	-0.30	0.30	0.15	Pass
1,000.00	0.00	0.00	-0.30	0.30	0.15	Pass
1,995.26	-0.03	-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	0.02	0.02	-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—

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 6, 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	0.52	-0.70	0.70	0.16	Pass
37.00	0.41	-0.70	0.70	0.16	Pass
38.00	0.32	-0.70	0.70	0.16	Pass
39.00	0.24	-0.70	0.70	0.16	Pass
40.00	0.17	-0.70	0.70	0.16	Pass
41.00	0.16	-0.70	0.70	0.16	Pass
42.00	0.11	-0.70	0.70	0.16	Pass
43.00	0.06	-0.70	0.70	0.17	Pass
44.00	0.05	-0.70	0.70	0.17	Pass
45.00	0.05	-0.70	0.70	0.16	Pass
46.00	0.02	-0.70	0.70	0.16	Pass
47.00	0.00	-0.70	0.70	0.16	Pass
48.00	-0.02	-0.70	0.70	0.16	Pass
49.00	0.01	-0.70	0.70	0.16	Pass
54.00	-0.03	-0.70	0.70	0.16	Pass
59.00	-0.03	-0.70	0.70	0.16	Pass
64.00	-0.02	-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	-0.03	-0.70	0.70	0.16	Pass
84.00	-0.03	-0.70	0.70	0.16	Pass
89.00	-0.03	-0.70	0.70	0.16	Pass
94.00	-0.03	-0.70	0.70	0.16	Pass
99.00	0.02	-0.70	0.70	0.15	Pass
104.00	0.02	-0.70	0.70	0.15	Pass
109.00	0.02	-0.70	0.70	0.15	Pass
114.00	0.00	-0.70	0.70	0.15	Pass
119.00	0.01	-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	0.01	-0.70	0.70	0.15	Pass

— End of measurement results—

Peak Rise Time

Peak rise time performed according to IEC 60651:2001 9.4.4 and ANSI S1.4:1983 (R2006) 8.4.2

Amplitude [dB]	Duration [μs]		Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
136.95	40	Negative Pulse	135.02	133.54	135.54	0.15	Pass
		Positive Pulse	135.02	133.54	135.54	0.15	Pass
	30	Negative Pulse	134.09	133.54	135.54	0.15	Pass
		Positive Pulse	134.09	133.54	135.54	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
135.95	3	OVLD	± 1.00	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
125.95	3	-0.13	± 1.00	0.15 ±	Pass
	5	-0.14	± 1.00	0.16 ±	Pass
115.95	3	-0.14	± 1.00	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass
105.95	3	-0.15	± 1.00	0.15 ±	Pass
	5	-0.14	± 1.00	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
135.95	3	OVLD	± 1.00	0.15 ±	Pass
	5	OVLD	± 1.00	0.15 ±	Pass
125.95	3	-0.13	± 1.00	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass
115.95	3	-0.14	± 1.00	0.15 ±	Pass
	5	-0.13	± 1.00	0.15 ±	Pass
105.95	3	-0.15	± 1.00	0.15 ±	Pass
	5	-0.14	± 1.00	0.15 ±	Pass

— End of measurement results—

Gain

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

Measurement	Test Result [dB]	Lower limit [dB]	Upper limit [dB]	Expanded Uncertainty [dB]	Result
0 dB Gain	93.96	93.91	94.11	0.15	Pass
0 dB Gain, Linearity	40.26	39.41	40.81	0.16	Pass
OBA Low Range	94.01	93.91	94.11	0.15	Pass
OBA Normal Range	94.01	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	26.79	36.00	Pass
C-weight Noise Floor	26.31	35.00	Pass
Z-weight Noise Floor	31.99	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	135.60	134.15	135.75	0.15	Pass
THD	-67.46	-58.00	-58.00	0.01 ±	Pass
THD+N	-63.09	-58.00	-58.00	0.01 ±	Pass

— End of measurement results—

1/3-Octave Self-Generated Noise



The SLM is set to low range.

Frequency [Hz]	Test Result [dB]	Upper limit [dB]	Result
6.30	18.75	24.60	Pass
8.00	17.59	24.00	Pass
10.00	16.98	23.50	Pass
12.50	15.85	23.00	Pass
16.00	15.01	22.90	Pass
20.00	14.56	22.40	Pass
25.00	13.22	22.30	Pass
31.50	12.47	21.50	Pass
40.00	11.25	20.20	Pass
50.00	10.34	18.80	Pass
63.00	9.52	17.60	Pass
80.00	8.69	16.60	Pass
100.00	7.97	15.90	Pass
125.00	7.50	15.70	Pass
160.00	7.11	15.50	Pass
200.00	6.83	15.20	Pass
250.00	6.72	15.20	Pass
315.00	6.99	15.20	Pass
400.00	7.32	15.70	Pass
500.00	7.77	16.00	Pass
630.00	8.48	16.60	Pass
800.00	9.07	17.30	Pass
1,000.00	9.85	18.10	Pass
1,250.00	10.71	18.90	Pass
1,600.00	11.61	19.80	Pass
2,000.00	12.51	20.80	Pass
2,500.00	13.42	21.70	Pass
3,150.00	14.36	22.60	Pass
4,000.00	15.36	23.50	Pass
5,000.00	16.30	24.50	Pass
6,300.00	17.27	25.50	Pass
8,000.00	18.30	26.50	Pass
10,000.00	19.29	27.40	Pass
12,500.00	20.30	28.50	Pass
16,000.00	21.25	29.50	Pass
20,000.00	22.26	30.40	Pass

— End of measurement results—

— End of Report—

Signature: [Redacted]

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



LARSON DAVIS
A PCB DIVISION

2023-3-22T19:01:45

Page 8 of 8

D0001.8407 Rev G

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7139 MOO 13, SOI SUTINAKORN 11 TAMBON BANG KAEU,
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 166-09-2116-5860-1 FAX: 166-09-2116-7140



Page 1 of 2

Certificate of Calibration

Customer

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

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

Unit Under Calibration Details

Measurement Item : Acoustic Calibrator
Manufacturer : SVANTEK
Model : SV 36
Serial Number : 107224
ID : UAE.EFM.171/2564

Class : 1
Range : 94 , 114 dB / 1000 Hz
Instrument Status : Used

Calibration Environment and Details

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

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

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

Note

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

Calibrated By : [Redacted]
Mr. Noppadon Luangart
Service Calibration Engineer

Approved By : [Redacted]
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-700-01-01-02 Rev. 01 (2023-01-01)

เอกสารไม่ควบคุม

INNOVATIVE INSTRUMENT CALIBRATION LAB
INNOVATIVE INSTRUMENT CO., LTD. HEAD OFFICE
7139 MOO 13, SOI SUTINAKORN 11 TAMBON BANG KAEU,
AMPHOE BANG PHU SAMUT PRAKAN PROVINCE 10540 THAILAND
TEL: 166-09-2116-5860-1 FAX: 166-09-2116-7140



Page 2 of 2

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

Sound pressure level

Calibration Results : Without Adjustment

Calibration Range (dB)	Without Adjustment (dB)		Adjustment (dB)		Uncertainty (± dB)	Acceptance limit Class 1 (± dB)
	Measured	Error	Measured	Error		
94 dB / 1000 Hz	94.03	0.03	-	-	0.13	0.25
114 dB / 1000 Hz	114.11	0.11	-	-	0.13	0.25

Frequency of Sound pressure level

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

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

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

Note :

- Acceptance limit was IEC60942:2017 Class 1
- The calibration results exclude the 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-700-01-01-02 Rev. 01 (2023-01-01)

เอกสารไม่ควบคุม

CERTIFICATE OF CALIBRATION

Customer : United Analyst and Engineering Consultant Co., Ltd.
Address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Description of Equipment : Console meter
Manufacturer : Apex Instrument
Model Number : XC-572-V
Serial Number : 1701019
ID/Control No. : -
Environment Conditions : Temperature (25 ± 2) °C
Humidity (50 ± 15) % RH
Cal. Date : 25/04/2023
Issue Date : 25/04/2023

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

This certificate is traceable to national standard, which realize the units of measurement according to the International System of Units (SI).

Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envi Equipment Service Company Limited.

These reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level

Calibrated by : [Redacted]

Approved by

(Mr. Mana Fuekhud)
Technical Manager

เอกสารไม่ควบคุม

METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	25/04/2023	10:00 AM	Std Temp	293	K
Console Serial Number	1701019	Calibration Reference No.	SER23-04016			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	757.49	mmHg		K1	0.386	
DGM Serial Number	00002028	Calibration Meter Gamma	0.999			Console Leak Check	PASS	

Calibration Data									
Run Time	Metering Console					Calibration Meter			
	Elapsed (Q)	DGM Orifice DH (Pm)	Volume Initial (Vmi)	Volume Final (Vmf)	Outlet Temp Initial (Tmi)	Outlet Temp Final (Tmf)	Volume Initial (Vwi)	Volume Final (Vwf)	Outlet Temp Initial (Twi)
	min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C
12.17	13.0	2094.611	2094.751	34	34	136.89522	137.03608	30	30
12.15	13.0	2094.751	2094.891	34	34	137.03608	137.17600	30	30
8.50	26.0	2094.897	2095.037	35	35	137.18408	137.32456	29	29
8.47	26.0	2095.037	2095.177	35	35	137.32456	137.46414	29	29
13.80	40.0	2095.183	2095.463	36	36	137.47002	137.74746	29	29
13.72	40.0	2095.463	2095.743	36	36	137.74746	138.02270	29	29
10.32	70.0	2095.752	2096.032	36	36	138.03154	138.30536	28	28
10.30	70.0	2096.032	2096.312	37	37	138.30536	138.57884	28	28
9.00	90.0	2096.324	2096.604	37	37	138.58928	138.86564	28	28
8.98	90.0	2096.604	2096.884	37	37	138.86564	139.14072	27	27



เอกสารไม่ควบคุม

METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	25/04/2023	10:00 AM	Std Temp	293	K
Console Serial Number	1701019	Calibration Reference No.	SER23-04016			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	757.49	mmHg		K1	0.386	
DGM Serial Number	00002028	Calibration Meter Gamma	0.999			Console Leak Check	PASS	

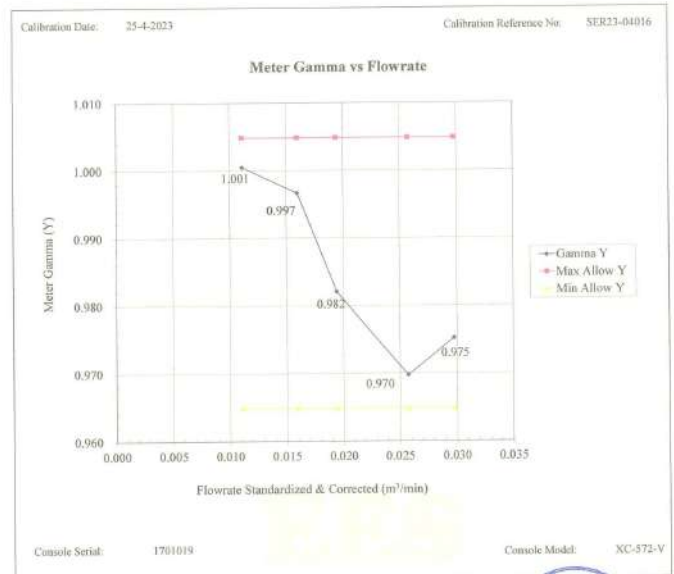
Calibration Data									
Results									
Dry Gas Meter									
Standardized Data									
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate		Variation	
(V _{mi})	(Q _{std})	(V _{wi})	(Q _{wi})	Value (Y)	Variation (ΔY)	Std & Corr (Q _{std})	0.0212 m ³ /min (ΔH _g)	Variation (ΔH _g)	
m ³	m ³ /min	m ³	m ³ /min			m ³ /min	mm H ₂ O		
0.135	0.011	0.136	0.011	1.004	0.019	0.011	45.580	-0.318	
0.135	0.011	0.135	0.011	0.997	0.012	0.011	46.068	0.170	
0.136	0.016	0.136	0.016	1.000	0.015	0.016	44.700	-1.199	
0.136	0.016	0.135	0.016	0.993	0.009	0.016	44.924	-0.975	
0.272	0.020	0.268	0.019	0.986	0.001	0.019	46.608	0.701	
0.272	0.020	0.266	0.019	0.978	-0.007	0.019	46.777	0.879	
0.274	0.027	0.265	0.026	0.970	-0.015	0.026	46.996	1.007	
0.274	0.027	0.265	0.026	0.969	-0.016	0.026	46.870	0.972	
0.274	0.030	0.268	0.030	0.977	-0.007	0.030	45.230	-0.669	
0.275	0.031	0.268	0.030	0.973	-0.012	0.030	45.332	-0.567	
				0.985	Y Average			45.899	ΔH _g Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.

For ΔH_g, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H₂O.

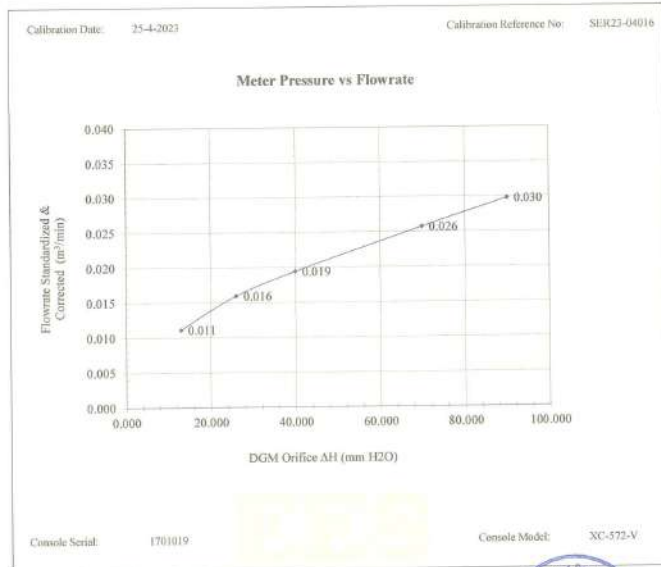
เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	25/04/2023	10:00 AM	Std Temp	293	K
Console Serial Number	1701019	Calibration Reference No.	SER23-04016			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	757.49	mmHg		K1	0.386	
DGM Serial Number	00002028	Calibration Meter Gamma	0.999			Console Leak Check	PASS	



เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	25/04/2023	10:00 AM	Std Temp	293	K
Console Serial Number	1701019	Calibration Reference No.	SER23-04016			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	757.49 mmHg			K ₁	0.386	
DGM Serial Number	00002028	Calibration Meter Gamma	0.999			Console Leak Check	PASS	



เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information		Calibration Conditions			
Console Model Number	XC-572-V	Date	Time	25/04/2023	12:00 PM
Console Serial Number	1701019	Calibration Reference No.	SER23-04016		
DGM Model Number	SK25EX	Reference Thermometer	DIGICON		
DGM Serial Number	00002028	Serial Number	183169105		
Meter Box Model Number	JENCO 765 KF				
Meter Box Serial Number	JC 19031				

Results											
Console Thermocouple Simulator											
Channel and test point	Meter Box Channel Temperature Reading (°C)										
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0	1038.0
Stack	-19.0	23.0	36.0	92.0	149.0	259.0	373.0	484.0	596.0	820.0	1044.0
Aux	-19.0	23.0	36.0	92.0	149.0						
Probe	-19.0	23.0	36.0	92.0	149.0						
Filter	-18.0	23.0	36.0	93.0	149.0						
Oven	-19.0	23.0	36.0	93.0	149.0						
Exit	-18.0	23.0	36.0								

Tolerance Range			
Stack	± 1.50%	Absolute	Meter ± 3.0 °C
Probe	± 3.0 °C		Exit ± 2.0 °C
Filter	± 3.0 °C		



เอกสารไม่ควบคุม

Envi Equipment Service Co., Ltd.
110/254 Moo 3, Tambon Bang Rak Phatthana, Amphur Bang Bua Thong, Nonthaburi 11110.
Tel. 098 362 9152, 089 478 7885
E-mail: sales@envi-ees.com

Certificate No. : E23-08066
Page : 1 of 6

CERTIFICATE OF CALIBRATION

Customer	: United Analyst and Engineering Consultant Co., Ltd.
Address	: 81 Soi Udomsuk 41, Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260
Description of Equipment	: Console meter
Manufacturer	: Apex Instrument
Model Number	: XC-572-V
Serial Number	: 1904011
ID/Control No.	: -
Environment Conditions	: Temperature (25 ± 2) °C
	: Humidity (50 ± 15) % RH
Cal. Date	: 05/08/2023
Issue Date	: 05/08/2023

Calibration Method or Calibration Procedure Used

US EPA Method (United State Environmental Protection Agency)

This certificate is traceable to national standard, which realize the units of measurement according to the International System of Units (SI).

Result of Calibration

This certificate may not be reproduced other than in full except with prior Written approval of the Technical Manager, Envi Equipment Service Company Limited.

These reported uncertainties of measurement are expanded by a coverage factor of k=2, providing a 95% confidence level



Calibrated by : [Redacted]

Approved by : [Redacted]

(Mr. Mana Fuchlud)
Technical Manager

เอกสารไม่ควบคุม

Certificate No. : E23-08066
Page : 2 of 6METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	05/08/2023	09:50 AM	Std Temp	293	K
Console Serial Number	1904011	Calibration Reference No.	SER23-08027			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	758.99 mmHg			K ₁	0.386	
DGM Serial Number	00004114	Calibration Meter Gamma	0.999			Console Leak Check	PASS	

Calibration Data											
Run Time	Metering Console					Calibration Meter					
	DGM Orifice	Volume	Volume	Outlet Temp	Outlet Temp	Volume	Volume	Outlet Temp	Outlet Temp		
Elapsed (Q)	(P _m)	(V _m)	(V _m)	(t _m)	(t _m)	(V _w)	(V _w)	(t _w)	(t _w)		
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C		
12.35	13.0	1342.996	1343.136	29	29	155.32046	155.46168	27	27		
12.42	13.0	1343.136	1343.276	29	29	155.46168	155.60264	27	27		
8.80	26.0	1343.282	1343.422	29	29	155.60872	155.75014	27	27		
8.80	26.0	1343.422	1343.562	30	30	155.75014	155.89098	26	26		
13.95	40.0	1343.569	1343.849	30	30	155.89796	156.17902	26	26		
13.95	40.0	1343.849	1344.129	31	31	156.17902	156.45838	26	26		
10.50	70.0	1344.138	1344.418	31	31	156.46734	156.74556	26	26		
10.47	70.0	1344.418	1344.698	32	32	156.74556	157.02264	26	26		
9.12	90.0	1344.711	1344.991	32	32	157.03528	157.31088	26	26		
9.12	90.0	1344.991	1345.271	32	32	157.31088	157.58638	25	25		



เอกสารไม่ควบคุม

METHOD 5 CONSOLE CALIBRATION
USING REFERENCE WET GAS METER W-NK-2.5-B-Z No.547425
5-POINT METRIC UNIT

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	05/08/2023	09:50 AM	Std Temp	293	K
Console Serial Number	1904011	Calibration Reference No.	SER23-08027			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	758.99 mmHg			K ₁	0.386	
DGM Serial Number	00004114	Calibration Meter Gamma	0.999			Console Leak Check	PASS	

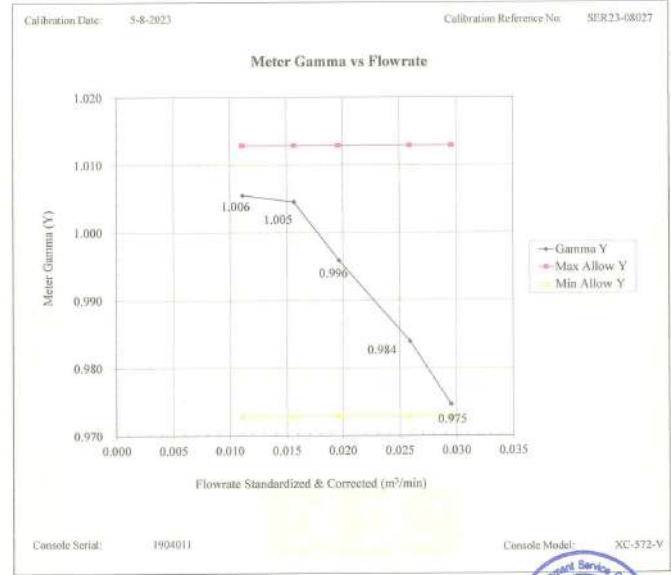
Calibration Data									
Results									
Standardized Data				Dry Gas Meter					
Dry Gas Meter		Calibration Meter		Calibration Factor		Flowrate			
(V _{read})	(Q _{stat})	(V _{Wstat})	(Q _{Wstat})	Value (Y)	Variation (ΔY)	Std & Corr (Q _{stat})	.0212 m ³ /min (ΔH _g)	Variation (ΔH _g)	
m ³	m ³ /min	m ³	m ³ /min			m ³ /min	mm H ₂ O		
0.137	0.011	0.138	0.011	1.006	0.014	0.011	46.171	-0.333	
0.137	0.011	0.137	0.011	1.005	0.012	0.011	46.843	0.339	
0.137	0.016	0.138	0.016	1.007	0.014	0.016	46.870	0.366	
0.137	0.016	0.138	0.016	1.002	0.010	0.016	47.099	0.595	
0.275	0.020	0.275	0.020	0.999	0.006	0.020	45.847	-0.657	
0.275	0.020	0.273	0.020	0.993	0.000	0.020	46.407	-0.097	
0.276	0.026	0.272	0.026	0.986	-0.007	0.026	46.656	0.152	
0.276	0.026	0.271	0.026	0.982	-0.011	0.026	46.743	0.239	
0.276	0.030	0.269	0.030	0.975	-0.018	0.030	46.263	-0.241	
0.277	0.030	0.270	0.030	0.974	-0.018	0.030	46.142	-0.362	
				0.993	Y Average			46.584	ΔH _g Average

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is ±0.02.
For ΔH_g, orifice pressure differential that equates to 0.75 cfm (0.0212 m³/min) at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H₂O.



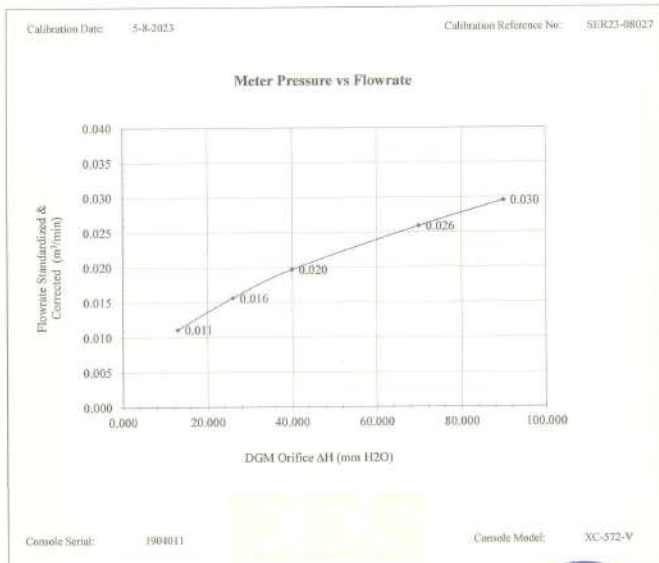
เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	05/08/2023	09:50 AM	Std Temp	293	K
Console Serial Number	1904011	Calibration Reference No.	SER23-08027			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	758.99 mmHg			K ₁	0.386	
DGM Serial Number	00004114	Calibration Meter Gamma	0.999			Console Leak Check	PASS	



เอกสารไม่ควบคุม

Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-V	Date	Time	05/08/2023	09:50 AM	Std Temp	293	K
Console Serial Number	1904011	Calibration Reference No.	SER23-08027			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	758.99 mmHg			K ₁	0.386	
DGM Serial Number	00004114	Calibration Meter Gamma	0.999			Console Leak Check	PASS	



เอกสารไม่ควบคุม

THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information		Calibration Conditions			
Console Model Number	XC-572-V	Date	Time	05/08/2023	12:10 PM
Console Serial Number	1904011	Calibration Reference No. SER23-08027			
DGM Model Number	SK25EX	Reference Thermometer DIGICON			
DGM Serial Number	00004114	Serial Number 183169105			
Meter Box Model Number	JENCO 765 KF				
Meter Box Serial Number	JC 17215				

Results										
Console Thermocouple Simulator										
Channel and test point	Meter Box Channel Temperature Reading (°C)									
	-18.0	25.0	38.0	93.0	149.0	260.0	371.0	482.0	593.0	816.0
Stack	-17.0	25.0	37.0	93.0	149.0	258.0	370.0	481.0	592.0	814.0
Aux	-16.0	25.0	37.0	93.0	149.0					
Probe	-17.0	24.0	37.0	93.0	149.0					
Filter	-16.0	24.0	37.0	93.0	149.0					
Oven	-16.0	24.0	37.0	93.0	149.0					
Exit	-16.0	24.0	37.0							

Tolerance Range			
Stack	± 1.50%	Absolute	Meter ± 3.0 °C
Probe	± 3.0 °C		Exit ± 2.0 °C
Filter	± 3.0 °C		



เอกสารไม่ควบคุม

Instrument description : Flue gas Analyzer
Instrument model : Testo 350 New
Instrument serial no. : 62289477
ID no. or control no. : UAE.EFM.090/2563
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial : -
Customer name : United Analyst and Engineering Consultant Co.,Ltd.
Customer address : 81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10260

Total pages of certificate : 3 Pages
Receiving no. : L-230960
Receiving date : 18-Apr-23
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm, Nitrogen Dioxide 30.34,80.96,202.2 ppm, Nitric Oxide 30.08,150.9,320.6 ppm, Sulphur Dioxide 50.04,100.8,601.1 ppm)

Condition of UUC. : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory

Temperature : 23 ± 5 °C
Humidity : 55 ± 15 %RH

Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210

Calibration procedure no. : This instrument was calibrated by comparison with Standard gas mixture according to calibration work instruction no. WI-CL-26-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement Multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.
This certificate is applied only to item under test Environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.
Calibration certificates without signature and seal not valid and The results relate only to the items tested/calibrated.
This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 20-Apr-23



Mr. Kwanchai Khamboung
Calibration Technician



Mrs. Nongluck Wongpettee
Technical Manager

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O2) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O2) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O2) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	45513	Linde	09-Aug-24
Nitrogen Dioxide (NO2) 30.34 ppm	2703/22	Nimt	22-Aug-24
Nitrogen Dioxide (NO2) 80.96 ppm	3240/21	Linde	26-Jun-24
Nitrogen Dioxide (NO2) 202.2 ppm	3239/21	Linde	20-Jul-23
Nitric Oxide (NO) 30.08 ppm	CG-0089-22	Nimt	13-Jun-24
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide (SO2) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide (SO2) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO2) 601.1 ppm	3204/21	Linde	20-Jul-23

Measured room conditions

Temperature : 22.8 °C Humidity : 61.1 %RH Pressure : 1009.2 mbar

Calibration conditions

Gas Temperature : 24 °C Flow rate : 1,200 ml/min Gas pressure : 1020.3 mbar

Calibration Results (before adjustment) (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (+)
O2 (%Vol)	2.498	2.58	0.082	0.20
O2 (%Vol)	10.04	10.12	0.08	0.40
O2 (%Vol)	21.02	21.15	0.13	0.80
CO (ppm)	80.14	79	-1.14	3.0
CO (ppm)	309.9	305	-4.9	6.0
CO (ppm)	1003	984	-19	12
NO2 (ppm)	30.34	25.6	-4.74	8.0
NO2 (ppm)	80.96	71.9	-9.06	8.0
NO2 (ppm)	202.2	184.2	-18.0	12
NO (ppm)	30.08	28	-2.08	8.0
NO (ppm)	150.9	146	-2.9	8.0
NO (ppm)	320.6	297	-23.6	12
SO2 (ppm)	50.04	46	-4.04	6.0
SO2 (ppm)	100.8	95	-5.8	6.0
SO2 (ppm)	601.1	584	-17.1	13

Calibration Results (after adjustment) (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (+)
O2 (%Vol)	2.498	2.58	0.082	0.20
O2 (%Vol)	10.04	10.12	0.08	0.40
O2 (%Vol)	21.02	21.15	0.13	0.80
CO (ppm)	80.14	81	0.86	3.0
CO (ppm)	309.9	310	0.1	6.0
CO (ppm)	1003	1003	0	12
NO2 (ppm)	30.34	29.6	-0.74	8.0
NO2 (ppm)	80.96	80.5	-0.46	8.0
NO2 (ppm)	202.2	204.3	2.1	12
NO (ppm)	30.08	31	0.92	8.0
NO (ppm)	150.9	153	2.1	8.0
NO (ppm)	320.6	317	-3.6	12
SO2 (ppm)	50.04	49	-1.04	6.0
SO2 (ppm)	100.8	101	0.2	6.0
SO2 (ppm)	601.1	602	0.9	13

Remark : 1 mmol/mol = 1 %vol , 1 µmol/mol = 1 ppm.

End of Report

Instrument description : Flue gas Analyzer
Instrument model : Testo 350 New
Instrument serial no. : 60899698
ID no. or control no. : UAE.EFM.008/2560
Manufacturer : Testo SE & Co. KGaA
Probe description : -
Probe model : -
Probe serial : -
Customer name : UNITED ANALYST CONSULTANT CO.,LTD.
Customer address : 81 SOI UDOMSUK41,SUKHUMVIT ROAD,BANGCHAK PRAKANONG BANGKOK 10260

Total pages of certificate : 3 Pages
Receiving no. : L-230327
Receiving date : 15-Feb-23
Parameter of calibration : Gas Calibration(Oxygen 2.498,10.04,21.02 %vol, Carbon Monoxide 80.14,309.9,1003 ppm, Nitrogen Dioxide 30.34,80.96,202.2 ppm, Nitric Oxide 30.08,150.9,320.6 ppm, Sulphur Dioxide 50.04,100.8,601.1 ppm)

Condition of UUC. : Used
Ambient condition : All of the Measurement were carried out the stabilized laboratory
Temperature : 23 ± 5 °C
Humidity : 55 ± 15 %RH
Calibration place : 17/121 Soi Ngamwongwan 47 Yaek 48, Toongsonghong, Lakki, Bangkok 10210

Calibration procedure no. : WI-CL-26-C

The calibration certificate expanded uncertainty of measurement is stated as the standard uncertainty of measurement Multiplied by coverage factor $k=2$, which for a normal distribution corresponds to a coverage probability of approximately 95%.
This certificate is applied only to item under test Environmental condition.
This Calibration Certificate may not be reproduced other than in full except with the permission of the issuing laboratory.
Calibration certificates without signature and seal not valid.
This calibration certificate documents are traceability to national standards, which realize measurement according to the International System of Units (SI).

Date of calibration : 17-Feb-23



Mr. Sattawat Nueathong
Calibration Technician



Mrs. Nongluck Wongpettee
Technical Manager

Standard References (Table 1)

Standard	Certificate No.	Vendor	Due date
Oxygen (O ₂) 2.498 % Vol	4219/21	Linde	30-Sep-25
Oxygen (O ₂) 10.04 % Vol	CG-0153-21	Nimt	18-Nov-26
Oxygen (O ₂) 21.02 % Vol	CG-0041-22	Nimt	10-Feb-27
Carbon monoxide (CO) 80.14 ppm	CG-0040-22	Nimt	14-Feb-27
Carbon monoxide (CO) 309.9 ppm	2803/21	Linde	22-Jun-23
Carbon monoxide (CO) 1003 ppm	2583/22	Linde	09-Aug-24
Nitrogen Dioxide (NO ₂) 30.34 ppm	2703/22	Linde	22-Aug-24
Nitrogen Dioxide (NO ₂) 80.96 ppm	2041/22	Linde	26-Jun-24
Nitrogen Dioxide (NO ₂) 202.2 ppm	3239/21	Linde	29-Jul-23
Nitric Oxide (NO) 30.08 ppm	CG-0089-22	Nimt	13-Jun-24
Nitric Oxide (NO) 150.9 ppm	2857/21	Linde	27-Jun-23
Nitric Oxide (NO) 320.6 ppm	2944/21	Linde	02-Jul-23
Sulphur Dioxide (SO ₂) 50.04 ppm	3205/21	Linde	25-Jul-23
Sulphur Dioxide (SO ₂) 100.8 ppm	3507/22	Linde	09-Nov-24
Sulphur Dioxide (SO ₂) 601.1 ppm	3264/21	Linde	20-Jul-23

Measured room conditions

Temperature : 22.3 °C Humidity : 58.5 %RH Pressure : 1012.4 mbar

Calibration conditions

Gas Temperature : 23 °C Flow rate : 1,200 ml/min Gas pressure : 1020.4 mbar

Calibration Results Before Adjustment (Table 2)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.498	2.54	0.042	0.20
O ₂ (%Vol)	10.04	10.08	0.04	0.40
O ₂ (%Vol)	21.02	21.13	0.11	0.80
CO (ppm)	80.14	80	-0.14	3.0
CO (ppm)	309.9	309	-0.9	6.0
CO (ppm)	1003	1002	-1	12
NO ₂ (ppm)	30.34	29.2	-1.14	8.0
NO ₂ (ppm)	80.96	79.3	-1.66	8.0
NO ₂ (ppm)	202.2	198.5	-3.7	12
NO (ppm)	30.08	26	-4.08	8.0
NO (ppm)	150.9	145	-5.9	8.0
NO (ppm)	320.6	297	-23.6	12
SO ₂ (ppm)	50.04	49	-1.04	6.0
SO ₂ (ppm)	100.8	100	-0.8	6.0
SO ₂ (ppm)	601.1	598	-3.1	13

Calibration Results After Adjustment (Table 3)

Parameter of Standard	Standard Values	Mean of UUC	Error	Uncertainty (±)
O ₂ (%Vol)	2.498	2.54	0.042	0.20
O ₂ (%Vol)	10.04	10.08	0.04	0.40
O ₂ (%Vol)	21.02	21.13	0.11	0.80
CO (ppm)	80.14	80	-0.14	3.0
CO (ppm)	309.9	309	-0.9	6.0
CO (ppm)	1003	1002	-1	12
NO ₂ (ppm)	30.34	29.2	-1.14	8.0
NO ₂ (ppm)	80.96	79.3	-1.66	8.0
NO ₂ (ppm)	202.2	198.5	-3.7	12
NO (ppm)	30.08	26	-4.08	8.0
NO (ppm)	150.9	145	-5.9	8.0
NO (ppm)	320.6	297	-23.6	12
SO ₂ (ppm)	50.04	49	-1.04	6.0
SO ₂ (ppm)	100.8	100	-0.8	6.0
SO ₂ (ppm)	601.1	598	-3.1	13

Remark : 1 cmol/mol = 1 %vol , 1 μmol/mol = 1 ppm.

End of Report

รายการใบรับรองสอบเทียบ/ทวนสอบ เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพอากาศ									
1	Analytical Balance (Readability 0.1 mg)	ฝุ่นละอองทั้งหมด (TSP) ฝุ่นละอองขนาดเล็กกว่า 10 ไมครอน (PM-10)	Mettler-Toledo	AB204-S / 1128312528	Mettler-Toledo (Thailand) Ltd.	23MM331	7 Apr 23	5 Apr 24	-
2	Analytical Balance (Readability 0.1 mg)		Mettler-Toledo	AB204-S/FACT / B108115858	Mettler-Toledo (Thailand) Ltd.	23MM332	7 Apr 23	5 Apr 24	-



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 :
(/) Pornthippa Tameyakul
(/) Malee Butkruea
Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-1
Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

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

Before Adjustment :

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
(g)	(g)	(g)	(± mg)	(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	Standard Deviation of Reading (g)
(g)	
100	0.00007
200	0.00007

เอกสารไม่ควบคุม



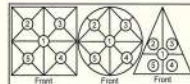
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-1

Cert.No.: 23MM331
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



Maximum difference between off-center and central loading

Position 1	Position 2	Position 3	Position 4	Position 5	
(g)	(g)	(g)	(g)	(g)	(g)
-0.0001	-0.0002	+0.0004	-0.0001	-0.0006	0.0005

3. Departure from nominal value

Applied Weight	Balance Reading	Correction	Measurement Uncertainty	Coverage Factor
(g)	(g)	(g)	(± mg)	(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 %.

-000-

เอกสารไม่ควบคุม



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 :
(/) Pornthippa Tameyakul
(/) Malee Butkruea
Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



Equipment : 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)	15684	24053	70RC007	MM-0010-22	20 Jan 2024

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

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

Range capacity : 0 g to 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

เอกสารไม่ควา

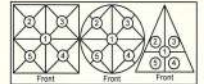


Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-2
Cert.No.: 23MM332
Page: 3 of 3

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



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

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

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 %.

-o0o-

เอกสารไม่ควา

รายการใบรับรองสอบเทียบ/ทวนสอบ เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
เครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์คุณภาพน้ำ									
1	pH Meter	ความเป็นกรด-ด่าง (pH) อุณหภูมิ (Temperature)	Mettler-Toledo	Seven Easy S20 / 1231155210	National Food Institute, Ministry of Industry, Thailand	2301846-001-01	24 Feb 23	23 Feb 24	-
2	pH Meter		Mettler-Toledo	Seven Easy S20 / 1230525212	National Food Institute, Ministry of Industry, Thailand	2302181-001-01	24 Mar 23	22 Mar 24	-
3	Analytical Balance (Readability 0.01 mg)	ของแข็งแขวนลอย (SS) ของแข็งทั้งหมด (TS)	Mettler-Toledo	XSR205DU / C009071872	Technology Promotion Association (Thailand-Japan)	23MM112	26 Apr 23	24 Apr 24	-
4	Analytical Balance (Readability 0.01 mg)	ของแข็งละลายน้ำทั้งหมด (TDS)	Mettler-Toledo	XSR205DU / C210685394	Technology Promotion Association (Thailand-Japan)	23MM113	26 Apr 23	24 Apr 24	-
5	Hot Air Oven		Memmert	UF55 / B212.0411	Technology Promotion Association (Thailand-Japan)	23TM373	11 Apr 23	9 Apr 24	-
6	Analytical Balance (Readability 0.1 mg)	น้ำมันและไขมัน (Oil & Grease)	Mettler-Toledo	XSR204 / C117635043	National Food Institute, Ministry of Industry, Thailand	2302827-001-01	10 May 23	8 May 24	-
7	BOD Incubator	บีโอดี (BOD)	Arco	UC4-1320 / (UAE.WAO.015/2561)	Technology Promotion Association (Thailand-Japan)	23TM249	15 Feb 23	14 Feb 24	-
8	BOD Incubator		Arco	UR-1320 / (UAE.WAO.018/2551)	Technology Promotion Association (Thailand-Japan)	23TM375	12 Apr 23	10 Apr 24	-
9	COD Reactor (Heating Block)	ซีโอดี (COD)	Hanna	HI839800-02 / 648001901	Hanna Instruments (Thailand) Ltd.	HIT-2313-0403	29 Mar 23	27 Mar 24	-
10	COD Reactor (Heating Block)		Hanna	HI839800 / 1147807	Hanna Instruments (Thailand) Ltd.	HIT-2318-0547	28 Apr 23	26 Apr 24	-
11	UV-VIS Spectrophotometer	ไซยาไนด์ (CN ⁻), ฟีนอล (Phenol), ซีโอดี (COD) ฟีนอล (Phenol)	Agilent Technologies	Cary60 G6860A / MY15410009	DQE Services Co.,Ltd.	SP23-021	20 May 23	18 May 24	-
12	UV-VIS Spectrophotometer		Hitachi	U-1900 / 2021-064	DQE Services Co.,Ltd.	SP23-007	6 Jan 23	5 Jan 24	-
13	Atomic Absorption Spectrophotometer (AAS)	ปรอท (Hg) -น้ำทิ้ง	Agilent Technologies	System ID: G8432A AA240FS / MY13160001	Thailand Institute of Scientific and Technological Research (TISTR)	MTCACL.No. 387/66	2 Feb 23	1 Feb 24	-
14	Cold Vapor Atomic Fluorescence Spectrometer (CVAFS)	ปรอท (Hg) -น้ำทะเล	Analytik Jena	mercur DUO plus / K170A0153	Analytik Jena FarEast Thailand Ltd.	Maintenance Protocol	2 Feb 23	1 Feb 24	-

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

Calibration Certificate

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

Page 1 of 5

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.

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

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
Page 2 of 5

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	NF18TH 007/18	PONPE 490	QR22-0886	26 April 2023	
Certified Reference Material		Lot No.	Manufacturer	Ref N	Expiry Date
2.4 pH buffer 4.008 (Primary pH buffer Solution)		832606	CPAchem	PH216.L5	8 August 2024
2.5 pH buffer 5.865 (Primary pH buffer Solution)		832607	CPAchem	PH217.L5	8 August 2024
2.6 pH buffer 10.01 (Primary pH buffer Solution)		832608	CPAchem	PH228.L5	8 August 2023
2.7 pH buffer 7.00 (Standard pH buffer Solution)		832610	CPAchem	PH187.L5	8 August 2023

3. This certification is traceable to The International System of Unit (SI Unit)
3.1 Instruments No.2.1 through NSG-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0008
3.2 Instruments No.2.2 through NSC-TISI-TIS 17025 Laboratory Accreditation of Calibration No.0061
3.3 Instruments No.2.3 through NSC-TISI-TIS 17025 Laboratory Accreditation 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 H-27 LotN 04.06.2021; BIM RefN H-28 LotN 28.05.2021; BIM RefN H-27 LotN 04.06.2021; BIM RefN H-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.

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

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
Page 3 of 5

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

Nominal pH	DC Voltage Standard (mV)	Average Indicator Reading		Uncertainty (±mV)	Coverage Factor (k)
		mV	pH		
0	414.129	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	59.180	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
Manufacturer: Mettler Toledo
Serial No.: 9018311
Type: Combined Electrode
Model: InLab Solids
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	186	-	0.0071	2.00
6.865	6.90	19	97.68	0.0075	2.00
10.008	10.01	-180	97.29	0.0095	2.00
6.985	6.99	15	-	0.0082	2.00

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

Calibration Report

Certificate No.: 2301846-001-01
Equipment: Digital Thermometer with RTD
Resolution: 0.1 °C
Model: SevenEasy TM S20 pH
Serial No.: 1231155210
ID No.: UAE.WAT.010/2553
Manufacturer: Mettler Toledo
Date of Calibration: 24 February 2023
Page 4 of 5

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

Condition of this results of Calibration:

- 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.

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

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

Calibration Report

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

Calibration point: 15.0, 25.0 and 35.0 °C
Calibration result: - The probe was immersed in liquid bath or dry bath to a minimum depth of 120 mm.
- Description of probe, model: - S/N: -
Dimension of probe: Diameter 9 mm., Length 120 mm.,
Sheath material: Stainless Steel

Table with 4 columns: UUC* Reading (°C), Standard Temperature (°C), Correction Value (°C), Uncertainty ± (°C). Rows show data for 15.1, 25.0, and 35.1 °C.

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 %.

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

Calibration Certificate

Certificate No.: 2302181-001-01
Client name: UNITED ANALYST AND ENGINEERING CONSULTANT CO.,LTD.
Address: 3 Soi Udomsak 41, Sukhumvit Road,
Bangchack, Prakhnong, 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 (Mr.Nuttapol Niyomchart) Specialist, Division of Calibration Laboratory
Date of Issue: 24 March 2023 Responsible for the Technical Management Team

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

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

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

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
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: Table with columns: Instruments, Serial / ID No., Manufacturer, Certificate No., Due Date.
3. This certificate is traceable to The International System of Unit (SI Unit): List of instruments and materials traceable to NIST and BIPM standards.
4. This certificate was certified only for the instrument we calibrated.
5. This result of calibration was found accurate as shown on date and place of calibration only.

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

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)

Table with 5 columns: Nominal pH, DC Voltage Standard (mV), Average Indicator Reading (mV and pH), Uncertainty (±mV), Coverage Factor (k). Rows show data for pH values from 0 to 14.

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)

Table with 5 columns: Certified Value @25 °C (pH), Average Indicator Reading (pH and mV), Relative Slope (%), Uncertainty (± pH), Coverage Factor (k). Rows show data for pH values 4.008, 6.865, 10.010, and 9.985.

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

Calibration Report

Certificate No.: 2302181-001-01
Equipment: Digital Thermometer with RTD (pH Meter)
Resolution: 0.1 °C Model: SevenEasy pH
Serial No.: 1230525212 ID No.: UAE.WAS.003/2553
Manufacturer: METTLER TOLEDO
Date of Calibration: 24 March 2023 Page 4 of 5

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:

- 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	ABS997	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

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

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

Calibration Report

Certificate No.: 2302181-001-01
Equipment: Digital Thermometer with RTD (pH Meter)
Resolution: 0.1 °C Model: SevenEasy pH
Serial No.: 1230525212 ID No.: UAE.WAS.003/2553
Manufacturer: METTLER TOLEDO
Date of Calibration: 24 March 2023 Page 5 of 5

Calibration point: 15.0, 25.0 and 30.0 °C

Calibration result:

- The probe was immersed in liquid bath or dry bath to a minimum depth of 120 mm.
- Description of probe, model : N/A S/N : N/A
Dimension of probe : Diameter 3 mm., Length 120 mm.,
Sheath material : N/A

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

Note

- UUC* : Unit Under Calibration

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

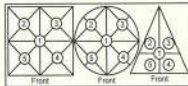
----- End -----

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



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

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



Maximum difference between off-center and central loading

Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	(g)
-0.0001	-0.0001	0.0000	-0.0001	-0.0001	0.0001

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.00000	0.00000	0.014	2.13
0.05	0.05001	-0.00001	0.015	2.09
0.1	0.10001	-0.00001	0.015	2.09
1	1.00001	-0.00001	0.018	2.04
5	5.00003	-0.00003	0.026	2.00
20	20.00006	-0.00006	0.045	2.00
50	50.00006	-0.00006	0.080	2.00
80	80.00004	-0.00004	0.15	2.00
100	100.00000	0.00000	0.16	2.00
150	150.00000	0.00000	0.29	2.00
200	200.00000	0.00000	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 %.

-00o-

เอกสารไม่

a 1159272



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
554/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484



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

Certificate of Calibration

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

A 0053700



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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

Range capacity : 0 g to 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

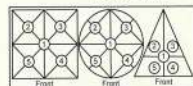
เอกสารไม่

a 1159272



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

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



Maximum difference between off-center and central loading

Position 1 (g)	Position 2 (g)	Position 3 (g)	Position 4 (g)	Position 5 (g)	(g)
-0.0001	-0.0001	0.0000	-0.0001	-0.0001	0.0001

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (± mg)	Coverage Factor (k)
Unload	0.00000	0.00000	0.014	2.11
0.05	0.04999	+0.00001	0.015	2.09
0.1	0.09999	+0.00001	0.015	2.07
1	1.00000	0.00000	0.018	2.04
5	5.00000	0.00000	0.026	2.00
20	20.00002	-0.00002	0.045	2.00
50	50.00002	-0.00002	0.080	2.00
80	80.00002	-0.00002	0.15	2.00
100	100.00000	0.00000	0.17	2.00
150	150.00000	0.00000	0.29	2.00
200	199.9999	+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 %.

-00o-

เอกสารไม่

a 1159271



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
334/4 PATTANAKARN ROAD SOI 1K, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484



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 :

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

Issue Date : 24 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0053359



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

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

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

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

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

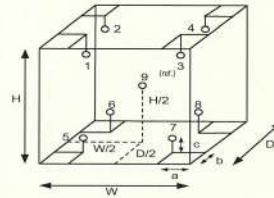
3. This certification is traceable to the International System of Unit.

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 D = 0.50 m
b = 5.0 cm W = 0.80 m
c = 5.0 cm H = 0.75 m
Capacity = 0.30 m³

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

-000-

เอกสารไม่ควบคุม

a 1158260



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



Calibration Certificate

Certificate No.: 2302827-001-01

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

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

Page 1 of 4

Equipment: Electronic Balance

Manufacturer: METTLER TOLEDO

Model: XSR204

Serial No.: C117635043

ID No.: UAE.WAS.012/2564

Order No.: 2302827

Operation No.: 2302827-001

Date of Receipt: 10 May 2023

Date of Calibration: 10 May 2023

Calibrated by Mr.Manas Somsak
Specialist

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

Date of Issue: 18 May 2023

The uncertainties are for a confidence probability of approximately 95%

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

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

เอกสารไม่ควบคุม

2008 เทคโนโลยีสารสนเทศ 35 ถนนสุขุมวิท 35 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10710
2008 501 35, Asoke Asoke Road, Bang WKhao Subdistrict, Bang Phra District, Bangkok 10700, Thailand
Tel: +66(0) 2422 8566 Fax: +66(0) 2422 8565

Calibration Report

Certificate No.: 2302827-001-01

Equipment:

Electronic Balance

Model: XSR204

Serial No.: C117635943

Capacity: 220 g

Manufacturer: METTLER TOLEDO

Resolution: 0.0001 g

ID No.: UAE.WAS.012/2564

Date of Calibration: 10 May 2023

Page 2 of 4

Environment Condition: Ambient Temperature: 21.4 ± 0.2 °C Relative Humidity: 43.4 ± 0.9 %

Place of Calibration: Balance room (Water Analysis Unit), UNITED ANALYST AND ENGINEERING CONSULTANT CO., LTD.

Condition of Equipment: Good Condition

Condition of This Results of Calibration:

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

2. Reference Standards:

Reference Standard	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Standard Weight Class E2	1mg to 200g	B505567572	TCS	M23040535	8 April 2024
Instrument	Model	Serial No.	Calibrated By	Certificate No.	Due Date
Thermo-Hygro Meter	608-H1	NFI.BTH 016/23	Quality Reborn	QR23-0489	21 February 2024

3. This certification is traceable to SI UNIT

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

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

Calibration Results:

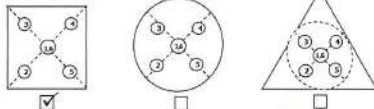
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
100	0.000032
200	0.000032

2. Off-Center Error:

A mass of 100 g was placed and moved to various position on pan.

The balance reading obtained is given in the table.



1	2	3	4	5	6	(Maximum Difference)
(g)	(g)	(g)	(g)	(g)	(g)	(g)
100.0002	100.0002	100.0002	100.0002	100.0003	100.0002	0.0001

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

Certificate No.: 2302827-001-01

Equipment:

Electronic Balance

Model: XSR204

Serial No.: C117635943

Capacity: 220 g

Manufacturer: METTLER TOLEDO

Resolution: 0.0001 g

ID No.: UAE.WAS.012/2564

Date of Calibration: 10 May 2023

Page 3 of 4

Calibration Results: (Continued)

Calibration Range: 0 - 200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
Uncal	0.00000	0.0000	0.0000	0.000085	2.00
0.01	0.01000	0.0100	0.0000	0.000085	2.00
0.02	0.02001	0.0200	0.0000	0.000085	2.00
0.05	0.05000	0.0500	0.0000	0.000085	2.00
0.1	0.10001	0.1000	0.0000	0.000085	2.00
0.2	0.20001	0.2000	0.0000	0.000085	2.00
0.5	0.50002	0.5000	0.0000	0.000085	2.00
1	1.00000	1.0000	0.0000	0.000086	2.00
2	2.00002	2.0000	0.0000	0.000086	2.00
3	3.00003	3.0000	0.0000	0.000087	2.00
5	5.00002	5.0000	0.0000	0.000087	2.00
10	10.00001	10.0000	0.0000	0.000088	2.00
20	20.00003	20.0000	0.0000	0.000092	2.00
30	30.00004	30.0000	0.0000	0.000098	2.00
40	40.00007	40.0000	0.0000	0.00011	2.00
45	45.00009	45.0001	0.0000	0.00013	2.00

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

Calibration Report

Certificate No.: 2302827-001-01

Equipment:

Electronic Balance

Model: XSR204

Serial No.: C117635943

Capacity: 220 g

Manufacturer: METTLER TOLEDO

Resolution: 0.0001 g

ID No.: UAE.WAS.012/2564

Date of Calibration: 10 May 2023

Page 4 of 4

Calibration Results: (Continued)

Calibration Range: 0 - 200 g

Calibration Adjustment: Internal Calibration

3. Departure from Nominal Value:

Nominal Value (g)	Standard Value (g)	Average Reading (g)	Correction (g)	Uncertainty (± g)	Coverage Factor k
50	50.00003	50.0000	0.0000	0.00011	2.00
55	55.00005	55.0000	0.0000	0.00012	2.00
60	60.00004	60.0000	0.0000	0.00012	2.00
65	65.00005	65.0000	0.0000	0.00013	2.00
70	70.00006	70.0001	-0.0001	0.00013	2.00
75	75.00008	75.0002	-0.0001	0.00013	2.00
80	80.00007	80.0002	-0.0001	0.00014	2.00
85	85.00009	85.0002	-0.0001	0.00014	2.00
90	90.00010	90.0002	-0.0001	0.00015	2.00
100	100.00006	100.0002	-0.0001	0.00016	2.00
120	120.00009	120.0002	-0.0001	0.00018	2.00
150	150.00009	150.0002	-0.0001	0.00021	2.00
200	200.00016	200.0003	-0.0001	0.00028	2.00

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

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



TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES & EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD 508 18, SEAN LIANG, SIAN LIANG BANGKOK 10250
TEL: 0-2717-3000-29 FAX: 0-2719-9484



Cert. No.: 23TM249

Page : 1 of 3

Certificate of Calibration

Equipment : BOD Incubator

Manufacturer : Arco

Model : UC4-1320

Serial No. : 13URC4S013201

ID No. : UAE.WAO.015/2561

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

Location : Lab Floor 2

Received Order : 15 February 2023

Calibration Date : 15 February 2023

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Preecha Hiahib

Approved by :

() Pornthippa Tameyakul

(/) Malee Bulkruea

() Suwil Imjai

Issue Date : 24 February 2023

The Uncertainties are for a confidence probability of approximately 95%

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



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

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

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

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

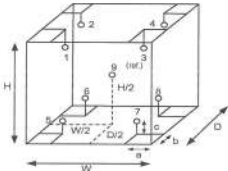
2. This certificate is valid only to the item calibrated on date and place of calibration.

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

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available



Probe Installation Details :

Dimension of Chamber :

a = 10 cm	D = 0.62 m
b = 10 cm	W = 1.2 m
c = 10 cm	H = 1.2 m
	Capacity = 0.89 m ³

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

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

เอกสารไม่ควบคุม



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

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

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

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

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

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

Overall Variation : The Difference of the maximum and minimum measured temperatures throughout observation.
UUC* : Unit Under Calibration

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

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

-o0o-

เอกสารไม่ควบคุม

a 1149512



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



Cert. No.: 23TM375
Page : 1 of 3

Certificate of Calibration

Equipment : BOD Incubator

Manufacturer : ARCO

Model : UR-1320

Serial No. : -

ID No. : UAE.WAO.018/2551

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

Location : Lab Floor 2

Received Order : 11 April 2023

Calibration Date : 12 April 2023

Ambient Temperature : (26 ± 10) °C

Relative Humidity : (50 ± 30) %

Calibrated by : Krisda Malee

Approved by :

() Ponthippa Tameyakul

(✓) Malee Butkruea

() Suwit Imjai

Issue Date : 24 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม

A 0053360



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2304-0156OC-2
Procedure Used :-

Cert. No.: 23TM375
Page : 2 of 3

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

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.

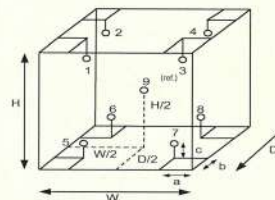
3. This certification is traceable to the International System of Unit.

Result of Calibration :- (*) Without Adjustment

Function of UUC* : Temperature Source

Fresh air setting : Not Available

Environment during calibration		
	Beginning	Finished
Temp. (°C)	28	27
REL.Humid. (%)	42	45
AC Supply (Volt)	219	220



Probe Installation Details :

Dimension of Chamber :

a = 10 cm	D = 0.62 m
b = 10 cm	W = 1.2 m
c = 10 cm	H = 1.2 m
	Capacity = 0.89 m ³

Position :	Ref. Std. ID No.:
1	20RTD-2/1
2	20RTD-2/2
3	20RTD-2/3
4	20RTD-2/4
5	20RTD-2/5
6	20RTD-2/6
7	20RTD-2/7
8	20RTD-2/8
9 (ref.)	20RTD-2/9

เอกสารไม่ควบคุม

a 1158259



Equipment : BOD Incubator
Condition As-Received : Used Item
Reference : 2304-0156OC-2
Result of Calibration :- (*) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Not Available

Cert. No.: 23TM375
Page : 3 of 3

Calibration Point (°C)	UUC* Setting (°C)	UUC* Reading (°C)	Temperature stability (± °C)	Temperature uniformity (°C)	Overall Variation (°C)	Coverage Factor k
20.0	20.0	20.0	0.48	0.42	1.2	2

Calibration Point (°C)	Measured Temperature (°C)									Uncertainty (± °C)
	1	2	3	4	5	6	7	8	9 (ref.)	
20.0	20.040	20.170	20.263	20.093	19.749	19.704	19.920	20.191	20.020	0.66

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

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

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

UUC* : Unit Under Calibration

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

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

-000-

เอกสารไม่ควบคุม

a 1158258



Hanna Instruments (Thailand) Ltd.

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



Certificate No.: HIT-2313-0403

Page : 1 of 2

CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater
Meter Model : HI839800-02
Tube Heater : 25 Vial Capacity
Temperature Range : -10 °C to 160 °C
Ambient Temperature : (25 ± 2) °C
Manufacturer : Hanna Instruments
Condition As-Received : Used Product
Customer name : United Analyst and Engineering Consultant Co., Ltd.
3 Soi Udomsuk 41, Sukhumvit Rd., Bangchak, Phrakhanong, Bangkok 10260
Received date : 23 March 2023
Calibrate date : 27 March 2023
Issue date : 31 March 2023
Calibrated Location : Hanna Instruments (Thailand) Ltd.
Calibration Procedure : This calibrator was conducted by using in-house: calibration procedure CP-04 by using certified reference material.

Calibrated by : ☒ Mr. Pichit Petthong
☐ Mr. Jakkapob Pentisan
☐ Mr. Channarong Soinak
Approved by : Mr. Anan Suwanchaisakul
Authorized Signatory



This certificate was certified only for the instrument we calibrated.

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

** This certificate may not be reproduced other than in full, except with the prior written **

approval of the head of Hanna Instrument (Thailand).

เอกสารไม่ควบคุม



Certificate No.: HIT-2313-0403

Page : 2 of 2

Condition of this calibration result

Reference Standard Instruments:

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

Calibration Result:

Measurement Temperature Source Accuracy for COD Reactor

Capacity (Vial)	Nominal Value (°C)	Average Value (°C)	± Uncertainty (°C)	± Tolerance of UUC (°C)	Acceptance Criteria
25 Vial	150.0	150.2	0.61	2	Pass

Figure: Shows the location of the temperature source.

(1A)	(2A)	(3A)	(4A)	(5A)
149.32°C	150.07°C	150.50°C	149.79°C	150.07°C
(1B)	(2B)	(3B)	(4B)	(5B)
149.68°C	149.85°C	150.84°C	150.52°C	149.69°C
(1C)	(2C)	(3C)	(4C)	(5C)
149.99°C	150.71°C	150.35°C	151.05°C	150.46°C
(1D)	(2D)	(3D)	(4D)	(5D)
150.00°C	150.50°C	150.08°C	149.90°C	149.85°C
(1E)	(2E)	(3E)	(4E)	(5E)
149.44°C	150.06°C	150.56°C	150.11°C	149.51°C

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

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

** End of certificate **

เอกสารไม่ควบคุม



Hanna Instruments (Thailand) Ltd.

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



Certificate No.: HIT-2318-0547

Page : 1 of 2

CERTIFICATE OF CALIBRATION

Equipment : COD Test Tube Heater
Meter Model : HI839800-02
Tube Heater : 25 Vial Capacity
Temperature Range : -10 °C to 160 °C
Ambient Temperature : (25 ± 2) °C
Manufacturer : Hanna Instruments
Condition As-Received : Used Product
Customer name : United Analyst and Engineering Consultant Co., Ltd.
81 Soi Udomsuk 41, Sukhumvit Rd., Bangchak, Phrakhanong, Bangkok 10260
Received date : 21 April 2023
Calibrate date : 28 April 2023
Issue date : 2 May 2023
Calibrated Location : Hanna Instruments (Thailand) Ltd.
Calibration Procedure : This calibrator was conducted by using in-house: calibration procedure CP-04 by using certified reference material.

Calibrated by : ☒ Mr. Pichit Petthong
☐ Mr. Jakkapob Pentisan
☐ Mr. Channarong Soinak
Approved by : Mr. Anan Suwanchaisakul
Authorized Signatory



This certificate was certified only for the instrument we calibrated.

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

** This certificate may not be reproduced other than in full, except with the prior written **

approval of the head of Hanna Instrument (Thailand).

เอกสารไม่ควบคุม

Condition of this calibration result

Reference Standard Instruments:

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

Calibration Result:

Measurement Temperature Source Accuracy for COD Reactor

Capacity (Vial)	Nominal Value (°C)	Average Value (°C)	± Uncertainty (°C)	± Tolerance of UUC (°C)	Acceptance Criteria
25 Vial	150.0	150.1	0.60	2	Pass

Figure: Shows the location of the temperature source.

(1A)	(2A)	(3A)	(4A)	(5A)
149.32°C	150.07°C	150.50°C	149.79°C	150.07°C
(1B)	(2B)	(3B)	(4B)	(5B)
149.68°C	149.85°C	150.84°C	150.52°C	149.69°C
(1C)	(2C)	(3C)	(4C)	(5C)
149.99°C	150.71°C	151.35°C	151.05°C	150.46°C
(1D)	(2D)	(3D)	(4D)	(5D)
150.00°C	150.50°C	150.08°C	149.90°C	149.85°C
(1E)	(2E)	(3E)	(4E)	(5)
149.44°C	150.06°C	150.56°C	150.11°C	149.51°C

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

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

** End of certificate **

เอกสารไม่ควบคุม

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. Tanawat Rittidach)

Approved by : 
(Ms. Chonthicha Sangnarn)

Technical Manager

Quality Manager

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

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

FM-708-02 R01 1/11/2021

เอกสารไม่ควบคุม

REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 2 of 5

Environment Condition : Ambient Temperature 25 ± 5 °C

Relative humidity 55 ± 20 %RH

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

Certified Reference Materials :

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

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

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

Spectral Band Width of UUC : 1.5 nm.

Scan Speed of UUC : 60 nm/min

Scan Interval of UUC : 0.15 nm.

Resolution of UUC : Photometric 0.0001 Abs.

Wavelength 0.1 nm.

FM-708-02 R01 1/11/2021

เอกสารไม่ควบคุม

REPORT OF CALIBRATION

Certificate No. : SP23-021

Page 3 of 5

Calibration Results : Without adjustment



Photometric Accuracy :

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

FM-708-02 R01 1/11/2021

เอกสารไม่ควบคุม

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





REPORT OF CALIBRATION

Certificate No. : SP23-021Page 4 of 5

Photometric Accuracy :

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

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



REPORT OF CALIBRATION

Certificate No. : SP23-021Page 5 of 5

Wavelength Accuracy :

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

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

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

- * Indicates non TISI accredited

- End of Certificate -



FM-708-02 R01 1/11/2021

FM-708-02 R01 1/11/2021

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

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



CERTIFICATE OF CALIBRATION

Certificate No. : SP23-007Page 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 : Hitachi

Model : U-1900

Serial No. : 2021-064


ID No. : UAE.WAS.006/2552


Received Date : 6 January 2023

Calibration Date : 6 January 2023

Issue Date : 10 January 2023

Condition Instrument : Used



Calibrated by : 
(Mr.Tanawat Ritidach)
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.

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



REPORT OF CALIBRATION

Certificate No. : SP23-007Page 2 of 5

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

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

Certified Reference Materials :

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

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

Spectral Band Width of UUC : 4.0 nm.

Scan Speed of UUC : 200 nm/min

Scan Interval of UUC : 0.1 nm.

Resolution of UUC : Photometric 0.001 Abs.
Wavelength 0.1 nm.

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021

FM-708-02 R01 1/11/2021



REPORT OF CALIBRATION

Certificate No. : SP23-007

Page 3 of 5

Calibration Results : Without adjustment

Photometric Accuracy :

Wavelength (nm.)	CRMs Values (Abs)	UUC Reading (Abs)	Correction (Abs)	Uncertainty (Abs)	Coverage factor k
420	0.0000	0.000	0.0000	0.0028	2.00
	0.5787	0.575	0.0037	0.0031	2.00
	1.0490	1.044	0.0050	0.0029	2.00
	2.1900	2.181	0.0090	0.0080	2.00
440	0.0000	0.000	0.0000	0.0028	2.00
	0.5607	0.558	0.0027	0.0034	2.00
	1.0247	1.021	0.0037	0.0035	2.00
	2.1229	2.115	0.0079	0.0081	2.00
465	0.0000	0.000	0.0000	0.0028	2.00
	0.5236	0.520	0.0036	0.0030	2.00
	0.9634	0.961	0.0024	0.0029	2.00
	1.9763	1.968	0.0083	0.0070	2.00
546.1	0.0000	0.000	0.0000	0.0028	2.00
	0.5191	0.518	0.0011	0.0031	2.00
	1.0003	1.000	0.0003	0.0033	2.00
	1.9987	1.993	0.0057	0.0084	2.00
590	0.0000	0.000	0.0000	0.0028	2.00
	0.5523	0.552	0.0003	0.0030	2.00
	1.0809	1.082	-0.0011	0.0030	2.00
	2.0391	2.031	0.0081	0.0080	2.00
635	0.0000	0.000	0.0000	0.0028	2.00
	0.5601	0.562	-0.0019	0.0032	2.00
	1.0512	1.052	-0.0008	0.0030	2.00
	1.9294	1.923	0.0064	0.0079	2.00

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021



REPORT OF CALIBRATION

Certificate No. : SP23-007

Page 4 of 5

Photometric Accuracy :

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

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021



REPORT OF CALIBRATION

Certificate No. : SP23-007

Page 5 of 5

Wavelength Accuracy :

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

Remark : - UUC = Unit Under Calibration

- N/A = Not Available

- The result expanded uncertainty of measurement U is stated as the standard uncertainty of measurement multiplied by the coverage factor k,

which for a normal distribution corresponds to a coverage probability of approximately 95%

- * Indicates non TISI accredited

- End of Certificate -

เอกสารไม่ควบคุม

FM-708-02 R01 1/11/2021



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, Bangkok, 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. [Redacted]

(Mr. Danai Srithongkum)

Approved by [Redacted]

(Miss Sutadida Deavtong)

2. [Redacted]

(Mr. Atipat Ratana)

Senior Technical Officer

Acting Director of Analytical Chemistry Laboratory

Ref. 2015266012600366001

Issued Date : 15 February 2023

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

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : numpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2378 6992
Fax. (66) 0 2378 6992
E-mail : surmalee@tistr.or.th

FMBL.MTC.002 Rev.4

เอกสารไม่ควบคุม



Request No. 25-66 / 0323

1 / 5

MTC. ACL. No. 387 / 66

CALIBRATION DATA

1. Noise Level

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

Continue 2 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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

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

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpa@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : sumalee@tistr.or.th

FMLBL.MTC.002 Rev.4



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
	0.30030	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

Continue 4 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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

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

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpa@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : sumalee@tistr.or.th

FMLBL.MTC.002 Rev.4



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	0.0441	0.0446	0.0444	0.0445	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

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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

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

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpa@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : sumalee@tistr.or.th

FMLBL.MTC.002 Rev.4



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

Continue 5 / 5

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE

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

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

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpa@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtg@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : sumalee@tistr.or.th

FMLBL.MTC.002 Rev.4

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. (Mr. Atipat Ratana)

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

INDUSTRIAL METROLOGY AND TESTING SERVICE CENTRE
 End of Certificate

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

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

Head Office
 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
 Changwat Pathumthani 12120, Thailand
 Tel. (66) 0 2577 9000
 Fax. (66) 0 2577 9009
 E-mail : numpai@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
 Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
 Amphoe Muang Changwat Samutprakarn 10280, Thailand
 Tel. (66) 0 2323 1672-80 ext. 115, 116
 Fax. (66) 0 2323 9165
 E-mail : mtr@tistr.or.th

Office
 196 Phahonyothin Road, Chatuchak, Bangkok 10900,
 Thailand
 Tel. (66) 0 2319 8592
 Fax. (66) 0 2319 8592
 E-mail : sumalee@tistr.or.th

FM.BLMTC.002 Rev.4

Serial-No.: K170A0153 Customer-No.: _____
 Date: 2 February 2023 Carried out by: Mr. Srichai Fak-On

Maintenance with following Operational Qualification (OQ) ☐
 (requires a separate OQ protocol)

Company	บริษัท ยูนิเทค แอนาไลติกส์ แอนด์ เอ็นจิเนียริ่งคอนซัลแตนท์ จำกัด
User	คุณเจนรีลิน สุจริต
Department	ห้องปฏิบัติการ (Mercur Analysis)
Street	3 ซอยอุดมสุข 44 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง
Zip Code, City	กรุงเทพมหานคร 10260
Country	ประเทศไทย
Phone	
Fax	
E-mail	

Maintenance Protocol

Atomic Fluorescence Spectrometer mercur DUO / mercur DUO plus

เอกสารไม่ควบคุม

Maintenance works basic unit

tightness visual check inside the Mercur ☒
 visual check if gold-traps are broken ☒
 visual check if spectrometer is contaminated ☒
 visual check of the fluorescence cell ☒
 visual check of the absorption cell, incl. window ☒
 reactor cleaning ☒
 check pump-hose, if necessary change it ☒
 check swivel drive (SEV) ☒
 check drying-hose, output gas-liquid-separator ☒
 test Bubble-Sensor ☒
 check gas flows ☒
 check volume flows, reagents ☒
 recording stray light values ☒
 measurement with 30 ng/l ☒

Maintenance works Autosampler

Serial No.: N/A

lubricate the dosing-winding (Teflon-grease-spray) ☐
 clean the dosing cylinder, if necessary exchange it ☐
 lubricate the winding system of the height drive with some drops of oil ☐
 check the toothed belt ☐
 check the position of the mechanical stopper (height: 13mm) ☐
 check the pump rate of mixing pump (<14s AS52, typ.7s/<20s AS52S, typ.10s) ☐
 check the pump rate of washing cup ☐
 check the electrical hose connections for good contact ☐
 check the connectors of the magnetic valves ☐
 check the dosing hose for buckling, if necessary exchange it ☐

Device parameter	nominal value	actual value
visual check general tightness inside the Mercur	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check Goldtraps	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
visual check spectrometer		
Fluorescence cell	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Absorption cell, incl. window	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
lens	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
Swivel drive (SEV)	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check pump hoses	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check hoses and hose connectors	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check and clean reactor	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check drying hose output Gas-liquid-separator	o.k.: <input checked="" type="checkbox"/>	changed: <input type="checkbox"/>
check bubble-sensor	o.k.: <input checked="" type="checkbox"/>	not o.k.: <input type="checkbox"/>
Check gasflow		
Argon pressure valve 4	1.2 – 1.5 bar	1.5 bar
Valve 1	10 Nl/h or 0.166 NL/min	0.167 NL/min
Valve 2	50 Nl/h or 0.833 NL/min	0.833 NL/min
Valve 3	5 Nl/h or 0.083 NL/min	0.084 NL/min
Valve 4	10 Nl/h or 0.166 NL/min	0.166 NL/min
Check liquidflow		
Acid	2.5ml/min ± 1 ml	2.5 ml/min
Red.-agent	2.5ml/min ± 1 ml	2.5 ml/min
Sample	10ml/min ± 2 ml	10 ml/min
Adventitious light - values		
(V)	from file	
100	0	0
200	0	0
300	0	0
350	0	0
400	1	1
450	3	3
500	8	8
550	18	18
575	26	26
600	37	35

Maintenance Protocol mercur DUO/ mercur DUO plus | update 27.06.2016 Version 2.1 Kioc
Analytik Jena AG | Konrad-Zuse-Str. 1 | 07745 Jena / Germany

เอกสารไม่ควบคุม 4/6

Device parameter	nominal value	actual value
Analytical parameters Fluorescence cell		
Conditions.: max.conc.: 10µg/L PMT-voltage: 453 V		
Blank-solution		Int. 0.0007
without enrichment / FBR 30 ng/L	Int > 0.0015 RSD < 3 %	Int. 0.0031 RSD 1.13 %
Conditions.: max.conc.: 1.7µg/L PMT-voltage: 444 V		
Blank-solution		Int. 0.0012
with enrichment / FBR 30 ng/L	Int > 0.008 RSD < 3 %	Int. 0.0117 RSD 2.90 %
Fok.- factor (Int ₂ / Int ₁)	> 3.5	3.77
Analytical parameters Absorption cell		
Blank-solution		Ext. 0.00168
without enrichment / FBR 100 ng/L	Ext. > 0.0012 RSD < 5 %	Ext. 0.00500 RSD 1.39 %
Comments		
# Sensitivity check (Without enrichment / FBR / 100 ng/L)		
Int. Blank = 0.000811		
Int. 100 ng/L = 0.009981		

Signature Technician

3 February 2023

Place, Date (DD/MM/YYYY)

Signature Customer

3 February 2023

Place, Date (DD/MM/YYYY)

Maintenance Protocol mercur DUO/ mercur DUO plus | update 27.06.2016 Version 2.1 Kioc
Analytik Jena AG | Konrad-Zuse-Str. 1 | 07745 Jena / Germany

เอกสารไม่ควบคุม 5/6

8/02/2023 10:16 Page 1/4

Mercur

Report file: C:\WinAAS\TMP\2023\Result\WO\Pro_019
Program version: 4.7.9.0 Printed on: 8/02/2023 10:16
Recording started on 8/02/2023 10:07 GMT+7.0
Operator:
Laboratory:
Code:
Remarks:

Method parameters

Method Without Enrichment / FBR / 30 µg/L_PM_3-02-2023
Created on 8/02/2023 Time 10:06
Program ---

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	35 s
PMT	451 V	Peak smoothing	12/5
AZ time	5 s		
Delay	0 s		
Working mode	w/o enrich.	System cleaning	Off
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	12 s	Gas load time	10 NL/h
Reaction time	12 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	30 s		
Purge time2	15 s	Gas wash time2	10 NL/h

Hg

Mercur

เอกสารไม่ควบคุม

8/02/2023 10:16 Page 2/4

QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(30.000 ng/L)	QC std.2 no.	3(0.100 ng/L)
QC std.1 limit	± 20.00%	QC std.2 limit	± 20.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off		
		Reaction	off
		QC Recal.factor	Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	Zero
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	Mean	Meas. cycles	3
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	off		

Calibration standards

No	Name	State	Pos	Conc./ ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: 0.000774 A: 0.01847	0.000038 0.000554	4.995 3.002
2	Cal-Std1	(--)	##	30.000	H: 0.003169 A: 0.05036	0.000036 0.000069	1.137 0.138

Hg

Mercur

เอกสารไม่ควบคุม

Calibration function 1

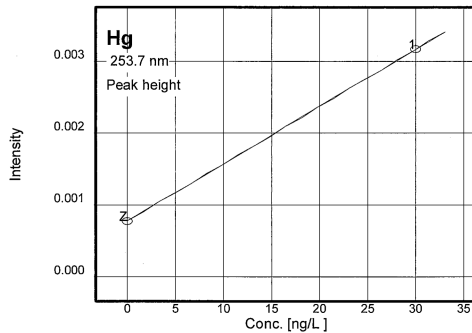
8/02/2023 10:16 Calibration (Peak height)

Ints=k1+k2*conc

k1=0.000775 k2=0.000080

Recal. factor: ---

Slope	0.00008 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---



Measurements and events (sorted by time)

Hg ID	Without Enrichment / FBR / 30 µg/L_PM_3-02-2023	8/02/2023	10:07
Conc.	Ints	BG	SD
Cal-Zero	0.000816		
	0.000765		
	0.000741		
0ng/L	0.000774	0.000038690	4.995
Cal-Std1	0.003130		
	0.003177		
	0.003201		
30.00ng/L	0.003169	0.000036050	1.137
Calibration	Calibration function: 01		10:16

Mercur

เอกสารไม่ควบคุม

Mercur

Report file: C:\WinAAS\TMP\2023\Result\WO\Pro_017

Program version: 4.7.9.0 Printed on: 3/02/2023 14:44

Recording started on 3/02/2023 14:25 GMT+7.0

Operator:

Laboratory:

Code:

Remarks:

Method parameters

Method Enrichment / FBR / 30 µg/L_PM 3-02-2023

Created on 3/02/2023 Time 13:41

Program ---

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	20 s
PMT	444 V	Peak smoothing	8/5
AZ time	5 s		
Delay	0 s		

Working mode	Enr. w/o reload.	System cleaning	Off
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	10 s	Gas load time	10 NL/h
Reaction time	10 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	20 s		
Purge time2	15 s	Gas wash time2	10 NL/h
Purge time3	10 s	Gas wash time3	10 NL/h
Heat.time coll.1	20 s	Cool. time coll.1	30 s

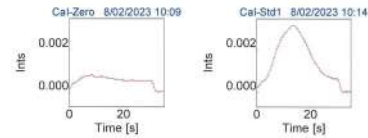
Hg

Mercur

เอกสารไม่ควบคุม

Peak plots

Hg



Mercur

เอกสารไม่ควบคุม

QC parameters

QC type	Conc. check		
QC check samp. 1	---	QC check samp. 2	---
Conc.	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(30.000 ng/L)	QC std.2 no.	1(30.000 ng/L)
QC std.1 limit	± 50.00%	QC std.2 limit	± 50.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off		
		Reaction	off
		QC Recal.factor	Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	off	Meas. cycles	1
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards

Hg

No	Name	State	Pos	Conc./ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: 0.001256 A: 0.003771	0.000060 0.000252	4.833 6.708
2	Cal-Std1	(--)	##	30.000	H: 0.01174 A: 0.03281	0.000341 0.000721	2.909 2.200

Mercur

เอกสารไม่ควบคุม

Calibration function 1

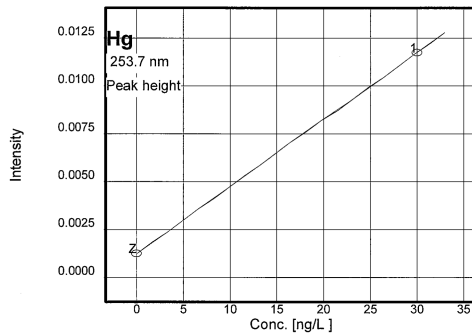
3/02/2023 14:38 Calibration (Peak height)

Ints=k1+k2*conc

k1=0.001256 k2=0.000349

Recal. factor: ---

Slope	0.00035 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	33.0 ng/L
Detection limit	---	Deter. limit	---

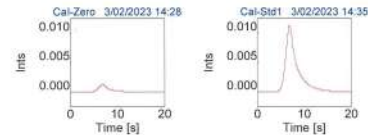


Measurements and events (sorted by time)

Hg ID	Enrichment / FBR / 30 µg/L PM 3-02-2023	3/02/2023 14:25
Conc.	Ints	BG
Cal-Zero	0.001263	SD
	0.001313	RSD/%
	0.001192	Int. type
	0.001256	Time
0ng/L	0.000060700	4.833
Cal-Std1	0.01135	PkH
	0.01189	14:35
	0.01198	14:36
30.00ng/L	0.01174	14:38
Calibration	Calibration function: 01	14:38

Peak plots

Hg



Mercur

เอกสารไม่ควบคุม

Mercur

เอกสารไม่ควบคุม

Mercur

Report file:

C:\WinAAS\TMP\2023\Result\WO\Pro_025

Program version:

4.7.9.0

Printed on:

8/02/2023 11:44

Recording started on

8/02/2023 11:31 GMT+7.0

Operator:

Laboratory:

Code:

Remarks:

Method parameters

Method Without enrichment / FBR 100 ng/L PM_3-02-2023
 Created on 3/02/2023 Time 11:53
 Program ---

Parameters Mercur Technique: Hg absorption

Line	253.7 nm	Integr. time	55 s
Lamp type	Hg-LP		
Integr. mode	Peak height		
PMT	238 V	Peak smoothing	12/5
AZ time	5 s		
Delay	0 s		

Working mode	w/o enrich.	System cleaning	Acid
FBR technique	off	Wash time acid	15 s
Pump speed	4	Soaking time	20 s
Sample load time	8 s	Gas load time	10 NL/h
Reaction time	12 s		
Waiting time AZ	15 s		
Purge time1	40 s		

QC parameters

QC type	Conc. check	QC check samp. 2	---
QC check samp. 1	---	Conc.	---
Conc.	---	Error limit	---
Error limit	---	Reaction	flag + continue
Rep. measurement	off	QC std.2 no.	1(100.00 ng/L)
QC std.1 no.	1(100.00 ng/L)	QC std.2 limit	± 0.00%
QC std.1 limit	± 50.00%		
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off	Reaction	off
		QC Recal.factor	Off

Mercur

เอกสารไม่ควบคุม

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	calculated
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	Mean	Meas. cycles	2
Confid. level	95.4 %	Blind cycles	1
Grubbs stat.	---		

Calibration standards

Hg

No	Name	State	Pos	Conc./ ng/L	Abs	SD	RSD/%
1	Cal-Zero	(--)	##	0.00	H: 0.000383 A: 0.009152	0.000070 0.002492	18.47 27.24
2	Cal-Std1	(--)	##	100.00	H: 0.002931 A: 0.040677	0.000034 0.002788	1.163 6.855

Calibration function 1

8/02/2023 11:43 Calibration (Peak height)

Abs=k1+k2*conc

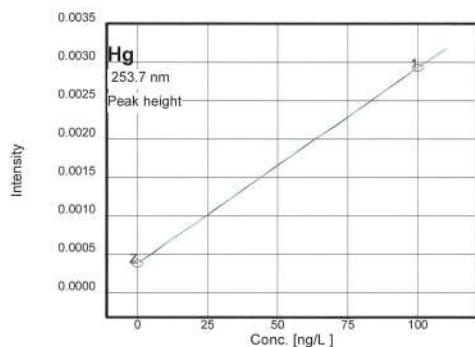
k1=0.000383 k2=0.000025

Recal. factor: ---

Slope	0.00003 Abs/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L	Charact. conc.	171.082 (ng/L)/1%
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---

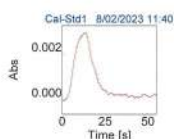
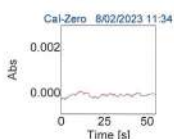
Mercur

เอกสารไม่ควบคุม



Measurements and events (sorted by time)

Hg	Without enrichment / FBR 100 ng/L PM_3-02-2023					8/02/2023	11:31
ID	Conc.	Abs	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.000363				PkH	11:34
		0.000324					11:35
		0.000461					11:37
	0ng/L	0.000383		0.000070827	18.47		11:37
Cal-Std1		0.002954				PkH	11:40
		0.002948					11:41
		0.002892					11:43
	100.ng/L	0.002931		0.000034104	1.163		11:43
Calibration	Calibration function: 01						11:43
Peak plots							Hg



Mercur

Report file: C:\WinAAS\TMP\2023\Result\WO\Pro_024
 Program version: 4.7.9.0 Printed on: 8/02/2023 11:22
 Recording started on 8/02/2023 11:13 GMT+7.0
 Operator:
 Laboratory:
 Code:
 Remarks:

Method parameters

Method Without Enrichment / FBR / 100 µg/L_PM_3-02-2023
 Created on 8/02/2023 Time 10:56
 Program ---

Parameters Mercur Technique: Hg fluorescence

Line	253.7 nm		
Lamp type	Hg-LP		
Integr. mode	Peak height	Integr. time	35 s
PMT	451 V		
AZ time	5 s	Peak smoothing	12/5
Delay	0 s		

Working mode	w/o enrich.	System cleaning	Off
FBR technique	on	Wash time acid	10 s
Pump speed	3	Soaking time	20 s
Sample load time	12 s	Gas load time	10 NL/h
Reaction time	12 s		
Waiting time AZ	5 s		
Delay	0 s		
Purge time1	30 s		
Purge time2	15 s	Gas wash time2	10 NL/h

Mercur

เอกสารไม่ควบคุม

Mercur

เอกสารไม่ควบคุม

QC parameters

QC type	Conc. check	QC check samp. 2	---
QC check samp. 1	---	Conc.	---
Error limit	---	Error limit	---
Rep. measurement	off	Reaction	flag + continue
QC std.1 no.	1(100.000 ng/L)	QC std.2 no.	3(0.100 ng/L)
QC std.1 limit	± 20.00%	QC std.2 limit	± 20.00%
QC std. act.	flag + continue		
Expect. blank abs.	0.0100± 0.0100	Reaction	flag + continue
QC precision	off		
		Reaction	off
		QC Recal.factor	Off

Calibration settings

Calib. meth	Standard calib.	Calibr. unit	ng/L
No. standards	1	Conversion fac.	1000000
Type of standards	---	Standard prep.	Premixed
		Blank correct.	---
		Recalib. std. no.	---
Output unit	µg/L	Conversion fac.	1000
Calib. stat.	Mean	Meas. cycles	3
		Blind cycles	1
Stock sol. 1	---	Stock sol. 2	---
Stock sol. 3	---	Stock sol. 4	---
Type of cal. curve	linear	Intercept	Zero
Weighted cal.	off	Grubbs stat.	off
Check of cal. curve	no outlier test		

Sample statistics

Stat. mode	Mean	Meas. cycles	3
Confd. level	95.4 %	Blind cycles	1
Grubbs stat.	off		

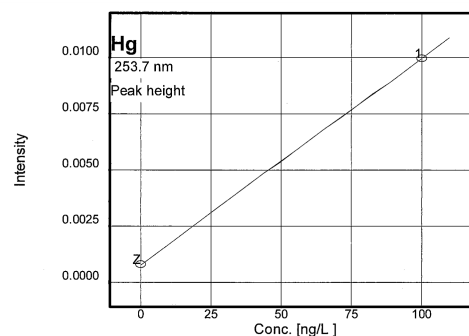
Calibration standards

No	Name	State	Pos	Conc./ng/L	Ints	SD	RSD/%
1	Cal-Zero	(--)	##	0.000	H: 0.000811 A: 0.01927	0.000020 0.000649	2.545 3.371
2	Cal-Std1	(--)	##	100.000	H: 0.009981 A: 0.1406	0.000073 0.001352	0.739 0.961

Calibration function 1

8/02/2023 11:22 Calibration (Peak height)

Ints=k1+k2*conc			
k1=0.000812	k2=0.000092	Recal. factor:	---
Slope	0.00009 Ints/(ng/L)	R2-adjusted	1.0000
sc0	1.00000 ng/L		
Lower limit	0 ng/L	Upper limit	110. ng/L
Detection limit	---	Deter. limit	---



Measurements and events (sorted by time)

Hg	Without Enrichment / FBR / 100 µg/L_PM_3-02-2023					8/02/2023	11:13
ID	Conc.	Ints	BG	SD	RSD/%	Int. type	Time
Cal-Zero		0.000796				PkH	11:15
		0.000803					11:16
		0.000835					11:17
		0.000811		0.000020660	2.545		11:17
Cal-Std1		0.009957				PkH	11:20
		0.009921					11:21
		0.01006					11:21
	100.0ng/L	0.009981		0.000073720	0.739		11:21
Calibration	Calibration function: 01						11:22

Mercur

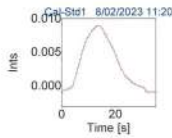
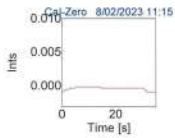
เอกสารไม่ควบคุม

Mercur

เอกสารไม่ควบคุม

Peak plots

Hg

**analytikjena**

An Endress+Hauser Company

Analytik Jena Instruments (Thailand) Ltd.
 35 Moo 5, 345 Road, Khlong Khro, Pat Khet,
 Northburi 11120 Thailand
 Phone: +66(2) 1062970-72
 Fax: +66(2) 1062973
 www.analytik-jena.com

Service Report

Customer's address:		Customer's Ref. No.	
230/135 PM		[Redacted]	
E-mail:		Phone:	Fax:
Job No. 230/135 PM		User: [Redacted]	Service Engineer: [Redacted]
Instrument model: Mercury 200		Serial No. K170A0103	Software Version No. 4.7.9.0
<input type="checkbox"/> Repair (RE) <input checked="" type="checkbox"/> Maintenance (PM) <input type="checkbox"/> Installation (IN) <input type="checkbox"/> Warranty <input type="checkbox"/> Application (AP) <input type="checkbox"/> Site Prep (SP) <input type="checkbox"/> Visit (VI)		<input type="checkbox"/> Error Code	
Fault / Claim: Preventive Maintenance (PM 2/6)			
Action taken: <ul style="list-style-type: none"> - Maintenance Next Basic Unit - Check device parameter - Check gas flow - Check liquid flow - Check Adventitious light - values 			
# Test run Analytical parameter Fluorescence cell Test run Analytical parameter Absorption cell			
Action Pending / Recommendation: [Redacted]			
<input type="checkbox"/> Spare Part <input type="checkbox"/> Instrument Configuration			
Item No.	Name	Quantity	Unit Price
1.			
2.			
3.			
4.			
5.			
6.			
7.			
8.			
Herewith the undersigned confirm the time devoted, the work performed, the perfect function of the device, and the receipt/delivery of the specified spare parts. *Traveled hours and kilometers can only be entered after the return of the service engineer.		Date / Signature of Service Engineer 3/2/2023 [Redacted]	Work completed? <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

Services are subject to the General Terms and Conditions of Analytik Jena AG, which will be sent on request.

Mercur

เอกสารไม่ควบคุม

เอกสารไม่ควบคุม