

ภาคผนวกที่ 5

เอกสารสอบเทียบเครื่องมือ

List of Instruments Certification for Air & Noise Quality Analysis

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration	Remark
Ambient									
1	Orifice Transfer Standard Calibrator	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Thermo Scientific	G25A 158M	Tisch Environmental,Inc.	05072022	5 Jul 22	4 Jul 24	-
2	U-Tube Manometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Dwyer	1221-36-W/M -	Technology Promotion Association (Thailand-Japan)	23P1402	9 May 23	8 May 24	-
3	Aneroid Barometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22P2722	22 Jul 22	21 Jul 23	-
4	Dial Thermo-Hygrometer	Total Suspended Particulate (TSP) Particulate Matter < 10 µm (PM ₁₀)	Barigo, Germany	-	Technology Promotion Association (Thailand-Japan)	22H1583	27 Jul 22	26 Jul 23	-
5	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1201778108	UAE Consultant Co.,Ltd.	28032023	28 Mar 23	27 Mar 24	-
6	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1201778109	UAE Consultant Co.,Ltd.	28032023	28 Mar 23	27 Mar 24	-
7	Nitrogen Dioxide Analyzer	Nitrogen Dioxide	Thermo Scientific	42i 1201778105	UAE Consultant Co.,Ltd.	13022023	13 Feb 23	12 Feb 24	-
8	Standard Gases (Mixture)	Nitrogen Dioxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-
9	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1200636467	UAE Consultant Co.,Ltd.	01092023	9 Jan 23	8 Jan 24	-
10	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48i 1200906880	UAE Consultant Co.,Ltd.	01092023	9 Jan 23	8 Jan 24	-
11	Carbon Monoxide Analyzer	Carbon Monoxide	Thermo	48C 48C-73881-375	UAE Consultant Co.,Ltd.	18012023	18 Jan 23	17 Jan 24	-
12	Standard Gases (Mixture)	Carbon Monoxide	Airgas	EB0143262 2015PSIG	Airgas an Air Liquide company	E04NI99E15A01D3	21 Jun 21	21 Jun 24	-

Certificate of Calibration

Calibration Certification Information				
Cal. Date: July 5, 2022	Rootsometer S/N: 438320	Ta: 297 °K		
Operator: Jim Tisch		Pa: 750.1 mm Hg		
Calibration Model #: G25A	Calibrator S/N: 158M			

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	3	2	1	1.3240	3.2	2.00
2	3	4	1	0.9480	6.4	4.00
3	9	6	3	0.8480	7.9	5.00
4	7	8	1	0.8060	8.7	5.50
5	9	10	1	0.6670	12.7	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pa_{std}} \right) \left(\frac{T_{std}}{T_a} \right)}$	Vs	Qs (x-axis)	$\left(\frac{\Delta H}{Ta} \right) \left(\frac{Pa}{Pa_{std}} \right)$
0.9860	0.7447	1.4073	0.9957	0.7521	0.8859
0.9818	1.0357	1.9902	0.9915	1.0459	1.2585
0.9789	1.1554	2.2351	0.9893	1.1650	1.4071
0.9788	1.2143	2.3337	0.9884	1.2263	1.4757
0.9735	1.4595	2.8146	0.9831	1.4739	1.7798
QSTD		m= 1.96745	QA		m= 1.23199
		ts= -0.03315			ts= -0.03361
		rs= 0.99995			rs= 0.99995

Calculations			
Vstd	ΔVol(Pa-ΔP)/Pstd	1 std/Δ	Va= ΔVol(Pa-ΔP)/Pa
Qstd	Vstd/ΔTime		Qa= Va/ΔTime
for subsequent flow rate calculation:			
Qstd = $1/m \left(\sqrt{\Delta H \left(\frac{Pa}{Pa_{std}} \right) \left(\frac{T_{std}}{T_a} \right)} \right) \cdot b$		Qa = $1/m \left(\sqrt{\Delta H \left(\frac{Pa}{Pa_{std}} \right) \left(\frac{T_{std}}{T_a} \right)} \right) \cdot b$	

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

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

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

www.tisch-env.com

TOL FREE: (877)263-7610

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG, BANGKOK 10250
TEL: 0-2717-3090-24 FAX: 0-2719-8484

Certificate of Calibration

Certificate No.: 23P1402
Page: 1 of 2

Equipment: U Tube Manometer
Manufacturer: Dwyer
Model: 1221-30-WM
Serial No.: -

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ID No.: UAE.EPM.1802561
Condition As-Received: Used Item
Received Date: 26 April 2023
Calibration Date: 09 May 2023

Reference: 2304-0703W/SC Submitted by: United Analyst and Engineering Consultant Co., Ltd.
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1010 mbar

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

Procedure used: The calibration was conducted by direct comparison method against Pressure Measuring Instruments Standard according to in-house calibration procedure CP-P4, using "DKD-R 6-1: Calibration of Pressure Gauges, Edition 03/2014" as a guidelines.

Condition of this result of calibration

- Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Pressure Calibrator	PCI60P	1189	MP-0137-22	24 Aug 2023
- This result of calibration was made on requested at the point specified by customer.
- Scale and conversion factor is 1 kPa = 4.0146293 inH2O
- This instrument was used clean air as pressure media.
- This instrument was calibrated by applied pressure to high-point (+) side and low-point (-) side open to atmospheric pressure.
- This instrument was installed in vertical orientation and top of the pressure port was used as the reference level.
- The certificate is valid only to the item calibrated on date and place of calibration.
- This Certification is traceable to the International System of Unit maintained through-
-National Institute of Metrology Thailand (NIMT)

Calibrated by: Suwit Aussarnee
Issue Date: 11 May 2023

Approved Signatory

Phatinee Prataipai
Sura Suwananari
Atsapol Panurach

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Cert.No.: 23P1402
Page: 2 of 2

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

UUC Indication					
Applied Pressure (inH2O)	High-port side (inH2O)	Low-port side (inH2O)	ΔP (inH2O)	Error (inH2O)	
0.00	0.00	0.00	0.00	0.00	
2.00	1.00	-1.00	2.00	0.00	
4.00	2.00	-2.00	4.00	0.00	
6.00	3.00	-3.00	6.00	0.00	
8.00	4.00	-4.00	8.00	0.00	
10.00	5.00	-5.00	10.00	0.00	
12.00	6.00	-6.00	12.00	0.00	
14.00	7.00	-7.02	14.02	0.02	
16.00	8.00	-8.02	16.02	0.02	
18.00	9.02	-9.04	18.06	0.06	
20.00	10.02	-10.04	20.06	0.06	
22.00	11.00	-11.04	22.04	0.04	
24.00	12.02	-12.06	24.08	0.08	
26.00	13.02	-13.06	26.08	0.08	
28.00	14.02	-14.04	28.06	0.06	
30.00	15.02	-15.02	30.04	0.04	
32.00	16.00	-16.02	32.02	0.02	
34.00	17.00	-17.00	34.00	0.00	
36.80	17.96	-17.98	35.94	0.14	

The uncertainty of measurement was ± 0.11 inH2O

* UUC = Unit Under Calibration

* ΔP = High-port side - Low-port side

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG, BANGKOK 10250
TEL: 0-2717-3090-24 FAX: 0-2719-8484

Certificate of Calibration

Certificate No.: 22P2722
Page: 1 of 2

Equipment: Aneroid Barometer
Manufacturer: Barigo
Model: -
Serial No.: -

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ID No.: UAE.ANV.0132547
Condition As-Received: Used Item
Received Date: 20 July 2022
Calibration Date: 22 July 2022

Reference: 2207-05849/SC Submitted by: United Analyst and Engineering Consultant Co., Ltd.
Ambient Temperature: (23 ± 2) °C
Relative Humidity: (50 ± 15) %
Atmospheric Pressure: 1010 mbar

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

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

Condition of this result of calibration

- Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Barometer	DP142	142259046	MP-0078-22	02 May 2023
- This instrument was installed in vertical orientation and center of the dial was used as the reference level.
- This result of calibration was made on requested at the point specified by customer.
- Scale and conversion factor is 1 kPa = 7.50062 mmHg
- This result of calibration instrument was in absolute pressure.
- This instrument was used clean air as pressure media.
- The certificate is valid only to the item calibrated on date and place of calibration.
- This Certification is traceable to the International System of Unit maintained at-
-National Institute of Metrology Thailand (NIMT)

Calibrated by: Suwit Aussarnee
Issue Date: 25 July 2022

Approved Signatory

Phatinee Prataipai
Sura Suwananari
Atsapol Panurach

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Cert.No.: 22P722
Page: 2 of 2

Result of calibration:- Without adjustment

Function: Absolute Pressure Measurement

Range: 720 mmHg to 780 mmHg
Scale Interval: 1 mmHg (The Fifth Estimate)

Increasing Pressure

Applied Pressure (mmHg)	718.46	729.33	739.65	750.22	760.90	772.01	785.89
UUC* Indication (mmHg)	720.0	730.0	740.0	750.0	760.0	770.0	780.0
Error (mmHg)	1.54	0.67	0.15	-0.22	-0.90	-2.01	-6.89

Decreasing Pressure

Applied Pressure (mmHg)	785.90	771.99	760.85	750.17	739.90	729.67	718.62
UUC* Indication (mmHg)	780.0	770.0	760.0	750.0	740.0	730.0	720.0
Error (mmHg)	-5.90	-1.99	-0.85	-0.17	0.10	0.43	1.38

The uncertainty of measurement was ± 0.24 mmHg

UUC = Unit Under Calibration

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTANAKARN ROAD SOI 18, SUANLIANG, SUANLIANG, BANGKOK 10250
TEL. 0-2717-3000-24 FAX. 0-2719-9484



Certificate of Calibration

Certificate No.: 22H1583
Page: 1 of 2

Equipment: Dial Thermo-Hygrometer

Manufacturer: Barigo

Model: -

Serial No.: -

ID No.: UAE/ANV.010/2547

Condition As-Received: Used Item

Received Date: 20 July 2022

Calibration Date: 22 July 2022

to 27 July 2022

Reference: 2007-056W93C

Ambient Temperature: (25 \pm 3) °C

Relative Humidity: (50 \pm 2) %

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

81 Soi Udomsuk 41, Sukhumvit Road, Bangkok, Phrakhanong, Bangkok 10280

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

Condition of this result of calibration

1.Reference standards instruments:

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Standard Chilled Mirror Hygrometer Sensor	Dew Prime II	31863	19714	17 Sep 2022
2) Standard Humidity/Temperature Meter	400	10240757	TH-0125-21	13 Dec 2022

2.The certificate is valid only to the item calibrated on date and place of calibration.
3.The Certification is traceable to the International System of Unit maintained at:-
-National Institute of Standards and Technology (NIST), The United States of America
-National Institute of Metrology Thailand (NIMT)

Calibrated by: Sornchal Dumvor
Issue Date: 03 August 2022

Approved Signatory:
[] Chakrit Vatanavongkul
[] Pornthipapa Tamsayakul
[] Viporn Tantiyawatt

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Cert. No.: 22H1583
Page: 2 of 2

Result of Calibration:-

Function: Humidity measurement.

Reference Temperature (°C)	Standard Humidity (%R.H.)	UUC* Reading (%R.H.)	Error (%R.H.)	Uncertainty of Measurement (\pm %R.H.)
25.0	40.1	42	1.9	1.6
25.0	60.0	63	3.0	1.8
25.0	80.0	78	-2.0	2.0

Result of Calibration:-

Function: Temperature measurement.

Standard Temperature (°C)	UUC* Reading (°C)	Error (°C)	Uncertainty of Measurement (\pm °C)
20.00	20.0	0.00	0.72
30.01	30.0	-0.01	0.72
35.04	35.0	-0.04	0.72
39.98	40.0	0.02	0.72

UUC* : Unit Under Calibration

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

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

MULTI-POINT GAS TEST REPORT

Test Date : Mar 28, 2023

Equipment : Gas Analyzer (NO_x) Model : 421
Manufacturer : Thermo Scientific Serial Number : 1201778108

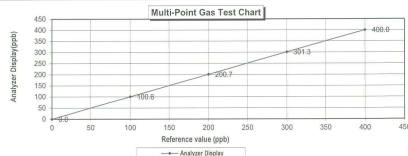
Standard Gas Concentration

Standard Gas Concentration	Dilutor Detail
Sulphur Dioxide (SO ₂)	44.68 PPM Manufacturer : Thermo Scientific
Nitric Oxide (NO)	45.94 PPM Model : 1491
Methane (CH ₄)	- PPM Serial Number : 1180540071
Carbon Monoxide (CO)	984.8 PPM
Cylinder No.:	EB0143262
Expiration Date :	Jun 21, 2024

Multi-point gas test data

Reference Value (ppb)	Analyzer Display (ppb)	Difference Error	Percent Error	[% Error]
Level 1 Zero	0.0	0.00	0.00	0.00
Level 2 20.00%	100.0	0.60	0.60	0.60
Level 3 40.00%	200.0	0.70	0.35	0.35
Level 4 60.00%	300.0	1.30	0.43	0.43
Level 5 80.00%	400.0	0.00	0.00	0.00

Remark : Measuring Range 500.0 ppb
Average Difference (%) 0.28
Acceptable Limit $\pm 5\%$



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MULTI-POINT GAS TEST REPORT

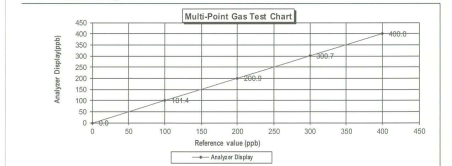
Test Date : Feb 28, 2023

Equipment : Gas Analyzer (NO_x) Model : 421
Manufacturer : Thermo Scientific Serial Number : 1201778109

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	1.40	1.38	1.38
Level 3	40.00%	200.0	20.09	0.90	0.45
Level 4	60.00%	300.0	300.7	0.70	0.23
Level 5	80.00%	400.0	400.0	0.00	0.00
Remark :	Measuring Range 500.0 ppb		Average Difference (%)		0.41
-Acceptable Limit $\pm 5\%$					



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13 Feb 2023

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MULTI-POINT GAS TEST REPORT

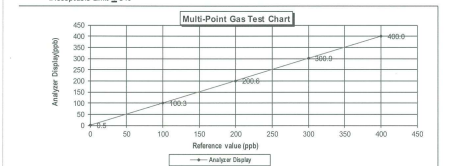
Test Date : Feb 13, 2023

Equipment : Gas Analyzer (NO_x) Model : 421
Manufacturer : Thermo Scientific Serial Number : 1201778105

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	0.50	0.50	0.50
Level 2 10.00%	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 (%)		0.28



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13 Feb 2023

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N198E15A01D3
Cylinder Number: EB0143262
Laboratory: 124 - Dutham (SAP) - NC
PGVP Number: B22021
Gas Code: CO,NO,NOX,SO2,BALN

Reference Volume: 122-402135167-1
Cylinder Volume: 144.4 CF
Cylinder Pressure: 2215 PSIG
Valve Outlet: 660
Certification Date: Jun 21, 2021

Certification performed in accordance with EPA Traceability Protocol for Analytical and Certification of Gasoline Calibration Standards (May 2012) document EPA 600/4-91-010, using the latest procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant interferences which affect the use of this calibration mixture. All concentrations are as a percentage by volume unless otherwise noted.

Component	Requested Concentration	ANALYTICAL RESULTS Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	$\pm 1.4\%$ NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.96 PPM	G1	$\pm 1.4\%$ NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.88 PPM	G1	$\pm 1.0\%$ NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	$\pm 0.7\%$ NIST Traceable	06/14/2021, 06/21/2021
NITROGEN	Balance	Balance			

Type	Lot ID	Cylinder No	CALIBRATION STANDARDS Concentration	Uncertainty	Expiration Date
NTM	2008-120	CC70888	49.82 PPM NITRIC OXIDE/NITROGEN	$\pm 1.2\%$	Feb 02, 2028
PM	1236	DS8009	5.91 PPM NITROGEN DIOXIDE/GAS	$\pm 2.2\%$	Feb 29, 2028
GMS	40142838102	CC05081	4.348 PPM NITROGEN DIOXIDE/NITROGEN	$\pm 2.1\%$	Feb 18, 2028
NTM	16011043	CC04277	46.02 PPM SULFUR DIOXIDE/NITROGEN	$\pm 1.8\%$	Nov 15, 2025
NTRM	14068119	CC04277	980.9 PPM CARBON MONOXIDE/NITROGEN	$\pm 0.6\%$	Nov 15, 2025

Instrument/Make/Model	ANALYTICAL EQUIPMENT Analytical Principle	Last Multi-point Calibration
Nicole 0700 AHR001333 CO	FTIR	Jan 03, 2021
Nicole 0700 AHR001333 NO	FTIR	Jun 03, 2021
Nicole 0700 AHR001333 NO2	FTIR	Jun 03, 2021
Nicole 0700 AHR001333 SO2	FTIR	Jun 03, 2021

Trid Data Available Upon Request

NOTES: PO #5221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



CERT 3012-01
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The analytical test results reported on this certificate relate only to the cylinder number specified above. This concludes the test report.

Approved for Release

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MULTI-POINT GAS TEST REPORT

Test Date : Jan 9, 2023

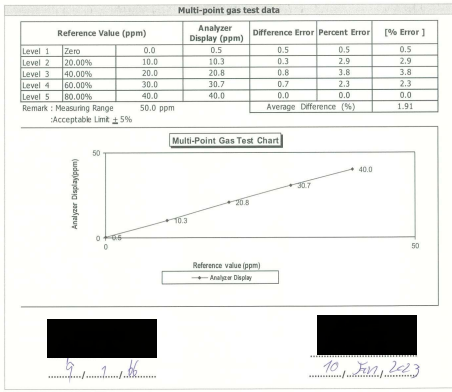
Equipment : Gas Analyzer (CO) Model : 48C
Manufacturer : Thermo Scientific Serial Number : 1209906880

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 20, 2024			

Dilutor Detail

Manufacturer : Thermo Scientific
Model : 1461
Serial Number : 1180540071



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MULTI-POINT GAS TEST REPORT

Test Date : Jan 18, 2023

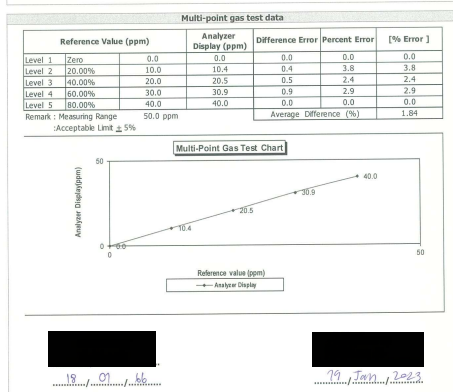
Equipment : Gas Analyzer (CO) Model : 48C
Manufacturer : Thermo Environmental Instruments Serial Number : 48C-73881-375

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 20, 2024			

Dilutor Detail

Manufacturer : Thermo Scientific
Model : 1461
Serial Number : 1180540071



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เอกสารไม่ควบคุม



Airgas Specialty Gases
Airgas USA, LLC
650 United Drive
Durham, NC 27703
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N199E15A01D3 Reference Number: 122-402135167-1
Cylinder Number: E04143262 Cylinder Volume: 144.4 CF
Laboratory: 124 - Durham (SAP) - NC Cylinder Pressure: 2015 PSIG
PGVP Number: B22021 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Jun 21, 2021
Expiration Date: Jun 21, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA-600/R-12/011, using the assay procedures listed. Analytical Metrology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of the calibration mixture. All concentrations are on a dry basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 6.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	45.96 PPM	G1	$\pm 1.4\%$ NIST Traceable	06/14/2021, 06/21/2021
NITRIC OXIDE	45.00 PPM	45.94 PPM	G1	$\pm 1.4\%$ NIST Traceable	06/14/2021, 06/21/2021
SULFUR DIOXIDE	45.00 PPM	44.88 PPM	G1	$\pm 1.0\%$ NIST Traceable	06/14/2021, 06/21/2021
CARBON MONOXIDE	1000 PPM	984.8 PPM	G1	$\pm 0.7\%$ NIST Traceable	06/14/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTM	2001-120	CD70868	49.02 PPM NITRIC OXIDE/NITROGEN	$\pm 1.0\%$	Feb 03, 2023
PPM	12360	D86029	9.91 PPM NITROGEN DIOXIDE/GAS	$\pm 2.0\%$	Feb 28, 2020
GMS	401423838102	CD050981	4.348 PPM NITROGEN DIOXIDE/NITROGEN	$\pm 2.1\%$	Feb 18, 2023
NTM	16011043	CD470277	46.02 PPM SULFUR DIOXIDE/NITROGEN	$\pm 1.6\%$	Nov 17, 2022
NTRM	16061119	CD434277	990.0 PPM CARBON MONOXIDE/NITROGEN	$\pm 0.6\%$	Nov 15, 2025

The GMS 990 in NOX column above is only a reference to the GMS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instruments/Make/Model	Analytical Principle	Last Multi-point Calibration
Nicolet 6700 AHR0801333 CO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 NO2	FTIR	Jun 03, 2021
Nicolet 6700 AHR0801333 SO2	FTIR	Jun 03, 2021

Test Data Available Upon Request

NOTES: PO #6221002807

GROSS WT: 28.40kg

NET WT: 4.73kg



The analytical test results reported on this certificate relate only to the cylinder number [redacted]. This concludes the test report.

Approved for Release



CERT 3012.01
เอกสารไม่ควบคุม

รายการเครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม


No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Laboratory Instrument/Equipments.(คุณภาพอากาศ)									
1	Analytical Balance (Readability 0.1 mg)	ฝุ่นละอองรวม (TSP) ฝุ่นละอองขนาดเล็กไม่เกิน 10 ไมครอน (PM10)	Mettler-Toledo	AB204-S / 1128312528	Mettler-Toledo (Thailand) Ltd.	23MM333	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	-

Due Date of Calibration* : Schedule the program once a year at least once a year.



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.0182550
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsak 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 : 
() Ponthippa Tameyakul
(✓) Malee Butkruea

Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



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

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

Procedure used :- Calibration were conducted using in-house calibration procedure CP-0B01 according to direct measurement method against standard weight.

Condition of this result of calibration

1. Reference standard instruments:-

Instruments	Model	Serial No.	ID No.	Test report No.	Due date
1) Standard Weight Set (E2)	15884	24053	70RC007	MM-0010-22	20 Jan 2024
2. This certificate is valid only to the item calibrated on date and place of calibration.					
3. This result of calibration was made on requested at the point specified by customer.					
4. This certificate is not certified for any commercial transaction.					
5. This certification is traceable to the International System of Unit.					

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

Range capacity : 0 g to 220 g Resolution 0.0001 g

Before Adjustment :

Applied Weight	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)

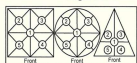
Applied Weight	Standard Deviation of Reading (g)
100	0.00007
200	0.00007

เอกสารไม่ควบคุม



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

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



Maximum difference between off-center and central loading

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	0.16	2.04
100	99.9999	+0.0001	0.19	2.03
150	150.0003	-0.0003	0.29	2.00
200	200.0005	-0.0005	0.29	2.00

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


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เอกสารไม่ควบคุม



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

Certificate of Calibration

Equipment : Electronic Balance
Manufacturer : Mettler Toledo
Model : AB204-S iFACT
Serial No. : B108115858
ID No. : UAE.AIR.01602555
Submitted by : United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsak 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 : 
() Ponthippa Tameyakul
(✓) Malee Butkruea
Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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เอกสารไม่ควบคุม



Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : Z304-00150C-2

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

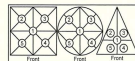
Applied Weight	Standard Deviation of Reading (g)
100	0.00009
200	0.00007

เอกสารไม่ควา



Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : Z304-00150C-2

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



2. Effect of off center loading

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

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

3. Departure from nominal value

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

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

-00-

เอกสารไม่ควา

รายการเครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
Laboratory Instrument/Equipments.(คุณภาพอากาศ)									
1	Analytical Balance (Readability 0.1 mg)	ฝุ่นละอองรวม (TSP) ฝุ่นละอองขนาดเล็กไม่เกิน 10 ไมครอน (PM10)	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	-
Laboratory Instrument/Equipments.(คุณภาพน้ำ)									
3	pH Meter	ค่าความเป็นกรด-ด่าง (pH) ค่าอุณหภูมิ (Temperature)	Mettler-Toledo	Seven Easy S20 / 1231155210	National Food Institute, Ministry of Industry, Thailand	2301846-001-01	24 Feb 23	23 Feb 24	-
4	BOD Incubator	ความสกปรกในรูปบีโอดี Biochemical Oxygen Demand (BOD)	Arco	UC4-1320 / (UAE.WAO.015/2561)	Technology Promotion Association (Thailand-Japan)	23TM249	15 Feb 23	14 Feb 24	-
5	BOD Incubator		Arco	UR-1320 / (UAE.WAO.006/2553)	Technology Promotion Association (Thailand-Japan)	23TM372	11 Apr 23	9 Apr 24	-
6	Analytical Balance (Readability 0.1 mg)	Oil & Grease (น้ำมันและไขมัน)	Mettler-Toledo	XSR204 / C117635043	National Food Institute, Ministry of Industry, Thailand	2302827-001-01	10 May 23	8 May 24	-
7	Analytical Balance (Readability 0.01 mg)	ของแข็งแขวนลอยทั้งหมด (Total Suspended Solids : TSS)	Mettler-Toledo	XSR205DU / C009071872	Technology Promotion Association (Thailand-Japan)	23MM112	26 Apr 23	24 Apr 24	-
8	Hot Air Oven		ของแข็งละลายน้ำทั้งหมด (Total Dissolved Solids : TDS)	Memmert	UF55 / B216.1666	Technology Promotion Association (Thailand-Japan)	22TM1490	19 Oct 22	18 Oct 23

รายการเครื่องมือหลักประจำห้องปฏิบัติการวิเคราะห์ สำหรับตรวจวิเคราะห์คุณภาพสิ่งแวดล้อม

No.	Instrument/Equipment	Parameter	Manufacturer	Model/Serial No.	Calibrator	Certification No.	Date of Calibration	Due date of Calibration*	Remark
9	UV-VIS Spectrophotometer	ไนเตรท (Nitrate)	Agilent Technologies	Cary60 G6860A / MY15410009	DQE Services Co.,Ltd.	SP23-021	20 May 23	18 May 24	-
		ฟอสเฟต (Phosphate)							-
10	UV-VIS Spectrophotometer	ไนเตรทในหน่วยไนโตรเจน (Nitrate-Nitrogen)	Hitachi	U-1900 / 2021-064	DQE Services Co.,Ltd.	SP23-007	6 Jan 23	5 Jan 24	-
11	Incubator	โคลิฟอร์มแบคทีเรียทั้งหมด (Total Coliform Bacteria)	Memmert	IF 75 / D317.0305	Technology Promotion Association (Thailand-Japan)	23TM727	27 Apr 23	25 Apr 24	-
12	Incubator		Memmert	IPP 260 / V616.0066	Technology Promotion Association (Thailand-Japan)	23TM728	27 Apr 23	25 Apr 24	-
13	Water Bath		Memmert	WNE 14 / L416.0606	Technology Promotion Association (Thailand-Japan)	23TM193	15 Feb 23	14 Feb 24	-
14	Water Bath		Memmert	WNE 14 / L416.0612	Technology Promotion Association (Thailand-Japan)	23TM194	15 Feb 23	14 Feb 24	-
15	Analytical Balance		OHAUS	PX623 / C236754745	DKSH (Thailand) Ltd.	C01223732	9 Dec 22	8 Dec 23	-
16	Auto Clave		ALP	CL-40L / 808763	Technology Promotion Association (Thailand-Japan)	23TM763	27 Apr 23	25 Apr 24	-

Due Date of Calibration* : Schedule the program once a year at least once a year.



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 : [Signature]
Approved Signatory
(/) Pornthippa Tameyakul
(/) Malee Butkruea
Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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

เอกสารไม่ควบคุม



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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

Range capacity : 0 g to 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



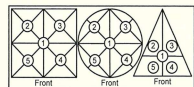
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-1

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 %.

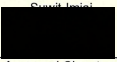
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เอกสารไม่ควบคุม



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 : 
Approved by : 
Issue Date : 10 April 2023

The Uncertainties are for a confidence probability of approximately 95%

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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) | 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	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	Standard Deviation of Reading (g)
(g)	
100	0.00009
200	0.00007

เอกสารไม่ควบคุม



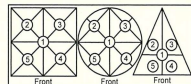
Equipment : Electronic Balance
Condition As-Received : Used Item
Reference : 2304-0015OC-2

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

Result of calibration

2. Effect of off center loading

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



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

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

3. Departure from nominal value

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

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

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เอกสารไม่ควบคุม

Calibration Certificate

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

Page 1 of 5

Equipment: pH Meter
Manufacturer: Mettler Toledo
Model: SevenEasy 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
Approved by: (Mr.Nuttapol Niyomchart)
Specialist, Division of Calibration Laboratory
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.

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

Page 2 of 5

Date of Calibration: 24 February 2023
Location: Chemical Calibration Laboratory, National Food Institute
Environment Condition: Ambient Temperature: (25.1 ± 1.5) °C
Relative Humidity: (50 ± 5) %
Condition of Equipment: Good Condition
Condition of this Results of Calibration

- 1. Calibration Method: In house method : W-CC-002 based on direct measurement by using standard voltage calibrator and certified reference material (CRM)
2. Reference Standards / Certified Reference Material: Table with columns: Instruments, Serial / ID No., Manufacturer, Certificate No., Due Date
3. This certification is traceable to The International System of Unit (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.

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)

Table with 5 columns: Nominal pH, DC Voltage Standard (mV), Average Indicator Reading (mV, 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.: 9018311
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, mV), Relative Slope (%), Uncertainty (± pH), Coverage Factor (k). Rows show data for pH values 4.008, 6.885, 10.008, 6.985.

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

Page 4 of 5

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

Condition of this results of Calibration:

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

2. Reference Standard Instrument :

Table with 6 columns: Instrument, Model, Serial No., Certificate No., Due Date, Through. Rows show data for HANDHELD THERMOMETER and Platinum Resistance Thermometer (PRT).

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

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

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 5 of 5

Calibration point: 15.0, 25.0 and 35.0 °C

Calibration result:

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

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

Note

- UUC* : Unit Under Calibration

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

----- End -----

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

2008 ตำบลนาบูนศรี 36 หมู่บ้านนาบูนศรี แขวงนาบูน 600 เขตบางพลี กรุงเทพมหานคร **เอกสารไม่ควบคุม**
2008 Sol 36, Arun Amarin Road, Bang Yi Khan Subdistrict, Bang Phli District, Bangkok 10700, Thailand
Tel : +66(0) 2422 8598 Fax : +66(0) 2422 8545

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nfi.or.th



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:-

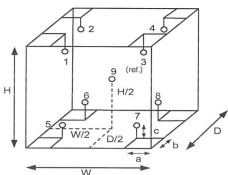
<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Data Acquisition	34972A	MY57013711	22LM93	02 Jul 2023

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 :

Use 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

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Equipment :	BOD Incubator
Condition As-Received :	Used Item
Reference :	2302-0297OC-1
<u>Result of Calibration :-</u>	(*) 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 <i>k</i>
20.0	20.0	19.3	0.32	0.57	1.0	0.60	2

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

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Calibration Report

Certificate No.: 2302827-001-01

Equipment:

Electronic Balance

Model: XSR204

Serial No.: C117635043

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	NFL.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:

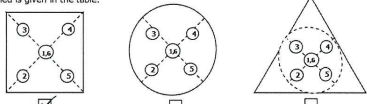
1. Repeatability of Reading:

Nominal Value (g)	Standard Deviation of Reading (g)
100	0.00032
200	0.00032

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

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

Calibration Report

Certificate No.: 2302827-001-01

Equipment:

Electronic Balance

Model: XSR204

Serial No.: C117635043

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
Unload	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

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

Calibration Report

Certificate No.: 2302827-001-01

Equipment:

Electronic Balance

Model: XSR204

Serial No.: C117635043

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 %.

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



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

Certificate of Calibration

Cert.No.: 23MM112

Page.: 1 of 3

Equipment :

Electronic Balance

Manufacturer :

Mettler Toledo

Model :

XSR205

Serial No. :

C009071872

ID No. :

UAE.WAO.012/2563

Submitted by :

United Analyst and Engineering Consultant Co.,Ltd.
3 Soi Udomsuk 41, Sukhumvit Road,
Bangchak, Phakhanong,
Bangkok 10260

Location :

Balance Room

Received order :

26 April 2023

Calibration Date :

26 April 2023

Ambient Temperature :

15 °C to 40 °C

Relative Humidity :

30 % to 90 %

Calibrated by :

Man Pattanapongpaiboon

Approved by :

Approved Signatory

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

Issue Date :

2 May 2023

The Uncertainties are for a confidence probability of approximately 95%

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

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

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

Procedure used :-

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

Condition of this result of calibration

1. Reference standard instruments:-

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

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

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

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

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

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

Range capacity :	0 g to 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 (\pm mg)	Coverage Factor (k)
80	80.00005	-0.00005	0.15	2.00
200	199.9999	+0.0001	0.29	2.00

After Adjustment :

1. Determination of the standard deviation of weighing machine

(n = 10)

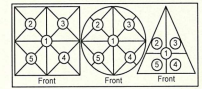
Applied Weight (g)	Standard Deviation of Reading (g)
80	0.000007
200	0.00000

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

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



2. Effect of off center loading

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

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

3. Departure from nominal value

Applied Weight (g)	Balance Reading (g)	Correction (g)	Measurement Uncertainty (\pm 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	100.0000	0.0000	0.16	2.00
150	150.00000	0.0000	0.29	2.00
200	200.00000	0.0000	0.29	2.00

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

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TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
5344 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL: 0-2717-3000-27 FAX: 0-2719-9484



Cert. No.: 22TM1490
Page: 1 of 3

Certificate of Calibration

Equipment : Hot Air Oven
Manufacturer : Memmert
Model : UF 55
Serial No. : B216.1666
ID No. : UAE.WAO.027/2559
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 : 19 October 2022
Calibration Date : 19 October 2022
Ambient Temperature : (26 \pm 10) °C
Relative Humidity : (50 \pm 30) %
Calibrated by : Preecha Hlahib
Approved by :
() Pornthippa Tameyakul
() Malee Butkruea
(✓) Suwit Imjai

Issue Date : 31 October 2022

The Uncertainties are for a confidence probability of approximately 95%

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

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Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0575OC-1

Cert. No.: 22TM1490
Page: 2 of 3

Procedure Used :-

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

The temperature scale used was based on ITS-90.

Condition of this result of calibration

1. Reference standard instrument:-

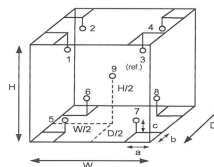
Instrument	Model	Serial No.	Cert. No.	Due Date
1) Data Acquisition	34970A	MY41021843	22LM4	10 Jan 2023

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



Probe Installation Details :	Dimension of Chamber :
a = 5.0 cm	D = 0.33 m
b = 5.0 cm	W = 0.40 m
c = 5.0 cm	H = 0.40 m
	Capacity = 0.053 m ³

Environment during calibration		
	Beginning	Finished
Temp. (°C)	29	30
REL.Humid. (%)	47	40
AC Supply (Volt)	221	220

Ref. Std. ID No.: @ Calibration Point		
Position :	(104) °C	(140,180) °C
1	18-04RTD-01	21-04TC-01
2	18-04RTD-02	21-04TC-02
3	18-04RTD-03	21-04TC-03
4	18-04RTD-04	21-04TC-04
5	18-04RTD-05	21-04TC-05
6	18-04RTD-06	21-04TC-06
7	18-04RTD-07	21-04TC-07
8	18-04RTD-08	21-04TC-08
9 (ref.)	18-04RTD-09	21-04TC-09

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Equipment : Hot Air Oven
Condition As-Received : Used Item
Reference : 2210-0575OC-1
Result of Calibration :- (°) Without Adjustment
Function of UUC* : Temperature Source
Fresh air setting : Close

Cert. No.: 22TM1490
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 <i>k</i>
104.0	104.0	104.0	0.061	1.3	1.7	0.42	2
140.0	140.0	140.0	0.14	2.3	2.4	1.1	2
180.0	180.0	180.0	0.21	3.5	3.6	1.3	2

Calibration Point (°C)	Measured Temperature (°C)								
	Position								
	1	2	3	4	5	6	7	8	9 (ref.)
104.0	103.076	103.876	103.777	104.124	104.667	104.426	104.012	103.928	104.370
140.0	138.199	139.189	138.808	139.550	140.266	139.622	139.293	139.385	140.369
180.0	177.930	179.267	178.643	179.753	181.011	180.093	179.496	179.743	181.278

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

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

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

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

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

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CERTIFICATE OF CALIBRATION

Certificate No. : SP23-021 Page 1 of 5

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

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

Location of calibration : Laboratory 315

Equipment : UV-Vis Spectrophotometer

Manufacturer : Agilent Technologies

Model : Cary 60

Serial No. : MY15410009

ID No. : N/A

Received Date : 20 May 2023

Calibration Date : 20 May 2023

Issue Date : 23 May 2023

Condition Instrument : Good

Calibrated by : (Mr.Tanawut Ritidach) Approved by : (Ms.Chonthicha Sangnern)
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.

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REPORT OF CALIBRATION

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Calibration Results : Without adjustment



Photometric Accuracy :

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

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DQE Services Co.,Ltd.
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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 0.7478	0.0000 0.7436	0.0000 0.0042	0.0050 0.0058	2.00 2.00
257	0.0000 0.8686	0.0000 0.8648	0.0000 0.0038	0.0050 0.0064	2.00 2.00
313	0.0000 0.2912	0.0000 0.2908	0.0000 0.0004	0.0050 0.0052	2.00 2.00
350	0.0000 0.6448	0.0000 0.6398	0.0000 0.0050	0.0050 0.0058	2.00 2.00

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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 -

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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.Tanawut Rittidach)
Technical Manager

Approved by : 
(Ms. Chonthicha Sangngern)
Quality Manager



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

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

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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.

FM-708-02 R01 1/11/2021

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