

ภาคผนวกที่ 5
เอกสารการสอบเทียบเครื่องมือตรวจวัด

ภาคผนวกที่ 5-1

เอกสารสอบเทียบเครื่องมือตรวจวัดคุณภาพอากาศในบรรยากาศ
โดยทั่วไป ความเร็วและทิศทางลม

RECALIBRATION

DUE DATE:

August 3, 2023

Certificate of Calibration

Calibration Certification Information

Cal. Date: August 3, 2022 Rootsmeter S/N: 438320 Ta: 296 °K
 Operator: Jim Tisch Pa: 748.3 mm Hg
 Calibration Model #: TE-5025A Calibrator S/N: **710725**

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3740	3.2	2.00
2	3	4	1	0.9780	6.4	4.00
3	5	6	1	0.8730	7.9	5.00
4	7	8	1	0.8300	8.8	5.50
5	9	10	1	0.6870	12.8	8.00

Data Tabulation

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9870	0.7183	1.4080	0.9957	0.7247	0.8895
0.9828	1.0049	1.9912	0.9914	1.0137	1.2579
0.9808	1.1234	2.2262	0.9894	1.1334	1.4064
0.9796	1.1802	2.3349	0.9882	1.1907	1.4750
0.9743	1.4182	2.8160	0.9829	1.4307	1.7789
QSTD	m=	2.00936	QA	m=	1.25823
	b=	-0.03294		b=	-0.02081
	r=	0.99998		r=	0.99998

Calculations

Vstd = $\Delta Vol \left(\frac{Pa - \Delta P}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)$ Va = $\Delta Vol \left(\frac{Pa - \Delta P}{Pa} \right)$
 Qstd = Vstd / ΔTime Qa = Va / ΔTime

For subsequent flow rate calculations:

$$Qstd = \frac{1}{m} \left(\left(\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)} \right) - b \right) \quad Qa = \frac{1}{m} \left(\left(\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)} \right) - b \right)$$

Standard Conditions

Tstd: 298.15 °K
 Pstd: 760 mm Hg

Key

ΔH: calibrator manometer reading (in H2O)
 ΔP: rootsmeter 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



บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
บริษัท เอ็นไวร์ เซอร์วิส จำกัด
ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 07 January 2022

Instruments Information

Analyzer Type: SO2 Analyzer Model: 43C	Manufacturer Thermo Environmental S/N: 43C-0607415772
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Calibration System

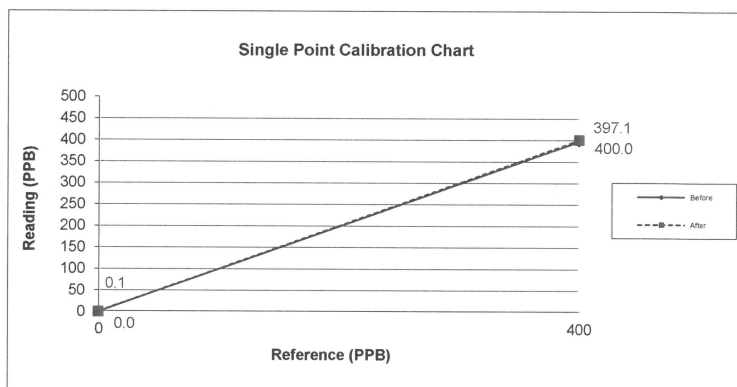
Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 55.47 PPM SO2 Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPB)	Reading (PPB)	Drift (PPB)	Reference (PPB)	Reading (PPB)	Drift%
Before	0.0	0.1	0.1	400.0	397.1	-0.7
After	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By :

Mr.PASAGORN SAMOL



บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
บริษัท เอ็นไวร์ เซอร์วิส จำกัด
ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 25 August 2022

Instruments Information

Analyzer Type: SO2 Analyzer Model: 43C	Manufacturer Thermo Environmental S/N: 43C-65967-356
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Calibration System

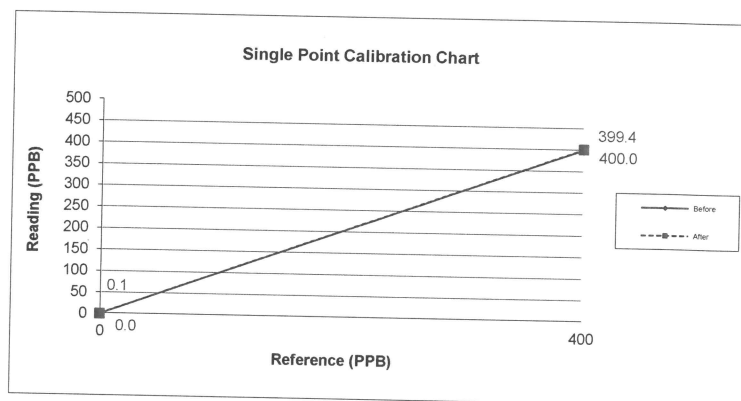
Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 55.47 PPM SO2 Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPB)	Reading (PPB)	Drift (PPB)	Reference (PPB)	Reading (PPB)	Drift%
Before	0.0	0.1	0.1	400.0	399.4	-0.2
After	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By :

Mr.PASAGORN SAMOL



บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
บริษัท เอ็นไวร์ เซอร์วิส จำกัด
ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 13 July 2021

Instruments Information

Analyzer Type: SO2 Analyzer Model: 43C	Manufacturer Thermo Environmental S/N: 43C-65967-350
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Calibration System

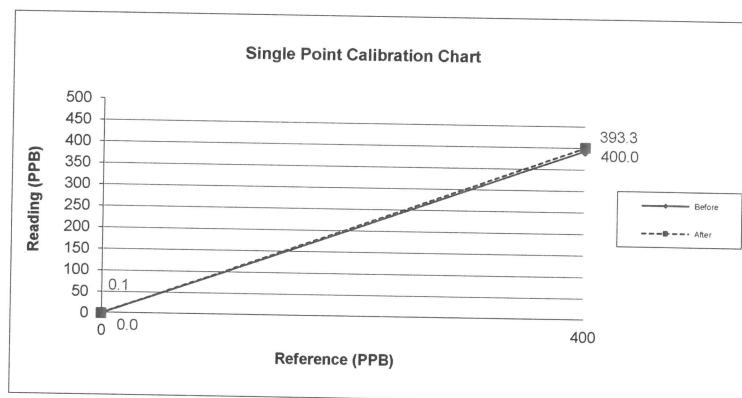
Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 55.47 PPM SO2 Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPB)	Reading (PPB)	Drift (PPB)	Reference (PPB)	Reading (PPB)	Drift%
Before	0.0	0.1	0.1	400.0	393.3	-1.7
After	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By :

Mr.PASAGORN SAMOL



บริษัท เอ็นไวร์ เซอร์วิส จำกัด
42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

บริษัท เอ็นไวร์ เซอร์วิส จำกัด

Analyzer Performance Test

Calibrated Date: 25 August 2022

Instruments Information

Analyzer Type: NO/NO ₂ /NO _x Analyzer Model: 42C	Manufacturer Thermo Environmental S/N: 0514811452
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API Model 701 S/N: 1924	NO Conc 55.47 PPM SO ₂ Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

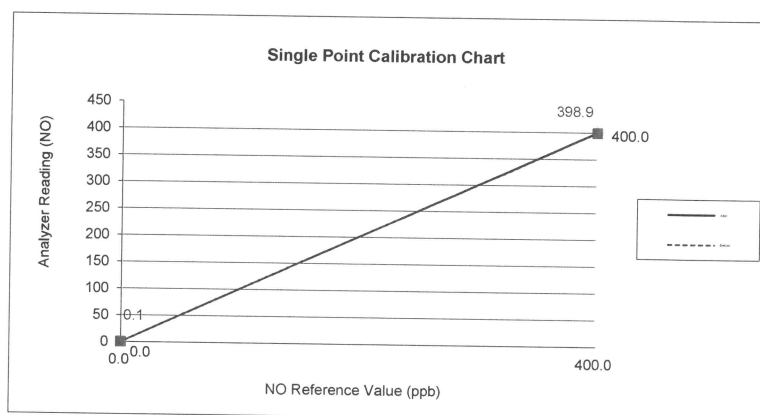
Humidity: 51 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.1	0.0	0.1	398.9	400.0	-0.3
NO _x	0.1	0.0	0.1	399.1	400.0	-0.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.0	0.0	0.0	400.0	400.0	0.0
NO _x	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By : Mr. Pasagorn Samol



บริษัท เอ็นไวร์ เซอร์วิส จำกัด
42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

บริษัท เอ็นไวร์ เซอร์วิส จำกัด

Analyzer Performance Test

Calibrated Date: 07 October 2022

Instruments Information

Analyzer Type: NO/NO ₂ /NO _x Analyzer Model: 42C	Manufacturer Thermo Environmental S/N: 0528012676
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API Model 701 S/N: 1924	NO Conc 55.47 PPM SO ₂ Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

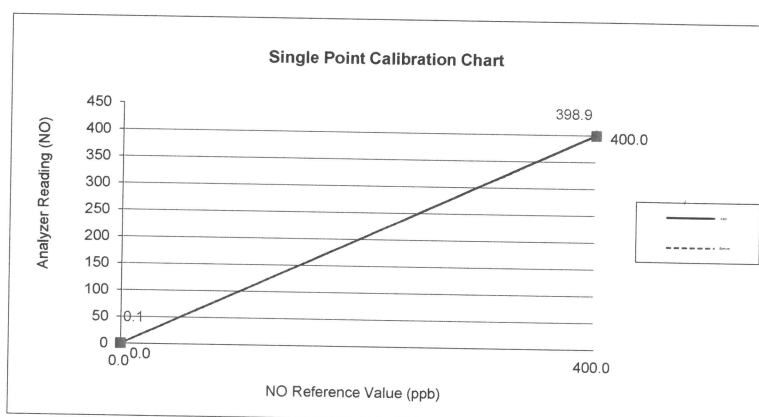
Humidity: 51 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.1	0.0	0.1	398.9	400.0	-0.3
NO _x	0.1	0.0	0.1	399.1	400.0	-0.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.0	0.0	0.0	400.0	400.0	0.0
NO _x	0.0	0.0	0.0	400.0	400.0	0.0



Signature

Calibrate By : Mr. Pasagorn Samol



บริษัท เอ็นไวร์ เซอร์วิส จำกัด

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201
 ENVIR SERVICE CO., LTD. 42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bangkok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 15 October 2021

Instruments Information

Analyzer Type: NO/NO ₂ /NO _x Analyzer Model: 42C	Manufacturer Thermo Environmental S/N: 0528012676
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API Model 701 S/N: 1924	NO Conc 55.47 PPM SO ₂ Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

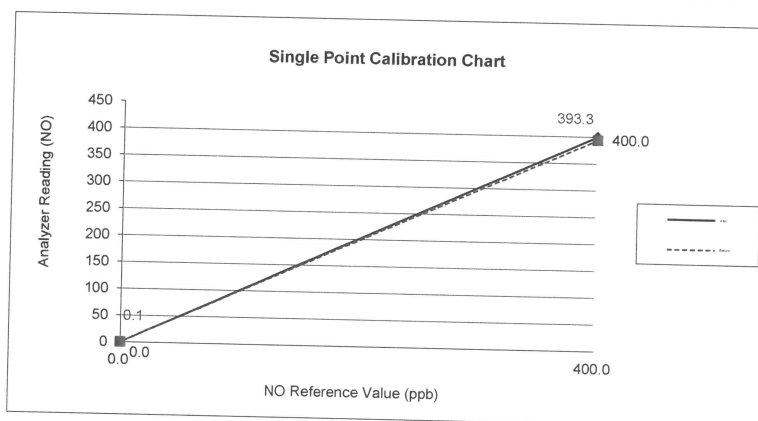
Humidity: 51 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.1	0.0	0.1	393.3	400.0	-1.7
NO _x	0.1	0.0	0.1	397.7	400.0	-0.6

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.0	0.0	0.0	400.0	400.0	0.0
NO _x	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By : Mr. Pasagorn Samol



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 23 November, 2021

Certification No. 504/21

Page : 1 of 3

Object : Wind speed and wind direction

Manufacturer : Davis Instruments Inc.

Type : Weather Wizard III Product No. 7425

Serial No. : WC70127A20

Customer : Pacific Laboratory Co., Ltd.
14/5358 Moo 14, T. Bang Bua,
A. Bang Bua Thong, Nonthaburi 11110.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1011.7 hPa

NATIONAL STANDARD WIND TUNNEL :

: Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 Pitot Tube Theodor Friedrichs Type 0800.0000 serial 9023

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

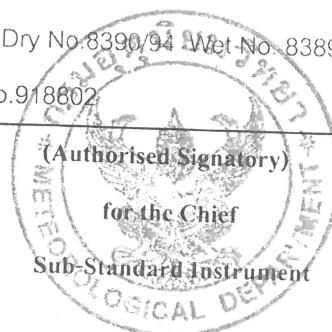
: Theodor Friedrichs Dry No. 8390/94 Wet No. 8389/94

No. 918802

Calibrated by

Mr. Watchara

Mechanica





THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 504/21

23 November, 2021

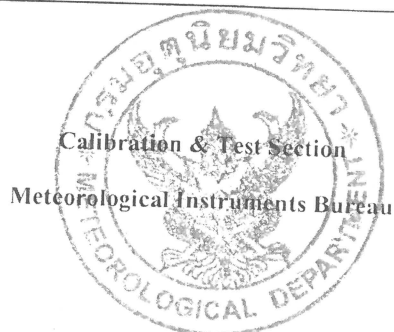
Page : 2 of 3

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacumm inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.5	0.50
7.04	-	-	-	6.8	0.24
9.02	-	-	-	8.5	0.52
11.01	-	-	-	10.7	0.31
13.01	-	-	-	12.5	0.51
15.01	-	-	-	14.8	0.21
17.02	-	-	-	16.5	0.52
20.02	-	-	-	19.8	0.22

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

Calibra

Mr. Watcharapol Subwat
Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

23 November, 2021

Certification No. 504/21

Page : 3 of 3

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.3	45.2	0.1
30.1	30.1	0.0
15.1	15.1	0.0

Calibrat



ภาคผนวกที่ 5-2
เอกสารสอบเทียบเครื่องมือตรวจวัดปริมาณสารเจือปนในอากาศที่
ระบายออกจากปล่อง



QUALITY CALIBRATION CO.,LTD.
235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160
Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584
www.qcalibration.com



CERTIFICATE No : 22M8888
REFERENCE No : 66223-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : DIGITAL BALANCE
MANUFACTURER : SHIMADZU
MODEL : AF225WD
SERIAL No : D316301828
ID No : LAB-BL-003
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : PACIFIC LABORATORY CO., LTD.
14/5358 MOO. 14 TAMBOL BANGBUA THONG
AMPHOE BANG NUA THONG, NONTHABURI
11110

CALIBRATED BY : ATSAWIN Y.

CALIBRATION DATE : 01-Aug-22

APPROVED BY :

ISSUED DATE : 02-Aug-22

RECEIVED DATE : 01-Aug-22

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 22M8888

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : DIGITAL BALANCE MODEL : AF225WD
MANUFACTURER : SHIMADZU S/N : D316301828
ID No : LAB-BL-003 RECEIVED DATE : 01-Aug-22
AIR PRESSURE : 1005mbar \pm 1mbar CALIBRATION DATE : 01-Aug-22
AMBIENT TEMPERATURE : 25° C \pm 1° C RELATIVE HUMIDITY : 56 %RH \pm 10 % RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY ACCORDING TO UKAS LAB 14 EDITION 6:2019 BY USING KNOWN WEIGHT STANDARD WEIGHT. THE BALANCE WAS ADJUSTED USING WEIGHT OF QUALITY CALIBRATION TO ADJUST. THE BALANCE HAS NO ZERO TRACKING FUNCTION. REPEATABILITY WAS MEASURED BY USING 10 REPEATED MEASUREMENTS. LINEARITY WAS MEASURED COVERING 10 POINTS, EVENLY SPREAD OVER THE RANGE. THE INSTRUMENT WAS SET ZERO BEFORE PERFORMING THE LINEARITY TEST. OFF-CENTER LOADING WAS MEASURED BY USING STANDARD WEIGHTS PLACED ON THE PAN AND MOVED TO VARIOUS POSITIONS ON THE PAN.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) STANDARD WEIGHT SET	E2	QK-I-151	C02210415	09-Feb-23
2) STANDARD WEIGHT	E2	15843	C02210419	10-Feb-23
3) STANDARD WEIGHT	E2	QK-I-349	M2103235S	26-Mar-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH CENTRAL BUREAU OF WEIGHTS&MEASURES

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

1. ZERO SETTING FUNCTION : NORMAL

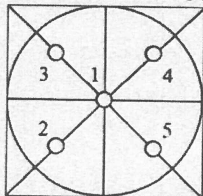
2. TARE FUNCTION : NORMAL

3. REPEATABILITY OF READING AT 200 g WAS 0.000045 g

4. DEPARTURE FROM NOMINAL VALUE/ LINEARITY

NOMINAL VALUE (g)	BALANCE READING (g)	CORRECTION (g)	UNCERTAINTY (\pm g)
0.000	0.0000	0.0000	0.000075
0.001	0.0010	0.0000	0.000075
0.010	0.0100	0.0000	0.000075
0.050	0.0500	0.0000	0.000076
0.100	0.1000	0.0000	0.000075
1.000	1.0000	0.0000	0.000077
2.000	2.0000	0.0000	0.000077
5.000	5.0000	0.0000	0.000079
20.000	20.0000	0.0000	0.000086
50.000	50.0000	0.0000	0.00011
100.000	100.0001	-0.0001	0.00019
150.000	150.0001	-0.0001	0.00026
200.000	200.0000	0.0000	0.00032

5. OFF CENTER LOADING ERROR



POINT	READING (g)
1	100.0000
2	100.0000
3	100.0000
4	100.0000
5	100.0000
OFF-CENTER LOADING	0.00

NOTE: THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY. THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY COVERAGE FACTOR $k=2$, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT

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. : E23-01009

Page : 1 of 6

CERTIFICATE OF CALIBRATION

Customer : Pacific Laboratory Co., Ltd.

Address : 14/5358 Moo 14, Tambon Bang Bua Thong, Amphoe Bang Bua Thong, Nonthaburi 11110

Description of Equipment : Console meter

Manufacturer : Apex Instrument

Model Number : XC-572-OV

Serial Number : 1306033

ID./Control No. : -

Environment Conditions : Temperature (25 ± 2) °C

: Humidity (50 ± 15) % RH

Cal. Date : 06/01/2023

Issue Date : 06/01/2023

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 (IS).

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 : Mr. Sanya Sangnil

Approved by : (Mr. Mana Fuekhud)
Technical Manger



Certificate No. : E23-01009

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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-OV	Date	Time	06/01/2023	10:00 AM	Std Temp	293	K
Console Serial Number	1306033	Calibration Reference No.		SER23-01003		Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure		759.74		K ₁	0.386	
DGM Serial Number	00009149	Calibration Meter Gamma		0.999		Console Leak Check	PASS	

Calibration Data									
Run Time	Metering Console					Calibration Meter			
Elapsed	DGM Orifice DH	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final	Volume Initial	Volume Final	Outlet Temp Initial	Outlet Temp Final
(Q)	(P _m)	(V _{mi})	(V _{mf})	(t _{mi})	(t _{mf})	(V _{wi})	(V _{wf})	(t _{wi})	(t _{wf})
min	mm H ₂ O	m ³	m ³	°C	°C	m ³	m ³	°C	°C
12.42	13.0	0.1450	0.2850	24	24	118.64438	118.64402	25	25
12.40	13.0	0.2850	0.4250	25	25	118.64402	118.78246	25	25
8.75	26.0	0.4360	0.5760	25	25	118.78792	118.92572	25	25
8.75	26.0	0.5760	0.7160	26	26	118.92572	119.06308	25	25
14.02	40.0	0.7220	1.0020	27	27	119.06932	119.34854	25	25
14.02	40.0	1.0020	1.2820	28	28	119.34854	119.62648	25	25
10.53	70.0	1.2930	1.5730	28	28	119.63648	119.91388	25	25
10.50	70.0	1.5730	1.8530	28	28	119.91388	120.19082	25	25
9.17	90.0	1.8640	2.1440	29	29	120.20082	120.48048	25	25
9.15	90.0	2.1440	2.4240	29	29	120.48048	120.75954	25	25



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

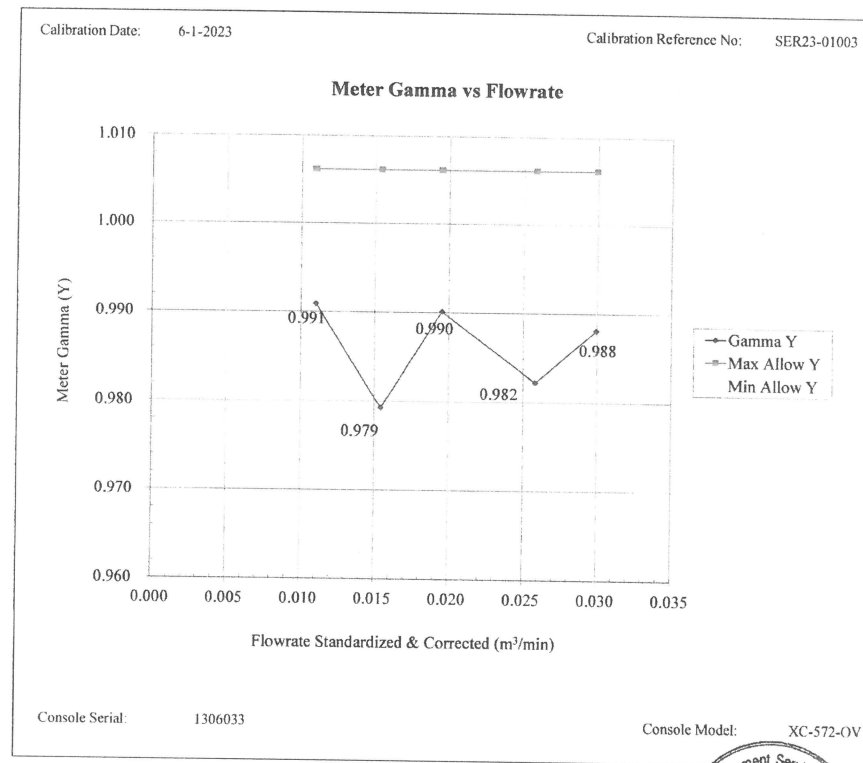
Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-OV	Date	Time	06/01/2023	10:10 AM	Std Temp	293	K
Console Serial Number	1306033	Calibration Reference No.	SER23-01003			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	759.74		mmHg	K ₁	0.386	
DGM Serial Number	00009149	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 _{m(std)})	(Q _{m(std)})	(V _{w(std)})	(Q _{w(std)})	Value	Variation	Std & Corr	.0212 m ³ /min	Variation
m ³	m ³ /min	m ³	m ³ /min	(Y)	(ΔY)	(Q _{m(std)corr})	(ΔH _g)	(ΔH _g)
m ³	m ³ /min	m ³	m ³ /min			m ³ /min	mm H ₂ O	
0.138	0.011	0.137	0.011	0.995	0.009	0.011	47.368	0.286
0.138	0.011	0.136	0.011	0.987	0.001	0.011	48.063	0.981
0.138	0.016	0.135	0.015	0.981	-0.005	0.015	48.432	1.350
0.138	0.016	0.135	0.015	0.978	-0.008	0.015	48.743	1.661
0.276	0.020	0.274	0.020	0.992	0.006	0.020	46.695	-0.387
0.276	0.020	0.273	0.019	0.988	0.002	0.019	47.126	0.044
0.277	0.026	0.272	0.026	0.983	-0.003	0.026	47.026	-0.056
0.277	0.026	0.272	0.026	0.981	-0.005	0.026	46.884	-0.198
0.278	0.030	0.275	0.030	0.989	0.003	0.030	45.227	-1.855
0.278	0.030	0.274	0.030	0.987	0.001	0.030	45.256	-1.826
				0.986	Y Average		47.082	ΔH@ 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.



Meter Console Information		Calibration Conditions				Factors/Conversions		
Console Model Number	XC-572-OV	Date	Time	06/01/2023	10:10 AM	Std Temp	293	K
Console Serial Number	1306033	Calibration Reference No.	SER23-01003			Std Press	760	mm Hg
DGM Model Number	SK25EX	Barometric Pressure	759.74		mmHg	K ₁	0.386	
DGM Serial Number	00009149	Calibration Meter Gamma	0.999			Console Leak Check	PASS	



Certificate No. : E23-01009

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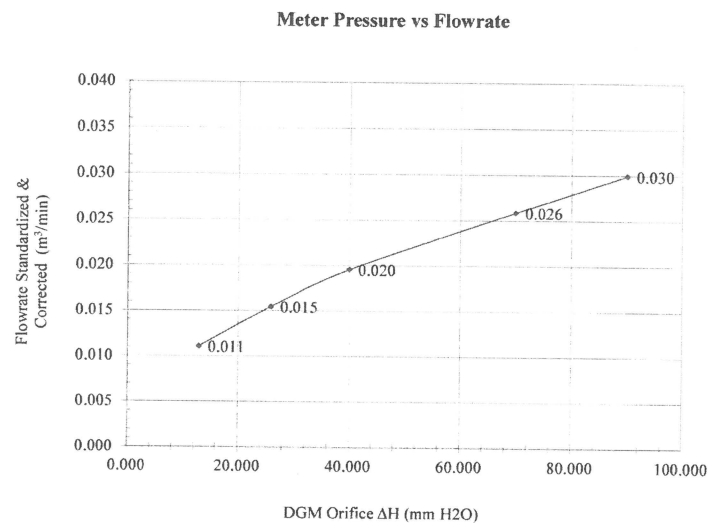
Meter Console Information	
Console Model Number	XC-572-OV
Console Serial Number	1306033
DGM Model Number	SK25EX
DGM Serial Number	00009149

Calibration Conditions			
Date	Time	06/01/2023	10:10 AM
Calibration Reference No.	SER23-01003		
Barometric Pressure	759.74	mmHg	
Calibration Meter Gamma	0.999		

Factors/Conversions		
Std Temp	293	K
Std Press	760	mm Hg
K ₁	0.386	
Console Leak Check	PASS	

Calibration Date: 6-1-2023

Calibration Reference No: SER23-01003



Console Serial: 1306033

Console Model: XC-572-OV



Certificate No. : E23-01009

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THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Console Model Number	XC-572-OV
Console Serial Number	1306033
DGM Model Number	SK25EX
DGM Serial Number	00009149
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 13335

Calibration Conditions			
Date	Time	06/01/2023	12:10 PM
Calibration Reference No.	SER23-01003		
Reference Thermometer	DIGICON		
Serial Number	183169105		

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	27.0	37.0	93.0	149.0	259.0	372.0	484.0	595.0	819.0
Aux	-17.0	27.0	37.0	92.0	149.0					
Probe	-17.0	27.0	37.0	93.0	149.0					
Filter	-17.0	27.0	37.0	93.0	149.0					
Oven	-17.0	27.0	37.0	93.0	149.0					
Exit	-17.0	27.0	37.0							

Stack ± 1.50% Absolute
 Probe ± 3.0 °C
 Filter ± 3.0 °C

Tolerance Range

Meter ± 3.0 °C
 Exit ± 2.0 °C



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. : E23-01010
Page : 1 of 3

CERTIFICATE OF CALIBRATION

Customer : Pacific Laboratory Co., Ltd.
Address : 14/5358 Moo 14, Tambon Bang Bua Thong, Amphoe Bang Bua Thong, Nonthaburi 11110
Description of Equipment : Standard Probe Method 5
Manufacturer : Apex Instrument
Model Number : PS-4HV
Serial Number : -
ID./Control No. : -
Environment Conditions : Temperature (25 ± 2) °C
: Humidity (50 ± 15) % RH
Cal. Date : 06/01/2023
Issue Date : 06/01/2023

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 (IS).

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 : Mr. Sanya Sangnil

Approved by :

(Mr. Mana Fuchai)
Technical Manager

Certificate No. : E23-01010
Page : 2 of 3

CALIBRATION RESULTS S-Type Geometric Pitot Tube Calibration

Sampling System Equipment Information

Probe Model : PS-4HV
Probe Number : -
Pitot Number : A9148
Pitot Tube Type : S-type

Calibration Condition

Date : 6 January 2023
Barometric Pressure : 759.74 mm Hg
Digital Caliper : CD-6" ASX
Serial number : A18008059

Pitot tube/Probe: # PS-4HV			
Parameter	Value	Allowable Range	Check
Assembly level?	Yes	Yes	Pass
Ports Damage?	No	No	Pass
$\alpha 1$	0	$-10^\circ < \alpha 1 < +10^\circ$	Pass
$\alpha 2$	1	$-10^\circ < \alpha 2 < +10^\circ$	Pass
$\beta 1$	0	$-5^\circ < \beta 1 < +5^\circ$	Pass
$\beta 2$	0	$-5^\circ < \beta 2 < +5^\circ$	Pass
γ	0	N/A	-
θ	0	N/A	-
Dt	0.374	.188 " to .375 "	Pass
A	0.966	$2.1Dt \leq A \leq 3Dt$	Pass
A/2Dt	1.291	$1.05 \leq P_A/D_t \leq 1.5$	Pass
$Z = A \tan \gamma$	0.047	$Z \leq .125"$	Pass
$W = A \tan \theta$	0.019	$W \leq .031"$	Pass

Remark:

I certified that probe model: **PS-4HV** meets or exceeds all specifications, criteria and/or applicable design and is hereby assigned a pitot tube certification factor of **0.84**. See 40 CFR Pt. 60, App. A, EPA Method 2.



THERMOCOUPLES SYSTEM CALIBRATION

Sampling System Equipment Information	
Probe Model Number	PS-4HV
Probe Serial Number	-
Meter Box Model Number	JENCO 765 KF
Meter Box Serial Number	JC 13335

Calibration Conditions			
Date	Time	06/01/2023	01:00 PM
Calibration Reference No.	SER23-01003		
Reference Thermometer	DIGICON		
Serial Number	183169105		

Thermocouple of Standard Probe method 5 = length 4 foot			
Set Point	Reference Thermocouple	Probe Thermocouple	Difference
100	100.0	97.0	0.80
250	250.0	247.0	0.19
300	300.0	298.0	0.35
350	350.0	347.0	0.48



Certificate of Calibration



CUSTOMER

Name
Pacific Laboratory Co., Ltd.
Address
**14/5358 Moo 14, Tambon Bang Bua Thong,
Amphoe Bang Bua Thong, Nonthaburi 11110
Department/ Division/ Vessel
N/A**

UNIT UNDER CALIBRATION (UUC)

Description
Flue gas analyzer
Manufacturers
testo Model 310
S/N.**42848034**
Measuring Range
O2 : 0-21 %Vol, CO : 0-4000 PPM

Cert. No. **SE-CM23SER117**

Cal. Date : 10-Mar-23
Cal. Due : 09-Mar-24
Work Order No. : SE-CM23SER117
Cal. Temp. : 25.0 ± 1°C
Cal. Humidity : 55.0 ± 10 %RH

Reference Standard

Description	Cert. No.	Expired Date
- GASCO Nitrogen = 99.99 %Vol	81-0078RK-01	6-May-25
- Linde Mixture Gas in Nitrogen	3278/22	17-Oct-24
Component : CO = 100 PPM, O2 = 18.0 %		

Function Setup

Items	O2	CO
Low alarm	None	None
High alarm	None	None
Unit	%Vol	PPM

Test Result

Visual Check	Criteria	Result	Operation Check	Criteria	Result
Structure	Proper	Good	Battery storage	Function	Pass
Indication, Symbol and letter	Proper	Good	Suction pump	Function	Pass
Gas sampling hose & probe	Proper	Good			



Calibration Result

Parameter	Zero						Span						Respond time Sec.		Judgment	Note:
	Std.	Acc.	Before	Cal.	After	Err.	Std.	Acc.	Before	Cal.	After	Err.	Acc.	Read		
O2 (%Vol)	0.0	± 1.5	0.0	0.0	0.0	0.0	18.0	± 1.0	18.4	18.4	18.4	0.0	≤30	14.0	Pass	- Respond time must be within 30 sec. to reach to 90% of Std. concentration.
CO (PPM)	0.0	0.0	0.0	0.0	0.0	0.0	100.0	± 5	85.0	85.0	85.0	0.0	≤30	18.0	Pass	

Std. = Standard, Read = Reading, Cal. = Calibrate, Acc. = Acceptance, Err. = Error, Sec. = Second

Comment/ Suggestion :

This UUC that has been tested and calibrated to meet the manufacturer's published specifications in accordance with our quality control system. The standards used for calibration are on record and traceable to the National Institute of Standard and Technology (NIST), and have accuracies equal to or greater than the UUC being tested. This result of calibration was found accurated as show on date and place of calibration only.

 (Engineer Specialist) Date : 10-Mar-23		(Gases Division Chief) Date : 10-Mar-23		Company Stamp	
				 Call Me CALL ME ENGINEER CO., LTD.	



Certificate of Calibration

Equipment:	SPECTROPHOTOMETER	Certificate No.:	C06220310
Model:	DR3900	Issued Date:	18 July 2022
Serial No. (or ID.):	2076219	Job No.:	KSPR2207318
Manufacturer:	HACH	Page:	1 of 2
Condition:	In Condition		

Customer: PACIFIC LABORATORY CO.,LTD.
14/5358 Moo 14 Tambol Bang Bua Thong,
Amphoe Bang Bua Thong, Nonthaburi 11110

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

Calibration Place: Environment Laboratory, SPC RT Co., Ltd.
1194 Soi Wachirathamsathit 57, Sukhumvit 101/1 Rd.,
Bangchak, Prakhnong, Bangkok 10260 Thailand

Calibration By: Miss. Kaewkan Suradech

Calibration Date: 18 July 2022

The Method used: In house method, SPCC-WI-24, base on ASTM E 275-08 and ASTM E 387-04

Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 93907 and 93914

The standard for Photometry Certificate No. 93908 and 93909

(Miss Kaewkan Suradech)

SPC RT Co., Ltd.

(Mr. Thalerngkeat Pongngam)

Person in charge

Authorized signatory

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SPC RT Co., Ltd.

Calibration Results:

Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 5 nm and UUC at 5 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
418.40	418	0.40	0.59
537.00	537	0.00	0.59
638.00	638	0.00	0.59
747.61	747	0.61	0.59
807.04	807	0.04	0.59

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5816	0.577	0.0046	0.0045
	0.7130	0.709	0.0040	0.0045
	1.0151	1.009	0.0061	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5649	0.560	0.0049	0.0045
	0.7012	0.700	0.0012	0.0045
	0.9982	0.995	0.0032	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5249	0.524	0.0009	0.0045
	0.6621	0.662	0.0001	0.0045
	0.9420	0.940	0.0020	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5214	0.519	0.0024	0.0045
	0.6982	0.699	-0.0008	0.0045
	0.9947	0.992	0.0027	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5549	0.552	0.0029	0.0045
	0.7736	0.771	0.0026	0.0045
	1.1041	1.099	0.0051	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5621	0.561	0.0011	0.0045
	0.7630	0.762	0.0010	0.0045
	1.0890	1.085	0.0040	0.0045

The End of Certificate

บริษัท เอสพีซี อาร์ที จำกัด

SPC RT CO., LTD.

สาขาที่ 00003 1194 ซอยวชิรธรรมสาธิต 57 ถนนสุขุมวิท 101/1 แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260

Branch 00003 1194 Soi Wachirathamsothit 57, Sukhumvit 101/1 Road, Bangchak, Phrakhanong, Bangkok 10260 Thailand

Tel: 0 2185 4333 Ext. 3300-3308 Fax: 0 2185 4424 E-mail: info.spc@spc-rt.com Website: www.spc-rt.com

Analyzer Performance Test

Calibrated Date: 27 April 2023

Instruments Information

Analyzer Type : CO Analyzer

Model : 48C

Manufacturer :

Thermo Environmental

Serial Number :

0528012677

Calibrator Unit

Dilutor Model :

Dasibi Model 5008

Serial Number :

705

ZERO AIR Generator :

API MODEL 701

Serial Number :

1924

Standard Gas Concentration

Nitric Oxide (NO)

55.47 PPM

Sulphur Dioxide (SO₂)

55.11 PPM

Carbon Monoxide (CO)

4,535 PPM

Cylinder number

EB0129027

Expire Date:

29 Oct. 2027

Environment : Temperature 25.5 °C Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.2	0.2	45.0	44.6	-1.0
After	0.0	0.0	0.0	45.0	45.0	0.0

Single Point Calibration Chart

