

ภาคผนวกที่ 5

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

ภาคผนวกที่ 5-1

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

ครั้งที่ 3/2566

โรงเรียนแสงหิรัญ

และสถาบันการบินพลเรือน

วันที่ตรวจวัดวันที่ 10-15 กุมภาพันธ์ 2567

PM10 High Volume Sampler Calibration

Verification Report No.
SC2400033-E001-PM 01

Site: ท่าอากาศยานดอนเมือง

UTM: 43P-152550 672800

Sampler: EPM33

Recorder: ECRD501618124

Date: 10 Feb 24

Technical Approval: [Redacted]

Barometric Press. (hPa): 1002.0

Temperature (deg C): 32.0

Corrected Avg Press. (hPa): 1013.0

Average Temp. (deg C): 30.0

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 5411

Barometric Press. (hPa): 1004.0

Temperature (deg C): 34.0

Corrected Avg Press. (hPa): 1013.0

Average Temp. (deg C): 30.0

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 5411

Plate or Test #	H2O (g)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.28	1.620	52.0	33.13
2	8.89	1.523	48.0	30.58
3	7.25	1.369	42.0	26.76
4	3.48	0.353	30.0	19.11
5	2.47	0.805	25.0	16.56

LINEAR REGRESSION
Slope = 19.9566
Intercept = 0.2266
Corr. coeff = 0.9978
SFR = 1.50
SSR = 36.31
of Observations: 5
Range of Chart: 34
at SFR ±10%: 39

Calibrated by: [Redacted]

10 February 2024

Approved by: [Redacted]

10 February 2024

PM10 High Volume Sampler Calibration

Verification Report No.
SC2400033-E001-PM 02

Site: สถานีตำรวจนครบาลปทุมธานี

UTM: 43P-152550 672807

Sampler: EPM33

Recorder: ECRD501618125

Date: 10 Feb 24

Technical Approval: [Redacted]

Barometric Press. (hPa): 1004.0

Temperature (deg C): 34.0

Corrected Avg Press. (hPa): 1013.0

Average Temp. (deg C): 30.0

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 5411

Barometric Press. (hPa): 1004.0

Temperature (deg C): 34.0

Corrected Avg Press. (hPa): 1013.0

Average Temp. (deg C): 30.0

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 5411

Plate or Test #	H2O (g)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.16	1.624	52.0	33.20
2	8.15	1.454	46.0	29.37
3	7.20	1.268	44.0	28.09
4	3.03	0.892	30.0	18.15
5	2.52	0.814	28.0	17.66

LINEAR REGRESSION
Slope = 18.7110
Intercept = 2.5267
Corr. coeff = 0.9993
SFR = 1.165
SSR = 37.89
of Observations: 5
Range of Chart: 35
at SFR ±10%: 40

Calibrated by: [Redacted]

10 February 2024

Approved by: [Redacted]

10 February 2024

Calibration Certification Information				
Cal. Date: February 9, 2024	Room: S/N: 438310	Ta: 295 °K	Pa: 749.0 mm Hg	
Operator: [REDACTED]	Calibrator S/N: 5411			
Calibration Model #: TE-5025A				

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3950	3.2	2.00
2	3	4	1	0.9840	6.4	4.00
3	5	6	1	0.8790	7.9	5.00
4	7	8	1	0.8430	8.8	5.50
5	9	10	1	0.6940	12.7	8.00

Data Tabulation				
Vstd (m3)	Qstd (m3)	$\sqrt{\Delta H \left(\frac{Pa}{Pa_{std}} \right) \times \frac{T_{std}}{T_a}}$ (y-axis)	Va (m3)	Qa (m3)
0.9914	0.7106	1.4111	0.9957	0.7138
0.9871	1.0032	1.9956	0.9915	1.0076
0.9851	1.1207	2.2312	0.9895	1.1257
0.9839	1.1672	2.3401	0.9883	1.1723
0.9787	1.4103	2.8222	0.9830	1.4165
QA	m= 2.02024		QA	m= 1.26504
	b= -0.07667			b= -0.01677
	r= 0.99993			r= 0.99993

Calculations	
$V_{std} \Delta H \left(\frac{Pa_{std}}{Pa} \right) / (P_{std} T_{std} / T_a)$	$V_a \Delta H \left(\frac{Pa_{std}}{Pa} \right) / (P_a T_{std} / T_a)$
Qstd = Vstd / ΔTime	Qa = Va / ΔTime
For subsequent flow rate calculations:	
$Q_{std} = 1/m \left(\sqrt{\Delta H \left(\frac{Pa}{Pa_{std}} \right) \times \frac{T_{std}}{T_a}} \right) \times b$	$Q_a = 1/m \left(\sqrt{\Delta H \left(\frac{Pa}{Pa_{std}} \right) \times \frac{T_{std}}{T_a}} \right) \times b$

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

Certificate of Calibration

Certificate No. : 67-200034-1

Submitted by : [REDACTED]

Equipment : Electronic Balance
Manufacturer : Sartorius
Model : SECURA224-1S
Serial No. : 0034803270
ID No. : ELABBALANCEN04
Capacity : 220 g
Resolution : 0.0001 g
On site calibration was carried out at the Balance Room, Easilab Co., Ltd.
Ambient Temperature : (22.8 to 23.6) °C
Relative Humidity : (44.6 to 45.3) %
Air Pressure : 1014.0 mbar

Date of Received : 01 February 2024
Date of Calibration : 01 February 2024
Date of Issue : 06 February 2024
Calibrated by : [REDACTED]
Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref: LAB 14
Edition 7 - November 2022

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Weights
ID No. E-261-E2624
Cert. No. C0222008
Due Date 08 Nov 2024
Traceability National Institute of Metrology (Thailand), (NIMT)

Certificate of Calibration

Certificate No. : 67-200034-1

Page : 2 of 2

Result of Calibration :

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty ± (g)
0.01	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00038

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.06$, providing a level of confidence of approximately 95%.



Eccentric error Load test : 50 g

A B C D E
-0.0001 -0.0001 -0.0001 0.0001 0.0000 g

Repeatability

Load test : 200 g

Subv. : 0.00005 g

-o-o-

SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6702006

Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer Model: AF22e	Manufacturer: Environnement SA, France S/N: NSCESAFAF32E454
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Calibration System

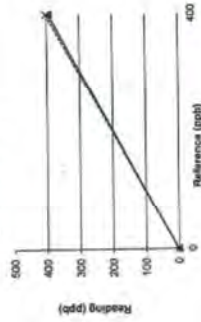
Calibrator Unit	Standard Gas
Dilutor Model ESA MDG101 S/N: 792	NOx Conc 45.50 PPM
ZERO AIR Generator ZAG7001 S/N: 844	NO Conc 46.50 PPM
	SO2 Conc 45.59 PPM
	CO Conc 4507 PPM
	Expire Date: Mar 31, 2026 EBD180267

Environment: Temperature 26.7 °C Humidity 62 %RH

Calibration Report

Status	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift (%)
Before	0.0	1.3	1.3	400.0	394.0	-0.8
After	0.0	0.2	0.2	400.0	402.0	0.2

Single Point Calibration Chart



SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6702006

Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

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Analyzer Signal Values				Time		13:11:00	
Date	1-Feb-24	Time	13:11:00				
Power Supplies							
Option	0.00	mV	+5 V Sensor	5	V		
+4 V	4068	mV	+3.3 V	3.3	V		
+24 V	24.1	V	+12 V	11.9	V		
+5 V	5	V	UV Lamp	44.3	mA		
1+24 V	1.2	A					
Optical Bench							
Dark UV sig.	0	mV	Dark PM sig.	88	mV		
UV ref.	0	mV	PM ref.	0	mV		
UV sig.	24.1	mV	PM sig.	138.6	mV		
Ref ratio	0		Mass ratio	0.34			
Mean sig.	0.7		Raw trend	11			
Raw sig.	24.4	ppb	Int. meas.	22.8	ppb		
UV Lamp	44.7	mA	UV PM	2626.80	mV		
Sample							
Internal Temp.	31.9	deg C	Chamber T.	50	deg C		
Gas Pr.	970	hPa	Pump Pr.	355.5	hPa		
Flow	18.7	l/h					

Calibrate By : [Redacted]

Date: 1-Feb-24

Approve By : [Redacted]

Date: 1-Feb-24

SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6702007
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer	Manufacturer: Environnement SA, France
Model: AF22a	S/N: NSCESAAF32E453

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Calibration System

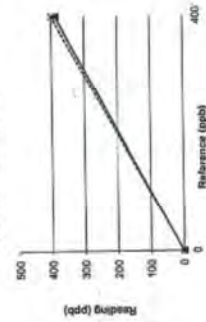
Calibrator Unit		Standard Gas
Dilutor Model ESA MGCT01		NOx Conc 45.50 PPM
S/N: 792		NO Conc 45.50 PPM
ZERO AIR Generator ZAG7001		SO2 Conc 45.59 PPM
S/N: 644		CO Conc 4500 PPM
		Expire Date: Mar 31 2025
		EB0160267

Environment: Temperature 26.7 °C Humidity 61 %RH

Calibration Report

Status	Reference	Zero	Drift	Span	Drift%
Before	0.0	1.0	1.0	398.0	-1.5
After	0.0	0.4	0.4	400.0	0.0

Single Point Calibration Chart



SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6702007
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Date	1-Feb-24	Time	13:11:00
Option	0.00	mV	+5 V Sensor
+4 V	4068	mV	+3.3 V
+24 V	24.1	V	+12 V
+5 V	5	V	1.1 V lamp
+24 V	1.2	A	
Dark UV seg.	0	mV	Dark PM seg.
UV ref.	0	mV	PM ref.
UV seg.	24.1	mV	PM seg.
Ref ratio	0		Mass ratio
Mean seg.	0.7		Raw trend
Raw seg.	24.4	ppb	inst.mos.
UV Lamp	44.7	mA	UV PM
			2626.80
			mV
Internal Temp.	31.9	deg C	Chamber T
Gas Pr.	970	hPa	Pump Pr.
Flow	16.7	l/min	
			355.5
			hPa

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Calibrate By : _____

Date: 1-Feb-24

Approve By : _____

Date: 1-Feb-24

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702004

Page:1/1

Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer	Manufacturer API
Model: 200E	S/N: EN0A200E0579

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NOx Conc 45.50 PPM
S/N: 792	NO Conc 45.50 PPM
ZERO AIR Generator ZAG7001	So2 Conc 45.59 PPM
S/N: 844	CO Conc 45.07 PPM
Expire Date: Mar 31 2025	EB0150287

Environment: Temperature: 26.5 °C Humidity: 61 %RH

Calibration Check (Before adjust)

Zero				
Gas	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Drift%
NO	2.7	0.0	2.7	1.4
NO2	0.9	0.0	0.9	0.4
NOx	3.6	0.0	3.6	1.7

Calibration Check (After adjust)

Zero				
Gas	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Drift%
NO	0.5	0.0	0.5	0.2
NO2	0.1	0.0	0.1	0.2
NOx	0.6	0.0	0.6	0.3

Single Point Calibration Chart



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702004

Page:1/1

Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Test Function/Value	Nominal value	Unit	Before	After	Note
Cells	1-Feb-24				Page:2/2
Time	11:25				
Purge	0.00 - 300.00 PPB	PPB	500.0	500.0	
Stability (Zero Gas)	± 0.2	PPB	0.5	0.2	
Sample Flow	500H-50	cc/min	074.0	441.0	
Oxygen Flow	60-60	cc/min	76.0	76.0	
PMT Detector	0-5000	mV	24.5	62.2	
AZERO	±0-150	mV	8.6	67.5	
NO/NO2	0-5000 constant	V	539.0	838.0	
DO/PS	2500 ± 200	mV	-	-	
NOx TEMP	50±1	Degrees C	50.0	50.0	
NOx TEMP	30-35	Degrees C	34.5	34.5	
PMF TEMP	7±1	Degrees C	7.0	7.1	
NOx TEMP	50±1	Degrees C	-	-	
NOx TEMP	315 ± 5	Degrees C	315.0	314.4	
NOx TEMP	4-10 constant	RH-Hg-A	4.20	7.90	
NOx TEMP	20-30 constant	RH-Hg-A	29.9	29.6	
NOx TEMP	1 ± 0.3	1.332	1.256	1.332	
NOx TEMP	1 ± 0.3	1.232	1.232	1.448	
NOx TEMP	10 to ± 150	mV	4.50	8.80	
NOx TEMP	10 to ± 150	mV	-3.00	-1.50	
Span and Cal Values					
Zero Value	NO	ppb	2.7	6.5	
Zero Value	NOx	ppb	3.6	8.8	
Span Value	NO	ppb	411.0	402.0	
Span Value	NOx	ppb	414.0	404.0	

Calibrate By:

Approve By:

Date: 1-Feb-24

Date: 1-Feb-24

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702005

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Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO ₂ /NOx Analyzer	Manufacturer API
Model: 200A	S/N: EN04200E01170

Calibration System

Dilutor Model ESA MGC101	NOx Conc 48.50 PPM
S/N: 792	NO Conc 48.50 PPM
ZERO AIR Generator ZAG7001	SO ₂ Conc 45.59 PPM
S/N: 644	CO Conc 4507 PPM
Expire Date: Mar 31, 2025	EB0160287

Environment: Temperature 26.5 °C Humidity 60 %RH

Calibration Check (Before adjust)

GAS	Zero		Span	
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)
NO	3.9	0.0	382.0	400.0
NO ₂	1.9	0.0	7.0	0.0
NOx	5.8	0.0	389.0	400.0

Calibration Check (After adjust)

GAS	Zero		Span	
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)
NO	0.2	0.0	403.0	400.0
NO ₂	0.2	0.0	5.0	0.0
NOx	0.4	0.0	408.0	400.0

Single Point Calibration Chart



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702005

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Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

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Date	1-Feb-24			
Time	10:10			
Range	0.00 - 500.00 PPM	PPM	500	500
Stability (Zero Gas)	< 0.2	PPM	0.4	0.2
Sample Flow	500 +/- 50	cc/min	482	494
Oxygen Flow	50-50	cc/min	74	77
PMT Detector	0-5000	mV	51	24
AZERO	50-100	mV	13.3	30.3
HYPS	400-600 constant	V	621	611
DCPS	3200 +/- 200	mV	2556	2558
PCELL TEMP	50 +/- 1	Degrees C	50	50
BOX TEMP	30-35	Degrees C	30.2	32.8
PMT TEMP	7 +/- 1	Degrees C	7.5	7.5
CO ₂ TEMP	50 +/- 4	Degrees C	-	-
MOXY Temp	315 +/- 5	Degrees C	315.0	314.5
PCELL PRES	4-10 constant	IN-Hg-A	8.8	8.8
SNAMP PRES	30-35 constant	IN-Hg-A	30.2	31.8
NO Slope	1 +/- 0.3		0.820	0.822
NO ₂ Slope	1 +/- 0.3		0.854	0.858
NO Offset	-10 to +100	mV	17.8	17.8
NOx Offset	-10 to +100	mV	5.0	5.0
Zero Value	NO	ppb	3.8	0.2
	NO ₂	ppb	5.8	0.4
Span Value	NO	ppb	403.0	403.0
	NO ₂	ppb	508.0	408.0

Calibrate By : _____

Approve By : _____

Date:

1-Feb-24

Date:

1-Feb-24

CO Analyzer Verification Test Report

Calibration Report No.: ES-C5702005
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: CO Analyzer	Manufacturer: Environment SA, France
Model: CO12E	S/N: ECOESACO12E202

Calibration System

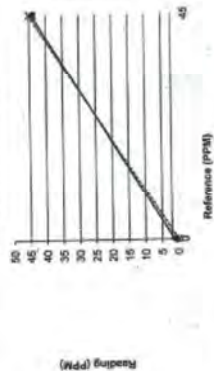
Calibrator Unit		Standard Gas	
Dilutor Model: ESA MGC101		NOx Conc: 46.50	PPM
S/N: 792		NO Conc: 46.50	PPM
ZERO AIR Generator: ZAG7001		SO ₂ Conc: 45.59	PPM
S/N: 844		CO Conc: 4507	PPM
		Expire Date: Mar 31, 2026	EB0160287

Environment: Temperature: 27.1 °C Humidity: 65 %RH

Calibration Report

Status	Zero		Drift	Span		Drift%
	Reference	Reading		Reference	Reading	
Before	0.0	1.234	1.2	45.0	44.23	-0.9
After	0.0	0.047	0.0	45.0	45.10	0.1

Single Point Calibration Chart



CO Analyzer Verification Test Report

Calibration Report No.: ES-C5702005
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

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Date	1-Feb-24	Time	1009:00		
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
IR current ratio	884.7	nA	Phase current	818.2	mV
Optical T.	45.0	deg C	Phase T.	-24.2	deg C
Measure sig.	506.4	mV	Refer Sig.	455.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Int. Ratio	1.109		Ratio	1.105	
Ref. ratio	1.109		Internal Temp.	28.9	deg C
Source Temp	46.0	deg C	Gas Pressure	997	nPa
Up Pressure	947.0	nPa	Flow	59	l/h

Calibrate By :  1-Feb-24
Approve By :  1-Feb-24

Date: 1-Feb-24 Date: 1-Feb-24

CO Analyzer Verification Test Report

Calibration Report No.: TD-C6702006
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: CO Analyzer	Manufacturer API
Model: T320	S/N: ECOA1T30000099

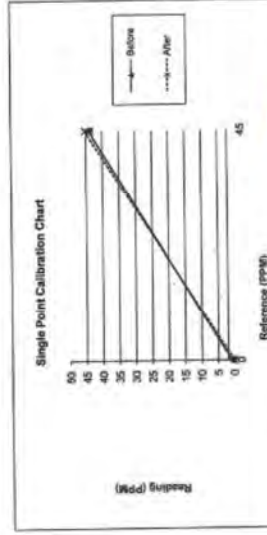
Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NOx Conc 48.50 PPM
S/N: 792	NO Conc 48.50 PPM
ZERO AIR Generator ZAG7001	SO ₂ Conc 45.59 PPM
S/N: 844	CO Conc 4507 PPM
Expiry Date: Mar 31, 2026	EB0150267

Environment: Temperature 27.1 °C Humidity 86 %RH

Calibration Report

Status	Reference (ppm)	Reading (ppm)	Drift (ppm)	Span	Drift%
Before	0.0	0.9	0.9	44.0	-1.1
After	0.0	0.1	0.1	45.2	0.2



CO Analyzer Verification Test Report

Calibration Report No.: TD-C6702006
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

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Date	1-Feb-24		
Time	14:57		
Range	0.1-1000 PPM	PPM	50
Stability	(0.1-2PPM)	ppb	0.22
CO Measure	2500 - 4800 MV	mV	3793.2
CO Reference	2500 - 4800 MV	mV	3143.8
MR Ratio	1.2 +/- 0.5		1.215
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	28.6
Sample Flow	720 - 880 cc/min	cc/min	859
Sample Temp	44 - 52 deg.C	deg.C	47.8
Bench Temp	47 - 49 deg.C	deg.C	48
Wheel Temp	66 - 70 deg.C	deg.C	68
Box Temp	27 - 50 deg.C	deg.C	32
PHT drive	250 - 4750 mV	mV	3015
Slope	0.600 - 1.200		0.867
Offset	0.05 +/- 0.2		0.008
Zero Gas	G	PPM	9.9
Span Gas	45	PPM	44.0
			± 5% of Range

Calibrate By:

Approve By:

Date:

1-Feb-24

Date:

1-Feb-24

Request No. 21-660381

MTC No. EEL- BP. 700366

CALIBRATION CERTIFICATE

Submitted by

Address

Calibrated at

Instrument Calibrated :

Description : Sound Level Calibrator

Manufacturer :

Model : 4230

Serial No. : 1351075

Standards used : 1. Digital Function Synthesizer NF Electronic DF-191A S/N 122037.
2. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.
3. Programmable Attenuator Tanigawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY4405569.
5. Pressure Transmitter Vaisala PT0307AD S/N 10650001.
6. Audio Analyzer Keithley 2015 P S/N 4106495.
7. Condenser Microphone Brüel&Kjær 4180 S/N 2869471.

Calibration Procedure: CP-102-04 based on IEC 60942:2003. The sound pressure level of instrument was measured by standard microphone using an insert volume technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt : 14 Mar. 2023

Date of Calibration : 16 Mar. 2023

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

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

Request No. 21-660381

MTC No. EEL- BP. 700366

1. Sound Pressure Level

Standard Microphone Type

Measured Sound Pressure Level (dB)

Deviated value (dB)

Uncertainty (dB)

Tolerance limit IEC60942:2003 Class 1

1/2 inch Brüel&Kjær 4180

93.78

-0.22

± 0.10

±0.40 dB

2. Frequency

Standard Microphone Type

Measured Frequency (Hz)

Deviated value (Hz)

Uncertainty (Hz)

Tolerance limit IEC60942:2003 Class 1

1/2 inch Brüel&Kjær 4180

999.0

-1.0

± 1.5

± 1.0%

3. Total distortion

Standard Microphone Type

Measured Total distortion (%)

Uncertainty (%)

Tolerance limit IEC60942:2003 Class 1

1/2 inch Brüel&Kjær 4180

1.05

± 0.50

±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

Approved by :

Date of Calibration : 16 Mar. 2023

Date of Issue : 17 Mar. 2023

End of Certificate

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

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

Calibration Certificate

Issued by :

Date of Issue : 2 October, 2023

Certification No. 339/23

Page : 1 of 6

Object : เครื่องมือตรวจวัดคุณภาพอากาศ

Manufacturer : Novall, Inc.

Type : Data Logger 110-WS-25DL-D

Serial No. : EWSNV110WS2511

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1007.1 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 042 SN 91563

: HOOK GAGE NO 1425

N.I.S.T. Test Reference Number 731241460

: Standard Velocity at 20 - 30 m/sec

Model DA-650-3TV

(Sensor TR-90AH)

Serial Number 110730029

(Sensor 120C09086)

JAPAN QUALITY ASSURANCE ORGANIZATION

: Standard Velocity at 0-20 m/sec

STANDARD THERMOMETER

Theodor Friedrich : Dry No. 8380164 Wet No. 8389164

STANDARD BAROMETER

The Result of Calibration

Sensor model : EWSNV110WS2511

Certification No. 339/23

Page : 2 of 6

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure inches HgO	Vacuum inches HgO	Velocity m/sec	Correction m/sec
1.00	-	-	3.4	0.60
3.00	-	-	2.7	0.12
5.00	-	-	4.9	0.10
7.04	-	-	7.0	0.04
9.02	-	-	5.9	0.12
11.01	-	-	11.0	0.01
13.01	-	-	12.9	0.11
15.01	-	-	15.8	0.01
17.02	-	-	16.9	0.12
20.02	-	-	20.0	0.02

Wind Aloft Picting Board.

US DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRECTION		TESTED WIND DIRECTION	
0	0	0	0
90	90	91	91
180	180	179	179
270	270	270	270



The Result of Calibration

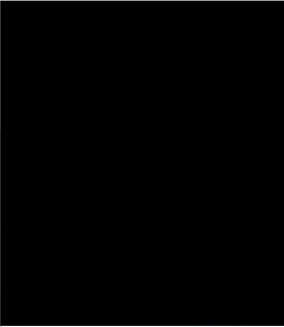
Sensor model EWSNV110WS2511

Certification No. 359/23

2 October, 2023

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1005.63	1004.60	0.83
1006.25	1005.42	0.63
1005.22	1005.40	0.62
1006.54	1005.66	0.66
1005.66	1006.13	0.75
1007.36	1006.53	0.83
1007.68	1006.79	0.79
1007.52	1006.81	0.71
1006.00	1004.63	0.77
1005.64	1005.04	0.80
1006.26	1005.44	0.84
1006.60	1005.80	0.78
1007.07	1006.21	0.86
1007.26	1006.37	0.89
1007.36	1006.04	0.84
1005.50	1004.62	0.88
1005.63	1004.96	0.85
1005.55	1005.68	0.87
1007.31	1006.42	0.89
1007.01	1006.13	0.86



Caliber

Average



The Result of Calibration

Sensor model

EWSNV110WS2511

Certification No. 359/23

2 October, 2023

Page : 4 of 6

Standard Temp. °C	Temperature Sensor	
	Reading °C	Correction °C
45.2	45.4	-0.2
31.1	31.0	0.1
15.8	15.9	-0.1



Caliber



The Result of Calibration

Sensor model EWSNV110W2511 Certification No. 33923
2 October, 2023 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor	
	Reading % R.H.	Correction % R.H.
85.2	82.1	4.1
62.4	56.5	3.9
45.6	43.8	1.8

Calibrate

Date of Issue 2 October, 2023

Certification No. 33923

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดใน ชีท Davis Instruments แบบ TIPPING BUCKET Product No. ทำการสอบเทียบกับแก้ววัดฝนแบบหัววง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No. 71082 และสามารถนำไปใช้ได้ทันทีเพื่อรายงานรายละเอียดของเครื่องมือ (0.2 mm/TIP)



Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 2 October, 2023

Certification No. 341/23

Page : 1 of 5

Object : เครื่องมือวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130152 ID No. : NWSDCMS1200152

Customer : 

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1028.9 hPa

NATIONAL STANDARD WIND TUNNEL : Micromanometer Theodor Friedrichs ID14 Serial 9510119

HOOK GAGE NO 1425 : Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731241460

Model DA-650-STY (sensor TR-90AH)

Serial Number 110730029 (sensor 120623586)

JAPAN QUALITY ASSURANCE ORGANIZATION

Thensor Friedrichs : Dry No.8390/84 Wet No. 8380/84

STANDARD THERMOMETER



The Result of Calibration

Source Wind Speed & Wind Direction Model WSD-1 P Certification No. 341/23

2 October, 2023

Serial No. 1226

Page : 2 of 5

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure mm-Hg	Vacuum mm-Hg	Velocity m/sec	Correction m/sec
1.00	-	-	0.7	0.30
3.02	-	-	2.9	0.12
5.00	-	-	5.0	0.00
7.04	-	-	7.0	0.04
9.02	-	-	9.1	-0.08
11.01	-	-	11.0	0.01
13.01	-	-	13.1	-0.09
15.01	-	-	14.9	0.11
17.02	-	-	17.0	0.02
20.02	-	-	20.0	0.02

Wind Aloft Plotting Board

US DEPARTMENT OF COMMERCE WEATHER BUREAU	
TESTED WIND DIRECTION	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	180

Calibrate



The Result of Calibration

Sensor Temperature Model TPHP-1 C Certification No. 341/23
Serial No. 6277 Page : 3 of 5

2 October, 2023

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.2	45.2	0.0
31.1	31.2	-0.1
15.6	15.8	0.0





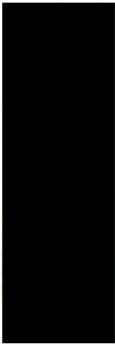


The Result of Calibration

Sensor Humidity Model TPHP-1 C Certification No. 341/23
Serial No. 6277 Page : 4 of 5

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
86.2	82.4	3.8
62.4	59.8	2.6
45.6	44.2	1.4



	Date of Issue 2 October, 2023	Certification No. 341/23
Page: 5 of 5		
ใบรับรอง		
หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ Davis Instruments แบบ TIPPING BUCKET Product  ทำการสอบเทียบกับแก้ววัดฝนแบบแก้วต่าง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON  และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/TIP) 		
ลงชื่อ... 		

**เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
โรงเรียนแสงหิรัญและสถาบันการบินพลเรือน
ครั้งที่ 4/2566
ตรวจวัดวันที่ 4-9 พฤษภาคม 2567**

TSP High Volume Sampler Calibration

Verification Report No.
SC0400118-E001 -TSP-01

PM ☒ Onsite ☐
Site: Tachasarakong
UTM: 47P 1516342 672860
Sampler: ETSW25
Recorder: ECRANG1515221

Date: 4 May 24

Technical: Anonchua K.
Approval: Wisan R.

CONDITIONS

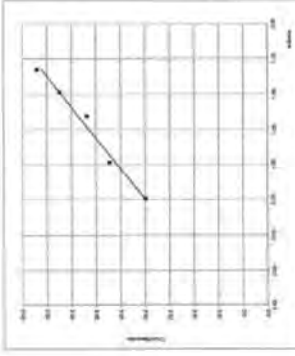
Barometric Press. (hPa): 897.0
Corrected Pressure (mm Hg): 672.8
Temperature (deg C): 37.0
Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0

CALIBRATION OFFICE

Brand: Tach Environmental, Inc
Model: TE-5025A
Serial#: 5411
Qtd Slope: 2.03024
Qtd Intercept: -0.02667
Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (l)	Qtd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	11.30	1.877	51.0	47.05	Slope = 23.0156 Intercept = -7.6651 Corr. coeff = 0.9908 # of Observations: 5 Range of Chart: 36 at 1.1 - 1.7 m3/min, 50
2	12.80	1.514	40.0	42.43	
3	9.56	1.349	40.0	36.90	
4	4.84	1.016	35.0	32.29	
5	2.96	0.766	27.0	24.91	



Calibrated by:

Approved by:

4 May 2024

4 May 2024

TSP High Volume Sampler Calibration

Verification Report No.
SC0400118-E001 -TSP-02

Date: 4 May 24

Technical: Anonchua K.
Approval: Wisan R.

CONDITIONS

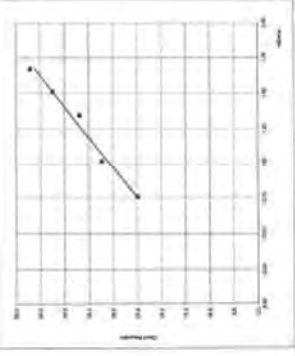
Barometric Press. (hPa): 897.0
Corrected Pressure (mm Hg): 672.8
Temperature (deg C): 37.0
Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0

CALIBRATION OFFICE

Brand: Tach Environmental, Inc
Model: TE-5025A
Serial#: 5411
Qtd Slope: 2.03024
Qtd Intercept: -0.02667
Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (l)	Qtd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	11.65	1.572	50.0	46.12	Slope = 34.5757 Intercept = -7.5735 Corr. coeff = 0.9908 # of Observations: 5 Range of Chart: 33 at 1.1 - 1.7 m3/min, 55
2	10.03	1.459	40.0	42.43	
3	6.48	1.176	30.0	35.05	
4	5.37	1.071	32.0	29.52	
5	4.01	0.928	25.0	23.06	



Calibrated by:

Approved by:

4 May 2024

4 May 2024

PM10 High Volume Sampler Calibration

Verification Report No.
SC0400116-E001 -PM 01

L. PM E. Onsite

Site: 151/1515342 672360
UTM: 47P-1515342 672360
Sampler: EPA10M32
Recorder: ECHOS501818125

Date: 4 May 24
Technical Approval: [Signature]

CONDITIONS

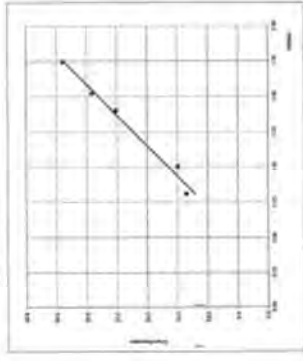
Barometric Press. (hPa): 987.0
Corrected Pressure (mm Hg): 872.8
Temperature (deg C): 37.0
Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0

CALIBRATION OFFICE

Brand: Tech Environmental, Inc
Model: TE-5025A
Serial#: 5411

Quid Slope: 1.2654
Quid Intercept: -0.01667
Date Certified: 9 Feb 2024

Plate or Test #	H2O (m)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	10.40	1.243	90.0	33.84	Slope = 73.0123 Intercept = -6.4297 Corr coeff = 0.9908 SFR = 1.306 SSP = 34.75 # of Observations: 5 Range of Chart at SFR ±10%: 32 38
2	7.90	1.521	43.0	29.19	
3	6.70	1.462	37.0	25.12	
4	3.40	1.002	22.0	14.83	
5	2.20	0.809	30.0	13.58	



Calibrated by:

Approved by:

4 May 2024

4 May 2024

PM10 High Volume Sampler Calibration

Verification Report No.
SC0400116-E001 -PM 02

L. PM E. Onsite

Site: 151/1515342 666797
UTM: 47P-1515342 666797
Sampler: EPA10M32
Recorder: ECHOS501818125

Date: 4 May 24
Technical Approval: [Signature]

CONDITIONS

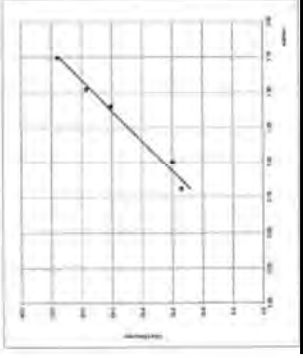
Barometric Press. (hPa): 903.0
Corrected Pressure (mm Hg): 877.3
Temperature (deg C): 31.0
Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0

CALIBRATION OFFICE

Brand: Tech Environmental, Inc
Model: TE-5025A
Serial#: 5411

Quid Slope: 1.2654
Quid Intercept: -0.01667
Date Certified: 9 Feb 2024

Plate or Test #	H2O (m)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	10.20	1.723	90.0	33.88	Slope = 30.1558 Intercept = -17.2828 Corr coeff = 0.9925 SFR = 1.301 SSP = 32.50 # of Observations: 5 Range of Chart at SFR ±10%: 28 36
2	7.90	1.519	43.0	26.14	
3	6.70	1.399	37.0	25.07	
4	3.40	1.001	22.0	14.91	
5	2.20	0.807	8.0	5.42	



Calibrated by:

Approved by:

4 May 2024

4 May 2024



Verification Test Report

Report No.:
SO2400118-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 1516287 672892

Calibrated Date: 4 May 2024

Site : 1516287

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1973

Environment: Temperature 34 °C Humidity 54 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230, Brüel&Kjaer

Serial No. 1351075

Date of Calibration : 14 Apr 2024

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.72	94.00	0.28	93.72

Calibrated By:

Date:

Approve By:

4 May 2024



Verification Test Report

Report No.:
SO2400118-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P 1526247 667887

Calibrated Date: 4 May 2024

Site : สถานีกรุงเทพ

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1968

Environment: Temperature 34 °C Humidity 54 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230, Brüel&Kjaer

Serial No. 1351075

Date of Calibration : 14 Apr 2024

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.72	94.00	0.28	93.72

Calibrated By:

Date:

Approve By:

4 May 2024



Certificate of Calibration

Calibration Certification Information			
Cal. Date:	February 9, 2024	Ta: 295	°K
Operator:		Pn: 749.0	mm Hg
Calibration Model R:	TE-5025A	Callibrator S/N:	5411

Run	Vol. Inlt (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3950	3.2	2.00
2	3	4	1	0.9840	6.4	4.00
3	5	6	1	0.6790	7.9	5.00
4	7	8	1	0.8430	8.8	5.50
5	9	10	1	0.6940	12.7	8.00

Data Tabulation			
Vstd (m3)	Qstd (m3)	$\sqrt{\Delta H \left(\frac{P_a}{P_{std}} \times \frac{T_{std}}{T_a} \right)}$ (y-axis)	Qa (m3) (x-axis)
0.9914	0.7106	1.4111	0.9957
0.9871	1.0082	1.9956	0.9915
0.9851	1.1207	2.2312	0.9895
0.9839	1.1672	2.3401	0.9883
0.9787	1.4103	2.8222	0.9830
QSTD	m= 2.02024	QA	m= 1.26504
	b= -0.03567		b= -0.01677
	r= 0.99993		r= 0.99993

Calculations	
Vstd = ΔVol(Pa ΔP) / Pstd (1std / Tstd)	Vstd = ΔVol(Pa ΔP) / Pstd
Qstd = Vstd / ΔTime	Qstd = Vstd / ΔTime
For subsequent flow rate calculations:	
Qstd = $\frac{1}{m} \left(\sqrt{\Delta H \left(\frac{P_a}{P_{std}} \times \frac{T_{std}}{T_a} \right)} \right)$	Qa = $\frac{1}{m} \left(\sqrt{\Delta H \left(\frac{P_a}{P_{std}} \right)} \right)$

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

Such Environmental, Inc.
45 South Miami Avenue
Village of Clevel, OH 45002

RECALIBRATION	
US EPA recommends annual recalibration per 1968 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	

Certificate of Calibration

Certificate No. : 67-200034-1

Submitted by :

Equipment :

Electronic Balance

Manufacturer : Sartorius

Serial No. : 0034803270

Capacity : 220 g Resolution : 0.0001 g

Model : SECURA224-IS

ID No. : ELABBALANCEN04

Resolution : 0.0001 g

Environment : On site calibration was carried out at the Balance Room, Envilab Co., Ltd.

Ambient Temperature : (22.8 to 23.6) °C

Relative Humidity : (44.6 to 45.3) %

Air Pressure : 1014.0 mbar

Date of Received : 01 February 2024

Date of Calibration : 01 February 2024

Date of Issue : 06 February 2024

Calibrated by :

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 14

Edition 7 + November 2022

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Weights

ID No.

E261-E2624

Cert. No.

C02132088

Due Date

08 Nov 2024

Traceability

National Institute of Metrology (Thailand), (NIMT)

Certificate of Calibration

Certificate No. : 67-200034-1

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of Indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty \pm (g)
0.01	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00038

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k =$

providing a level of confidence of approximately 95%.



Eccentric error

Load test : 50 g

A B C D E F

-0.0001 -0.0001 -0.0001 0.0001 0.0000 g

Repeatability

Load test : 200 g

Stddev :

0.00005 g

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:

Part Number: E80160287
Cylinder Number: T24 - P, Huntsville - PA
Lot Number: A12022
PGVP Number: CO, NO, COX, SO2, BALN
Gas Code:

Reference Number: [REDACTED]
Cylinder Volume: 2015 PSIG
Cylinder Pressure: 560
Valve Outlet: 560
Certification Date: Mar 31, 2023

Expiration Date: Mar 31, 2026

Calibration performed in accordance with EPA Traceability Protocol for Assess and Confirmation of Gasolent Calibration Standards (May 2012) issued EPA. The calibration was performed using a certified reference material (CRM) and a certified reference gas (CRG) which are both traceable to NIST. The results are reported in the table below. The report was not be reproduced except in full without approval of the laboratory. On any other use, this Certificate is void.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Assay Date
NOX	45.00 PPM	45.00 PPM	G1	03/24/2023, 03/31/2023
NITRIC OXIDE	45.00 PPM	45.00 PPM	G1	03/24/2023, 03/31/2023
SULFUR DIOXIDE	45.00 PPM	45.00 PPM	G1	03/24/2023, 03/31/2023
CARBON MONOXIDE	45.00 PPM	45.00 PPM	G1	03/24/2023, 03/31/2023
NITROGEN	45.00 PPM	45.00 PPM	G1	03/24/2023, 03/31/2023
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No.	Concentration	Uncertainty
NOX	21607-22	C079687	45.00 PPM NITRIC OXIDE/NITROGEN	$\pm 1.5\%$
NITRIC OXIDE	21607-22	C079687	45.00 PPM NITRIC OXIDE/NITROGEN	$\pm 1.5\%$
SULFUR DIOXIDE	21607-22	C079687	45.00 PPM SULFUR DIOXIDE/NITROGEN	$\pm 1.5\%$
CARBON MONOXIDE	21607-22	C079687	45.00 PPM CARBON MONOXIDE/NITROGEN	$\pm 1.5\%$
NITROGEN	21607-22	C079687	45.00 PPM NITROGEN	$\pm 1.5\%$

ANALYTICAL EQUIPMENT	
Instrument/Model	Analytical Principle
SIEMENS ULTRAMAT 6 N 1K2/18	NDR
Nicola (550) FTIR ALP2010245 NDR	FTIR
Nicola (550) FTIR ALP2010245 NDR	FTIR
Nicola (550) FTIR ALP2010245 NDR	FTIR

Last Multipoint Calibration

Mar 07, 2022

Mar 09, 2022

Mar 23, 2022

Mar 16, 2022

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705001
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100U	Manufacturer API SIN: ES0A100U00556
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Page: 1/2

Calibration System

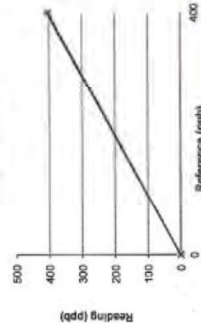
Dilutor Model ESA MGC101 SIN: 792 ZERO AIR Generator ZAG7001 SIN: 644	Standard Gas NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31, 2026 EB0160267
--	---

Environment: Temperature 25.4 °C Humidity 55 %RH

Calibration Report

Status	Reference Reading (ppb)	Drift ppb	Zero Reading ppb	Span Reading ppb	Drift %
Before	0.0	1.3	1.3	400.0	0.8
After	0.0	0.6	0.6	402.0	0.2

Single Point Calibration Chart



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705001
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Test Function Value	Normal range	Unit	Before	After	Note
Zero	2-May-24				
Range	50 - 5000	ppb	500	500	
Stability (Zero Gas)	± 0.2	ppb	0.4	0.2	
Sample Flow	400 (± 50)	ml/min	606	642	
PMT Detector	0 - 5000	mV	24.3	23.2	
Norm PMT Detector	0 - 5000	mV	31.4	34.3	
FVPS	400-800 constant	V	725	725	
DCPS	2500 (± 200)	mV	-	-	
RCCL TEMP	50 (± 1)	Designated C	50	50	
RCX TEMP	32-40	Designated C	32.9	35.1	
PMT TEMP	7 (± 1)	Designated C	8.3	8.3	
UV Lamp	1000-4000	mV	3251	3251	
Lamp Ratio	35-120	%	87.4	87.4	
STR Light (Zero Gas)	<100	ppb	36.5	38.6	
Dark PMT	(-50) - (-200)	mV	27.8	27.8	
Dark Lamp	(-50) - (-200)	mV	3.6	3.6	
SLAMP PRES	25-30 constant	psi-Hg-A	26.9	27.3	
Electric Test/Optic Test					
PMT Volt	2000 (± 500)	mV	2010	2008	
SO2 Conc	1000 (± 200)	ppb	1005	1003	
SO2 Slope	1 (± 0.3)	-	1.654	1.653	
SO2 Offset	± 200	mV	94.7	90.4	
Stability at Zero	± 0.2	ppb	0.1	0.1	
Stability at Span	± 2 ppb @ 400 ppb	ppb	0.4	0.2	
Gas Test Response					
Zero Gas (0.00 PPM)	0	ppb	1.3	0.6	
Span Gas (400 PPM)	400	ppb	406.3	402.0	± 5% of Range

Calibrate By: [Redacted]

Date: 2-May-24

Approve By: [Redacted]

Date: 2-May-24

SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6705003

Calibrated Date: 2-May-24

☒ PM ☐ OnSite

Instruments Information

Analyzer Type: SO2 Analyzer Model: AF22e	Manufacturer: Environmental SA, France S/N: ES0SAF22E2492
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Page:1/2

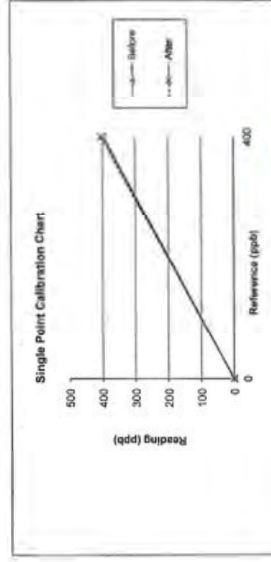
Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 702	NOx Conc 46.50 PPM
ZERO AIR Generator ZYG7001 S/N: 644	NO Conc 46.50 PPM
	SO2 Conc 45.59 PPM
	CO Conc 4007 PPM
	Expire Date: Mar 31, 2025 E60160267

Environment: Temperature 28.9 °C Humidity 61 %RH

Calibration Report

Status	Zero		Span	
	Reference (ppb)	Reading (ppb)	Reference (ppb)	Reading (ppb)
Before	0.0	1.1	400.0	396.3
After	0.0	0.5	400.0	403.0
				Drift%
				-0.5
				0.4



SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6705003

Calibrated Date: 2-May-24

☒ PM ☐ OnSite

Page:2/2

Analyzer Signal Values					
Date	2-May-24	Time	13:11:00		
Power Supplies					
Option	0.00	mV	+5 V Sensor	S	V
+4 V	4066	mV	+3.3 V	3.3	V
+24 V	24.1	V	+12 V	11.9	V
+5 V	5	V	UV lamp	44.3	nA
+24 V	1.2	A			
Optical Bench					
Dark UV sig.	0	mV	Dark PM sig.	83	mV
UV ref.	0	mV	PM ref.	0	mV
UV sig.	24.1	mV	PM sig.	138.6	mV
Ref ratio	0		Mass ratio	0.34	
Meas sig.	0.7		Raw trend	11	
Raw sig.	24.4	ppb	Inc. meas.	22.8	ppb
UV Lamp	44.7	nA	UV PM	2626.80	mV
Sample					
Internal Temp.	31.9	deg C	Chamber T.	50	deg C
Gas Pr.	970	nPa	Pump Pr.	355.5	nPa
Flow	16.7	l/h			

Calibrate By : _____ Approve By : _____

Date: 2-May-24

Date: _____

NOx Analyzer Verification Test Report

Calibration Report No.: ES-N8705007

Page:1/1

Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer	Manufacturer: Environnement SA, France
Model: AC32e	S/N: ENDESAC32E2401

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA/UGC101	NOx Conc 40.50 PPM
S/N: 792	NO Conc 46.50 PPM
ZERO AIR Generator ZAG7001	SO2 Conc 45.09 PPM
S/N: 644	CO Conc 4507 PPM
Expire Date: Mar 31, 2026	EB0160287

Environment: Temperature 28.8 °C Humidity 58 %RH

Calibration Check (Before adjust)

GAS	Zero		Span		Drift%
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)	
NO	0.457	0.0	395.0	400.0	-0.6
NO ₂	0.094	0.0	12.0	0.0	1.5
NOx	0.521	0.0	407.0	400.0	0.9

Calibration Check (After adjust)

GAS	Zero		Span		Drift%
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)	
NO	0.027	0.0	395.0	400.0	-0.1
NO ₂	0.022	0.0	1.0	0.0	0.1
NOx	0.089	0.0	400.0	400.0	0.0

Single Point Calibration Chart



NOx Analyzer Verification Test Report

Calibration Report No.: ES-N8705007

Page:1/1

Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Analyzer Signal Values		Time		14:14	
Date	2-May-24	Time	14:14		
Power Supplies					
Option		mV	+5 V Sensor	4.99	V
+3.3 V	3.3	V	+24 V	23.96	V
+12 V	11.88	V	+5 V	4.99	V
+4 V	3974.3	mV	+24V	2.4	A
LO3	82.74	mA			
Optical Bench					
Dark PM sig.	0.0	mV	PM NO sig.	84.28	mV
PM NOx sig.	107.0	mV	PM NO sig.	85.71	mV
Sample					
Chamber T	60	deg.C	Internal Temp.	33.33	deg.C
Chamber P	1120.8	hPa	PM T.	1.46	deg.C
Flow	47.21	l/min	Sample Pr.	993.2	hPa

Calibrate By

Date:

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6705005
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENO4200E03217
---	--

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA 100C101 S/N: 792	NOx Conc 48.50 PPM NO Conc 48.50 PPM SO2 Conc 45.59 PPM CO Conc 4527 PPM
ZERO AIR Generator ZAG1001 S/N: 644	Expire Date: Mar 31 2026 EBD1602017

Environment: Temperature 25.2 °C Humidity 55 %RH

Calibration Check (Before adjust)

GAS	Zero		Span		Drift%
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)	
NO	4.0	0.0	380.0	400.0	-1.3
NO ₂	0.5	0.0	2.0	0.0	0.3
NOx	4.5	0.0	382.0	400.0	-1.0

Calibration Check (After adjust)

GAS	Zero		Span		Drift%
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)	
NO	0.7	0.0	401.0	400.0	0.1
NO ₂	0.9	0.0	2.0	0.0	0.2
NOx	1.6	0.0	403.0	400.0	0.4

Single Point Calibration Chart



Page:1/1

Calibration Report No.: AP-N6705005
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

NOx Analyzer Verification Test Report

Test Function Value	Nominal range	Unit	Before	After	Note
Zero	2-May-24				
Time	15:30				
Range	0.00 - 500.00 PPM	PPM	500.0	500.0	
Stability (Zero Gas)	± 0.2	PPM	0.8	0.2	
Sample Flow	500 ± 50	cc/min	493.0	493.0	
Zero Flow	60-80	cc/min	90.0	76.0	
Orifice Flow	0-5000	mV	24.8	16.6	
PMT Detector	20-150	mV	11.7	7.3	
AZERO	400-600 constant	V	768.0	714.0	
HVPS	2500 ± 200	mV	-	-	
DCPS	500 ± 1	mV	-	-	
CELL TEMP	50.3	°C	50.3	50.3	
NOX TEMP	30-35	°C	38.0	37.5	
PMT TEMP	7 ± 0.1	°C	7.7	7.8	
ZS TEMP	50 ± 4	°C	-	-	
MOLY Temp	310 ± 5	°C	313.1	313.0	
REF PRES	14-10 constant	PSI-Hg-A	7.30	7.30	
SAMP PRES	20-30 constant	PSI-Hg-A	31.4	31.3	
NO Slope	1 ± 0.3		0.647	0.663	
NOx Slope	3 ± 0.3		0.602	0.640	
NO Offset	-10 to +150	mV	17.40	1.80	
NOx Offset	-15 to +150	mV	24.10	12.70	
Span and Cal Values					
Zero Value	NO	ppb	4.0	0.7	
	NO ₂	ppb	4.5	1.6	
Span Value	NO	ppb	390.0	401.0	
	NO ₂	ppb	392.0	403.0	

Calibrate By: _____

Date: 2-May-24

Approve By: _____

Date: 2-May-24

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6705002
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: ECOESACO12E202
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Page:1/2

Calibration System

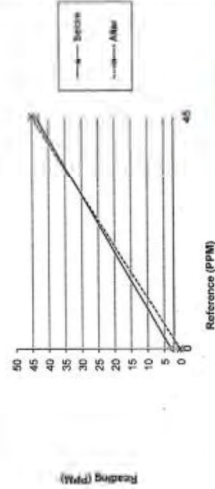
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 40.50 PPM
ZERO AIR Generator ZAG7001 S/N: 544	NO Conc 46.50 PPM
	SO2 Conc 45.59 PPM
	CO Conc 4507 PPM
	Expiry Date: Mar 31, 2026 EBO160267

Environment: Temperature 25.4 °C Humidity 55 %RH

Calibration Report

Status	Zero		Span		Drift%
	Reference (ppm)	Reading (ppm)	Reference (ppm)	Reading (ppm)	
Before	0.0	3.005	45.0	43.80	-1.4
After	0.0	0.216	45.0	45.04	0.0

Single Point Calibration Chart





CO Analyzer Verification Test Report

Calibration Report No.: ES-C6705002
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values		Date: 2-May-24	Time: 10:09:00
Power Supplies			
Option	0.0	mV	+5 V Sensor
+5.3 V	3.3	V	+24 V
+12 V	11.8	V	+5 V
+24 V	1.1	mV	
Optical Bench			
IR current ratio	864.7	mA	Pulse current
Optical T.	46.0	deg.C	Pulse T.
Measure sig.	506.4	mV	Refer Sig.
Min sig.	945.0	mV	Max Sig.
Sample			
Int. Ratio	1.109		Ratio
Ref. ratio	1.108		Internal Temp.
Source Temp	46.0	deg.C	Gas Pressure
Up Pressure	947.0	kPa	Flow

Calibrate By :  Approve By : 
Date: 2-May-24 Date: 2-May-24

CO Analyzer Verification Test Report

Calibration Report No.: TD-C6705003
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: CO Analyzer	Manufacturer API
Model: T300	S/N: ECOAIT30000099

Page: 1/2

Calibration System

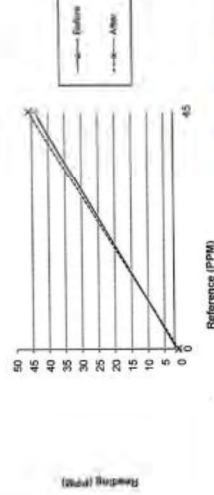
Calibrator Unit	Standard Gas
Dilutor Model ESA MGCT01	NOx Conc 46.50 PPM
S/N: 782	NO Conc 46.50 PPM
ZERO AIR Generator ZAG7001	SO ₂ Conc 45.99 PPM
S/N: 844	CO Conc 4507 PPM
	Expire Date: Mar 31, 2026 EBO160267

Environment: Temperature: 25.4 °C Humidity: 55 %RH

Calibration Report

Status	Reference (ppm)	Reading (ppm)	Drift (ppm)	Span (ppm)
Before	0.0	1.3	1.3	44.1
After	0.0	0.8	0.8	45.9

Single Point Calibration Chart



CO Analyzer Verification Test Report

Calibration Report No.: TD-C6705003
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Detail	Range	Unit	Before	After	Note
Date	2-May-24				
Time	14:57				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPM)	ppb	0.22	0	
CO Measure	2500 - 4800 MV.	mV	3793.2	3836.5	
CO Reference	2500 - 4800 MV.	mV	3143.6	3178.5	
MR Ratio	1.2 +/- 0.5		1.215	1.215	
Sample Pressure	28 - 30 in-Hg-A	in-Hg-A	28.6	28.6	
Sample Flow	720 - 880 cc/min	cc/min	859	859	
Sample Temp	44 - 52 deg.C	deg.C	47.8	46.7	
Bench Temp	47 - 49 deg.C	deg.C	48	48	
Wheel Temp	66 - 70 deg.C	deg.C	68	68	
Box Temp	27 - 50 deg.C	deg.C	32	34.9	
PHI drive	250 - 4750 mv.	mV	3015	3018.6	
Slope	0.000 - 1.200		0.887	0.875	
Offset	0.05 +/- 0.2		0.006	0.005	
Gas Test Response					
Zero Gas	0	PPM	1.3	0.8	
Span Gas	45	PPM	44.1	45.9	+ 5% of Range

Calibrate By :

Approve By :

Date:

2-May-24

Date:

2-May-24



Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 31 August, 2023 Certification No. 30523

Page : 1 of 6

Object : เครื่องมือวัดความเร็วลม

Manufacturer : NovaLynx

Type : Data logger NDWD100

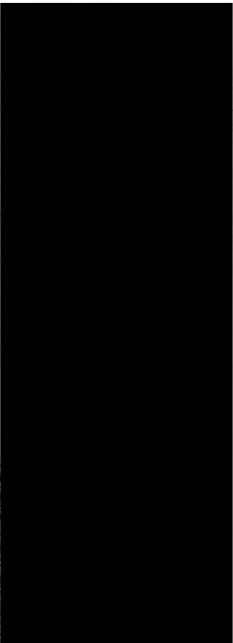
Serial No. : EWSNV110WS2506

Customer :



Calibration Condition : Temperature 25.1 °C Barometric Pressure 1007.5 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 SN 91563
: HOOK GAGE NO 1425 : Wind Aloft Plotting Board
N.I.S.T. Test Reference Number 731241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-30A-H)
Serial Number 110730029 (sensor 120529586)
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec
STANDARD THERMOMETER : Thermo-Fritzhof Dry No.8390194 Wet No. 8388094



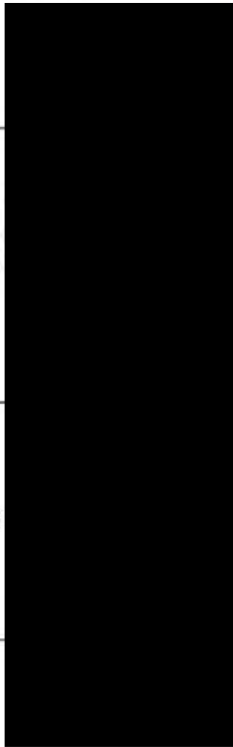
The Result of Calibration

Senior model EWSNV110WS2505 Certification No. 30523

31 August, 2023 Page : 2 of 6

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure hPa	Vacuum hPa	Velocity m/sec	Correction m/sec
1.00	-	-	0.4	0.60
3.02	-	-	2.9	0.12
5.00	-	-	4.7	0.30
7.04	-	-	6.9	0.14
9.02	-	-	8.7	0.32
11.01	-	-	10.9	0.11
13.01	-	-	12.7	0.31
15.01	-	-	14.9	0.11
17.02	-	-	17.0	0.02
20.02	-	-	20.1	-0.08

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

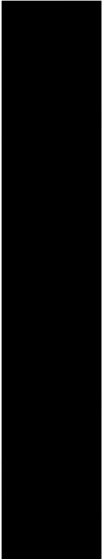
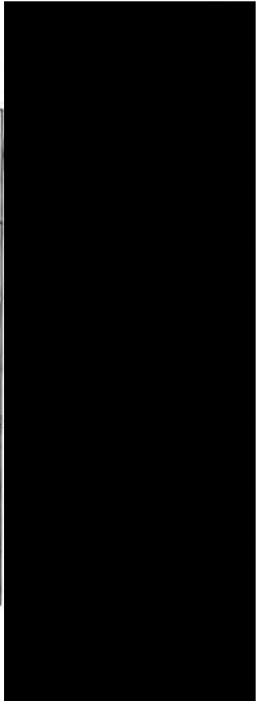




The Result of Calibration

Sensor model EWSNV110WS2505
31 August, 2023
Certification No. 305/23
Page : 3 of 6

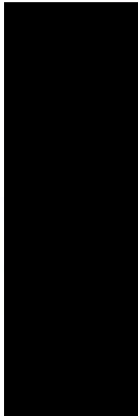
Standard Barometer Pressure	Tested Barometer Pressure	Correction
1010.30	1011.58	-1.28
1010.57	1011.92	-1.35
1010.38	1011.64	-1.26
1010.23	1011.64	-1.41
1009.83	1011.21	-1.38
1009.66	1010.83	-1.17
1009.41	1010.56	-1.15
1009.13	1010.32	-1.19
1008.96	1010.26	-1.30
1008.58	1009.92	-1.34
1008.25	1009.55	-1.30
1007.57	1008.78	-1.19
1007.27	1008.51	-1.24
1007.04	1008.36	-1.32
1006.63	1007.94	-1.31
1010.02	1011.28	-1.26
1008.77	1009.98	-1.21
1008.67	1009.84	-1.17
1008.54	1009.81	-1.27
1008.23	1009.52	-1.29



The Result of Calibration

Sensor model EWSNV110WS2505
31 August, 2023
Certification No. 305/23
Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	46.0	-0.4
30.2	30.4	-0.2
15.8	15.9	-0.1





The Result of Calibration

Sensor model EWSNV110WS2505 Certification No. 305/23

31 August, 2023

Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor	
	Reading % R.H.	Correction % R.H.
86.2	79	7.2
65.4	61	4.4
46.4	43	3.4



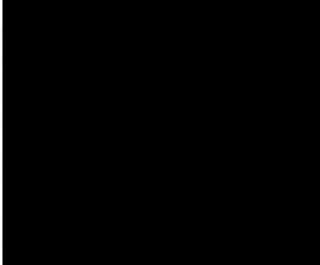
Date of Issue 31 August, 2023

Certification No. 305/23

Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีตส์ Davis Instruments แบบ TIPPING
BUCKET Product No. [REDACTED] ที่การสอบเทียบกันแก้ววัด
ฝนแบบแก้ววง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/TIP)





Issued by : Calibration & Test Section : Meteorological Instruments Bureau
Date of Issue 31 August, 2023
Certification No. 304/23
Page : 1 of 6

Object : เครื่องวัดความเร็วลม

Manufacturer : Novalynx

Type : Data Logger NDWD100

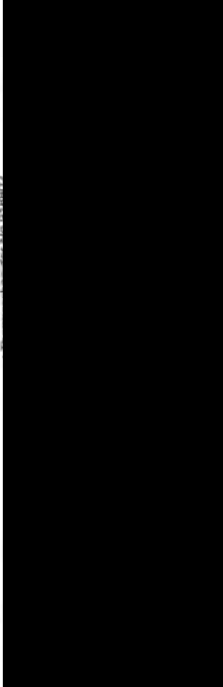
Serial No. : EWSNV110WS250E

Customer :



Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.1 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 SN 91563
HOOK GAGE NO 1425 : Wind Aloft Plotting Board
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 m/sec
 : Ultrasonic Anemometer Model DA-600-3TV (Sensor TR-90A41)
Serial Number 110730028 (Sensor 120629546)
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec
STANDARD THERMOMETER : Theodor Freiborch : Dry No. 839084 Wet No. 839084

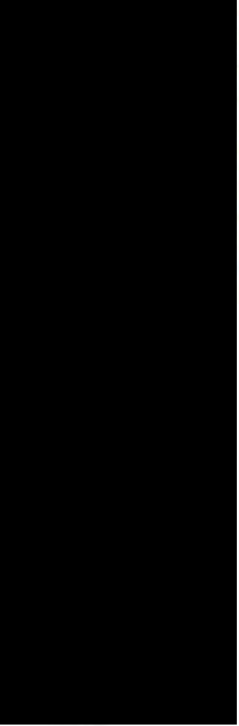


The Result of Calibration

Sensor model EWSNV110WS250E
Certification No. 304/23
Page : 2 of 6

Standard	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure inches H ₂ O	Vacuum inches H ₂ O	Velocity m/sec	Correction mm/sec
Ultrasonic Anemometer				
1.00	-	-	0.8	0.20
3.02	-	-	2.9	6.12
5.00	-	-	4.9	0.10
7.04	-	-	7.1	-0.66
9.02	-	-	9.1	-0.08
11.01	-	-	10.1	0.91
13.01	-	-	13.1	-0.09
15.01	-	-	15.0	0.01
17.02	-	-	17.0	0.02
20.02	-	-	20.1	-0.08

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



The Result of Calibration

Sensor model

EWSNV110WS2506

Certification No. 30423

31 August, 2023

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1010.30	1011.12	-0.82
1010.57	1011.35	-0.78
1010.38	1011.16	-0.78
1010.23	1011.03	-0.80
1009.93	1010.85	-0.92
1009.66	1010.81	-0.95
1009.41	1010.36	-0.95
1009.13	1009.95	-0.82
1008.96	1009.74	-0.78
1008.58	1009.46	-0.88
1008.25	1009.13	-0.88
1007.57	1008.41	-0.84
1007.27	1008.15	-0.88
1007.04	1007.91	-0.87
1006.63	1007.42	-0.79
1010.02	1010.86	-0.84
1008.77	1009.57	-0.80
1008.67	1009.46	-0.81
1008.54	1009.32	-0.78
1008.23	1009.06	-0.83

The Result of Calibration

Sensor model

EWSNV110WS2506

Certification No. 30423

31 August, 2023

Page : 4 of 6

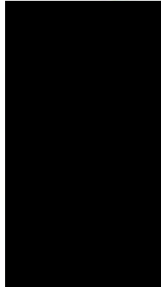
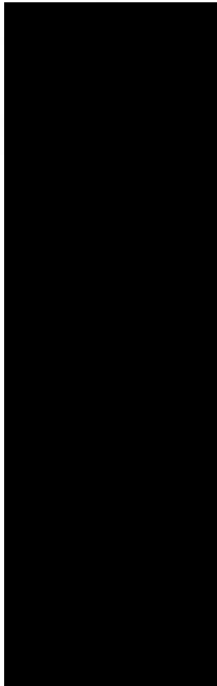
Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	45.9	-0.3
30.2	30.4	-0.2
15.6	15.7	0.1



The Result of Calibration

Sensor model EWSNV110WS2506 Certification No. 30423
31 August, 2023 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
66.2	62	4.2
65.4	62	3.4
46.4	41	2.4



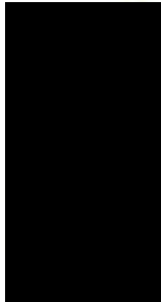
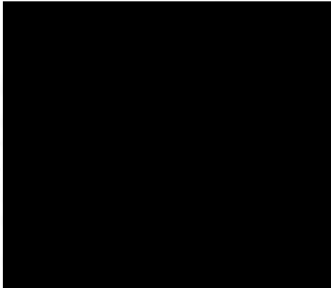
Date of Issue 31 August, 2023

Certification No. 30423

Page: 6 of 6

ใบรับรอง

หนังสือใบรับรองการสอบเทียบเครื่องมือวัดรุ่น ซีโด้ Davis Instruments แบบ TIPPING
BUCKET Product No. [REDACTED] ทำการสอบเทียบกันแก้ววัด
ฝนแบบแก้ววง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/TIP)



Request No. 21-67/0391

MTC No. EEL BP. 30/0467

Submitted by : Envliah Co.,Ltd.

Address :

Calibrated at :

Instrument Calibrated :

Description : Sound Level Calibrator

Manufacturer :

Model : 4230

Serial No. : 1351075

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

Standards used :

1. Digital Function Synthesizer NF Electronic DF-191A S/N 122037.

2. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

3. Programmable Attenuator Tamigawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Vaisala PTE202AD S/N T0650001.

6. Audio Analyzer Keithley 2015P S/N4106495.

7. Condenser Microphone B&K 4180 S/N 2899871.

Calibration Procedure: CP-102-04 based on IEC 60942:2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL) which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt : 9 Apr. 2024

Date of Calibration : 10 Apr. 2024

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

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

Request No. 21-67/0391

MTC No. EEL BP. 30/0467

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

Acoustic Output in dB re 20µPa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	93.72	-0.28	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	994.9	-5.1	± 1.5	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	1.25	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

Date of Calibration : 10 Apr. 2024

Date of Issue : 11 Apr. 2024

End of Certificate

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

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

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

ผ5-38

ภาคผนวกที่ 5-2

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
สถานีรถไฟฟ้าชองนนทบุรี (อาคารโดมอันทาวเวอร์)
และสถานีรถไฟฟ้าศาลาแดง (สถานีอาคารหอแว่น)
ครั้งที่ 3/2566
วันที่ตรวจวัด วันที่ 15-10 กุมภาพันธ์ 2567

TSP High Volume Sampler Calibration

Verification Report No.
SC2400032-E001 -TSP 01

☐ PM ☒ Onsite
Site: BTS สีลม
UTM: 47P 1517781 665371
Sampler: NTSP#20
Recorder: ECHO-PR119240
Date: 10 Feb 24
Technical: [Redacted]
Approver: [Redacted]

CONDITIONS

Barometric Press. (hPa): 1002.0
Temperature (deg C): 32.0
Corrected Avg. Press. (mm Hg): 751.8
Average Temp. (deg C): 30.0

CALIBRATION OFFICE

Brand: Tech Environmental, Inc
Model: TE-5025A
Serial#: 5411
Qstd Slope: 2.00224
Qstd Intercept: -0.02667
Data Certified: 9 Feb 24

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	10.78	1.611	54.0	50.08	Slope = 28.5538 Intercept = -0.0708 Corr coeff = 0.9953 # of Observations: 5 Range of Chart: 40 at 1.1, 1.7 m3/min
2	8.47	1.429	50.0	48.15	
3	7.21	1.320	44.0	43.25	
4	5.05	0.863	32.0	31.65	
5	2.41	0.789	30.0	28.49	



Calibrated by: [Redacted]

Approved by: [Redacted]

10 February 2024

10 February 2024

TSP High Volume Sampler Calibration

Verification Report No.
SC2400032-E001 -TSP 02

☐ PM ☒ Onsite
Site: BTS สีลม
UTM: 47P 1518187 665670
Sampler: ETSP#6
Recorder: ECHANG15315224
Date: 10 Feb 24
Technical: [Redacted]
Approver: [Redacted]

CONDITIONS

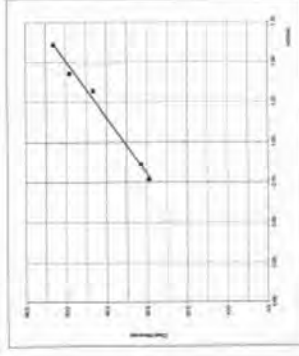
Barometric Press. (hPa): 1002.0
Temperature (deg C): 32.0
Corrected Avg. Press. (mm Hg): 751.8
Average Temp. (deg C): 30.0

CALIBRATION OFFICE

Brand: Tech Environmental, Inc
Model: TE-5025A
Serial#: 5411
Qstd Slope: 2.00224
Qstd Intercept: -0.02667
Data Certified: 9 Feb 24

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	10.44	1.585	52.0	51.11	Slope = 27.2307 Intercept = 7.3273 Corr coeff = 0.9945 # of Observations: 5 Range of Chart: 38 at 1.1, 1.7 m3/min
2	8.79	1.456	48.0	47.18	
3	7.03	1.303	42.0	41.28	
4	3.46	0.918	34.0	33.42	
5	2.33	0.756	28.0	27.52	



Calibrated by: [Redacted]

Approved by: [Redacted]

10 February 2024

10 February 2024

PM10 High Volume Sampler Calibration

Verification Report No.
SQ2400032-E001-PM 01

PM

Onsite

Site BTS สีลม

UTM 479 1517781 665371

Sampler NPM3

Recorder ECHO001818124

Date: 10 Feb 24

Technical

Approvals

CONDITIONS

Barometric Press. (hPa) 1002.0
Temperature (deg C) 32.0
Corrected Avg Press. (mm Hg) 759.8
Average Temp. (deg C) 30.0

CALIBRATION OFFICE

Brand Tech Environmental, Inc
Model TE-5025A
Serial# 3411

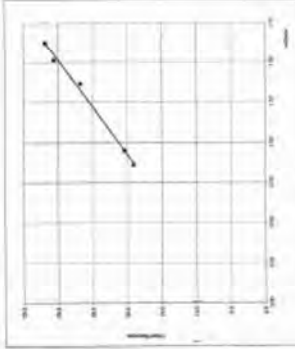
Slope 1.26504
Intercept -0.01677
Date Certified 9 Feb 24

CALIBRATIONS

Plate or Test #	H ₂ O (in)	Q ₀ (m3/min)	I (chart)	IC (corrected)
1	10.27	1.827	50.0	31.85
2	8.90	1.516	48.0	30.58
3	7.21	1.365	42.0	26.16
4	3.46	0.563	52.0	33.15
5	2.85	0.863	36.0	19.11

LINEAR REGRESSION

Slope = 18.9875
Intercept = 4.2503
Corr. coeff = 0.9968
SFR = 1.190
SSR = 37.34
of Observations: 5
Range of Chart 35
at SFR ±10% 40



Calibrated by:

Approved by:

10 February 2024

10 February 2024

PM10 High Volume Sampler Calibration

Verification Report No.
SQ2400032-E001-PM 02

PM

Onsite

Site BTS สีลม

UTM 479 1518187 665870

Sampler NPM3

Recorder ECHO001818125

Date: 10 Feb 24

Technical

Approvals

CONDITIONS

Barometric Press. (hPa) 1004.0
Temperature (deg C) 34.0
Corrected Avg Press. (mm Hg) 759.8
Average Temp. (deg C) 30.0

CALIBRATION OFFICE

Brand Tech Environmental, Inc
Model TE-5025A
Serial# 3411

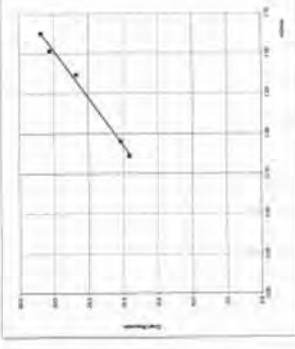
Slope 1.26504
Intercept -0.01677
Date Certified 9 Feb 24

CALIBRATIONS

Plate or Test #	H ₂ O (in)	Q ₀ (m3/min)	I (chart)	IC (corrected)
1	10.00	1.609	52.0	33.20
2	8.31	1.458	48.0	30.65
3	7.01	1.350	42.0	26.82
4	3.28	0.927	30.0	19.15
5	2.65	0.825	28.0	17.68

LINEAR REGRESSION

Slope = 20.0915
Intercept = 0.7537
Corr. coeff = 0.9967
SFR = 1.165
SSR = 37.46
of Observations: 5
Range of Chart 35
at SFR ±10% 40



Calibrated by:

Approved by:

10 February 2024

10 February 2024

Verification Test Report

Report No.:
SQ2400032-E001 -SLM 01

☐ PM

☒ Onsite

UTM : 47P 1517151 665360

Calibrated Date: 10 February 2024
Site : BTS สีลมบุรี

Equipment: Sound Level Meter
Manufacturer: PULSAR

Model: 44
Serial : 1885

Environment: Temperature 25 °C Humidity 72 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230,Brueel&Kjaer
Serial No.1351075
Date of Calibration : 16 March 2023

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.57	-0.21	93.78

Calibrated By:

10 February 2024

Date:

Approve By:

10 February 2024

Verification Test Report

Report No.:
SQ2400032-E001 -SLM 02

☐ PM

☒ Onsite

UTM : 47P 1518197 665865

Calibrated Date: 10 February 2024
Site : BTS ศาลาแดง

Equipment: Sound Level Meter
Manufacturer: PULSAR

Model: 44
Serial : 1877

Environment: Temperature 25 °C Humidity 72 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230,Brueel&Kjaer
Serial No.1351075
Date of Calibration : 16 March 2023

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.52	-0.26	93.78

Calibrated By:

10 February 2024

Date:

Approve By:

10 February 2024

Certificate of Calibration

Calibration Certification Information			
Cal. Date:	February 9, 2024	Roommeter S/Nr:	438320
Operator:	Jim Tich	Ta:	295 °K
Calibration Model #:	TE-5025A	Ps:	749.0 mm Hg
Calibrator S/Nr: 5411			

Run	Vol. Inlet (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3950	3.2	2.00
2	3	4	1	0.9840	6.4	4.00
3	5	6	1	0.8790	7.9	5.00
4	7	8	1	0.8430	8.8	5.50
5	9	10	1	0.6940	12.7	8.00

Data Tabulation			
Vol. Inlet (m3)	Qstd (Pa)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \times \frac{Tstd}{Tb} \right)}$ (y-axis)	$\Delta H \left(\frac{Pa}{Pstd} \right)$ (y-axis)
0.9914	0.7106	1.4111	0.9957
0.9871	1.0032	1.9956	0.9915
0.9851	1.1207	2.2311	0.9895
0.9839	1.1672	2.3401	0.9883
0.9787	1.4103	2.8221	0.9830
QSTD	m= 2.02024	QA	m= 1.26504
	b= -0.02657		b= -0.01677
	r= 0.99993		r= 0.99993

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

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH: calibrator manometer reading (in H2O)	
ΔP: reactor manometer reading (mm Hg)	
Ta: actual absolute temperature (°K)	
Ps: actual barometric pressure (mm Hg)	
B: Intercept	

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, 9.2.1.7, page 30	

Certificate of Calibration

Certificate No. : 67-200034-1

Page : 1 of 2

Submitted by :

Equipment :

Electronic Balance

Manufacturer : Sartorius

Model : SECURA224-1S

Serial No. : 0034803270

ID No. : ELABBALANCEN04

Capacity : 220 g

Resolution : 0.0001 g

Environment :

On site calibration was carried out at the Balance Room, Envilab Co., Ltd.

Ambient Temperature : (22.8 to 23.6) °C

Relative Humidity : (44.6 to 45.3) %

Air Pressure : 1014.0 mbar

Date of Received : 01 February 2024

Date of Calibration : 01 February 2024

Date of Issue : 06 February 2024

Calibrated by : Akaradeth Thippichai

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB J4

Edition 7 - November 2022

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Weights

ID No.

Cert. No.

Due Date

Traceability

E26142024

C92232008

08 Nov 2024

National Institute of Metrology (Thailand), (NIMT)

Certificate of Calibration

Certificate No. : 67-200034-1

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty ± (g)
0.01	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00038

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

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



Eccentric error Load test : 50 g
A B C D E
-0.0001 -0.0001 -0.0001 0.0000 0.0000 g

Repeatability Load test : 200 g
Stdev : 0.00005 g

CERTIFICATE OF ANALYSIS
Grade of Product: EPA PROTOCOL STANDARD

Customer: BANGKOK INDUSTRIAL
Part Number: GAS CO LTD
Cylinder Number: EDN095E15A00V3
Cylinder Volume: 144.0 CF
Reference Number: 160-402855487-1
Cylinder Pressure: 2015 PSIG
Valve Outlet: 800
PGVP Number: A17023
Gas Code: CO,NO,NOX,S02,BALN
Certification Date: Mar 31, 2023
Expiration Date: Mar 31, 2028

Certification performed in accordance with EPA Testability Protocol for Analytical Methods for Air and Certification of Gasoline Standards May 2017. Account EPA 806. This certificate is valid for the duration of the calibration and the test results are accurate. The certificate is a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this certificate. All measurements were made under the same conditions as the calibration. The results reported are reproduced except in full without approval of the laboratory. Do not use this Certificate below 100 ppb, or 0.1 mg/kg.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	48.50 PPM	G1	+/- 1.4% NIST Traceable	03/24/2023, 03/10/2023
NITRIC OXIDE	45.00 PPM	46.50 PPM	G1	+/- 1.4% NIST Traceable	03/24/2023, 03/10/2023
SULFUR DIOXIDE	45.00 PPM	45.50 PPM	G1	+/- 1.3% NIST Traceable	03/24/2023, 03/10/2023
CARBON MONOXIDE	4500 PPM	4527 PPM	G1	+/- 1.4% NIST Traceable	03/24/2023
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NT500	21000732	CCT06087	48.41 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%	Sep 21, 2025
PM10	12385	D807660	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 22, 2022
PM10	16089154	16089154	15.15 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 21, 2025
NTRM	16010101	C247186	48.00 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Feb 21, 2025
GMBS	172102228109	160141259	50.00 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Dec 31, 2028
CO	229008	C2744708	2851.8 PPM CARBON MONOXIDE/NITROGEN	+/-0.5%	Sep 30, 2028

Instrument Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMATE 8 NIKO579	NDIR	Mar 07, 2023
Nocalist 650 FTIR AUP2010245 NO	FTIR	Mar 06, 2023
Nocalist 650 FTIR AUP2010245 NO2	FTIR	Mar 23, 2023
Nocalist 650 FTIR AUP2010245 S02	FTIR	Mar 16, 2023

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S8702003
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer	Manufacturer API
Model: 100E	S/N: ESQA1100ED1218

Page:1/2

Calibration System

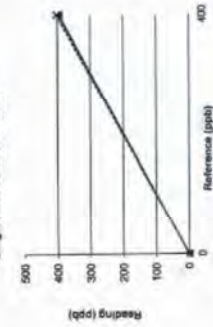
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NOx Conc 43.50 PPM
S/N: 792	NO Conc 43.50 PPM
ZERO AIR Generator ZAG7001	SO2 Conc 43.59 PPM
S/N: 544	CO Conc 4300 PPM
Expire Date: Mar 31, 2028	EBD160267

Environment: Temperature 26.2 °C Humidity 82 %RH

Calibration Report

Status	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.8	0.8	400.0	395.0	-0.6
After	0.0	0.5	0.5	400.0	402.0	0.2

Single Point Calibration Chart



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S8702003
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Page:2/2

Date	1-Feb-24		
Time	13:10		
Range	50 - 2000	PPB	500
Stability (Zero Gas)	< 0.2	PPB	0.6
Sample Flow	650 (± 50)	cc/min	659
PMT Detector	0 - 5000	mV	36.5
Norm PMT Detector	0 - 5000	mV	34.1
NOx	400-800 constant	V	718
DOFS	2502 (± 200)	mV	-
PCELL TEMP	58 (± 1)	Degree C	50
BOX TEMP	29-40	Degree C	34.1
PMT TEMP	7 (± 1)	Degree C	8.0
UV Temp	1000-4900	mV	4034.0
Lamp Ratio	30-120	%	114.0
STRT Light (Zero Gas)	<100	PPB	29
Dark PMT	(-50) - (±200)	mV	44.7
Dark Lamp	(-50) - (±200)	mV	5.1
SAMP PRESS	20-30 constant	IN-Hg-A	28.1
PMF Vols	2002 (± 200)	mV	2004
SO2 Conc	1002 (± 250)	PPB	1022
SO2 Slope	1 (± 0.3)	-	0.920
SO2 Offset	< 256	mV	85
Stability at Zero	< 0.2	PPB	0.1
Stability at Span	< 2 ppm @ 400 ppb	PPB	0.6
Zero Gas (0.00 %O2)	0	ppm	0.5
Span Gas (400 %O2)	400	ppm	395.0
			± 5% of Range

Calibrate By:

Approve By:

Date: 1-Feb-24

Date: 1-Feb-24

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6702005
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100E	Manufacturer API S/N: ESOA100E01108
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Page:1/2

Calibration System

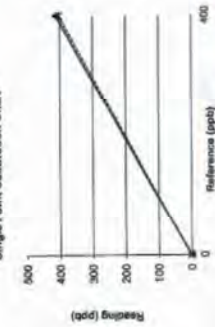
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM
ZERO AIR Generator ZAG7001 S/N: 944	Expire Date: Mar 31, 2026 EBO160267

Environment: Temperature 25.7 °C Humidity 62 %RH

Calibration Report

Status	Zero		Span	
	Reference (ppb)	Reading (ppb)	Reference (ppb)	Drift% (ppb)
Before	0.0	1.5	400.0	1.5
After	0.0	0.8	403.0	0.4

Single Point Calibration Chart



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6702005
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

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Date	1-Feb-24			
Time	13:10			
Range	50 - 20000	PPB	500	500
Stability (Zero Gas)	± 0.2	PPB	0.6	0.2
Sample Flow	650 (± 50)	cc/min	663	659
PMT Detector	0 - 5000	mV	38.5	34.5
Non-PMT Detector	0 - 5000	mV	34.1	32.8
HVPS	400-800 constant	V	719	648
DCPS	2500 (± 200)	mV	-	-
ROCELL TEMP	50 (± 1)	Onstage C	50	50
BOX TEMP	35-40	Onstage C	34.1	32.7
PMT TEMP	7 (± 1)	Onstage C	8.0	8.0
UV Temp	1000-4900	mV	4034.0	4034.0
Lamp Ratio	50-120	%	114.0	114.0
STRL Light (Zero Gas)	<100	PPB	28	28
Dark PMT	(-50) - (+200)	mV	44.7	44.7
Dark Lamp	(-50) - (+200)	mV	5.1	5.1
GAMP PRES	20-30 constant	IN-Hg-A	28.1	27.8
PMT Vols	200E (± 50S)	mV	20054	2009
SO2 Conc	1000 (± 250)	PPB	1002	1010
SO2 Slope	1 (± 0.3)	-	0.920	0.868
SO2 Offset	< 250	mV	85	130.1
Stability at Zero	± 0.2	PPB	0.1	0.1
Stability at Span	< 2 ppb @ 410 ppb	PPB	0.8	0.2
Zero Gas (0.00 PPM)	0	ppb	1.5	0.8
Span Gas (400 PPM)	400	ppb	412.8	403.9
				± 5% of Range

Calibrate By

Sirirat Poontak

Date: 1-Feb-24

Approve By

Date: 1-Feb-24

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702007
Calibrated Date: 1-Feb-24

Page:1/1

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NOINOx Analyzer	Manufacturer AP1
Model: T200	S/N: ENOAIT20003573

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NOx Conc 46.50 PPM
S/N: 792	NO Conc 46.50 PPM
ZERO AIR Generator ZAG7001	SO ₂ Conc 45.99 PPM
S/N: 644	CO Conc 4507 PPM
Expire Date: Mar 31, 2025 EBD190267	

Environment: Temperature 28.4 °C Humidity 61 %RH

Calibration Check (Before adjust)

Zero		Span	
Gas	Reading Value (ppb)	Expected Value (ppb)	Drift (%)
NO	1.6	391.0	-1.1
NO ₂	0.5	4.0	0.0
NOx	2.1	395.0	-0.6

Calibration Check (After adjust)

Zero		Span	
Gas	Reading Value (ppb)	Expected Value (ppb)	Drift (%)
NO	0.1	403.1	0.4
NO ₂	0.4	2.9	0.4
NOx	0.5	406.0	0.7

Single Point Calibration Chart



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702007
Calibrated Date: 1-Feb-24

Page:1/1

☒ PM ☐ Onsite

Test Function Value	Verified Range	Unit	Before	After	Risk
Date	1-Feb-24				
Time	8:25				
Range	0.00 - 500.00 PPM	PPM	500	500	
Stability (2m Gas)	< 0.2	PPM	0.5	0.2	
Sample Flow	500NL/50	cc/min	491	465	
Carrier Flow	60-90	cc/min	80	80	
PMT Detector	0-5000	mV	85.0	25.0	
AZEND	20-150	mV	94.1	14.5	
HMPS	400-3000 constant	V	734	734	
DOPS	2500 +/- 200	mV	-	-	
ROCELL TEMP	50 +/- 1	°C	50	50	
ROCK TEMP	20-35	°C	34.7	33.6	
PMAT TEMP	7 +/- 1	°C	7.0	7.0	
ZS TEMP	50 +/- 4	°C	-	-	
MOXY Temp	315 +/- 5	°C	314.0	314.0	
ICEEL PRESS	4-19 constant	PSI	5.0	5.0	
SLAMP PRESS	50-30 constant	PSI	28.8	27.8	
NO Slope	1 +/- 0.3		1.135	1.197	
NO ₂ Slope	1 +/- 0.3		1.260	1.114	
NO Offset	-10 to +150	mV	0.8	-3.8	
NOx Offset	-10 to +150	mV	-2.6	6.1	
Span and Cal Value					
Zero Value	0	ppb	1.6	0.1	
NOx	0	ppb	2.1	0.5	
Span Value	NO	ppb	391.0	403.1	
NOx	NOx	ppb	395.0	406.0	

Calibrate By

Date: 1-Feb-24

Approve By

Date: 1-Feb-24

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702003
Calibrated Date: 1-Feb-24

Page:1/1

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NONOX/NOx Analyzer Model: 200A	Manufacturer API S/N: ENOA200A02800
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MG5101 S/N: 792	NOx Conc 45.10 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.10 PPM
	SO2 Conc 45.10 PPM
	CO Conc 4507 PPM
	Expire Date: Mar 31 2026 EBO160267

Environment: Temperature 26.5 °C Humidity 64 %RH

Calibration Check (Before adjust)

GAS	Zero			Span			Drift%
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)		
NO	2.1	0.0	2.1	380.2	400.0	-2.5	
NO ₂	0.8	0.0	0.6	13.8	0.0	1.8	
NO _x	2.9	0.0	2.9	394.0	400.0	-0.8	

Calibration Check (After adjust)

GAS	Zero			Span			Drift%
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)		
NO	0.6	0.0	0.6	400.0	400.0	0.0	
NO ₂	0.1	0.0	0.1	3.0	0.0	0.0	
NO _x	0.7	0.0	0.7	403.0	400.0	0.4	

Single Point Calibration Chart



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702003
Calibrated Date: 1-Feb-24

Page:1/1

☒ PM ☐ Onsite

Test Function Value	Normal range	Unit	Before	After	Note
Date	1-Feb-24				
Time	11:20				
Range	0.00 - 500.00 PPM	PPM	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPM	0.8	0.2	
Sample Flow	500-1.50	cc/min	470.0	478.0	
Carrier Flow	80.00	cc/min	80.0	78.0	
PMT Detector	0.5000	mV	24.5	19.6	
AZERO	0.20100	mV	11.7	7.3	
IN-PS	400-800 constant	V	788.0	714.0	
DO-PS	2500 +/- 200	mV	-	-	
PCELL TEMP	50 +/- 1	Design C	50.3	50.3	
BOX TEMP	20-35	Design C	28.0	27.5	
PMT TEMP	7 +/- 1	Design C	7.7	7.8	
DO TEMP	50 +/- 4	Design C	-	-	
MO-TEMP	315 +/- 5	Design C	313.1	315.0	
PCELL PRES	4.10 constant	IN-Hg A	7.30	7.30	
SAMP PRES	20-30 constant	IN-Hg A	31.4	31.3	
NO Slope	1 +/- 0.3		0.847	0.863	
NOx Slope	1 +/- 0.3		0.652	0.840	
NO Offset	-10 to + 150	mV	17.40	6.60	
NOx Offset	-10 to + 150	mV	24.10	12.70	
Span and Cal Values					
Zero Value	NO	ppb	2.1	0.6	
Span Value	NOx	ppb	2.9	0.7	
Span Value	NO	ppb	380.2	400.0	
Span Value	NOx	ppb	394.0	403.0	

Calibrate By : _____

Date: 1-Feb-24

Approve By : _____

Date: 1-Feb-24

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6702001
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: CO Analyzer Model: CO1ZE	Manufacturer: Environnement SA, France SIN: NC0ESAO12E395
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Page:1/2

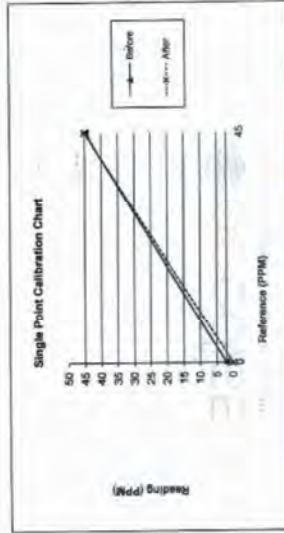
Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGCT01 SIN: 792	NOX Conc 48.50 PPM
ZERO AIR Generator ZAG7001 SIN: 944	NO Conc 48.50 PPM
	SO2 Conc 45.59 PPM
	CO Conc 4507 PPM
	Expire Date: Mar 31 2026 EBO160267

Environment: Temperature 27.2 °C Humidity 88 %RH

Calibration Report

Status	Reference (ppm)	Reading (ppm)	Drift (ppm)	Reference (ppm)	Reading (ppm)	Drift%
Before	0.0	2.035	2.0	45.0	44.82	-0.2
After	0.0	0.010	0.0	45.0	45.05	0.1



CO Analyzer Verification Test Report

Calibration Report No.: ES-C6702001
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

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Date	1-Feb-24	Time	10:09:00		
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
IR current ratio	894.7	mA	Phase current	618.2	mV
Optical T.	48.0	deg C	Phase T.	-24.2	deg C
Measure sig.	509.4	mV	Refer Sig.	458.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Inst. Ratio	1.109		Ratio	1.105	
Ref. ratio	1.109		Internal Temp.	28.9	deg C
Source Temp.	48.0	deg C	Gas Pressure	997	hPa
Up Pressure	947.0	hPa	Flow	59	l/h

Calibrate By

Approve By

Date:

Date:

CO Analyzer Verification Test Report

Calibration Report No.: ES-C5702002

Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: NCOESACO12E356
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Page: 1/2

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model: ESA NGC101 S/N: 792	NO Conc: 44.68 PPM SO ₂ Conc: 45.34 PPM CO Conc: 4500 PPM
ZERO AIR Generator ZAG7001 S/N: 644	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature: 27.2 °C Humidity: 88 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppm)	Reading (ppm)	Drift (ppm)	Reference (ppm)	Reading (ppm)	Drift%
Before	0.0	1.355	1.4	45.0	44.09	-1.0
After	0.0	0.037	0.0	45.0	45.02	0.0

Single Point Calibration Chart:



CO Analyzer Verification Test Report

Calibration Report No.: ES-C5702002

Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Page: 2/2

Date	1-Feb-24	Time	10:09:00		
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+25 V	1.1	mV			
IR current ratio	894.7	mA	Phase current	618.2	mV
Optical T.	46.0	deg. C	Phase T.	-24.2	deg. C
Measure sig.	506.4	mV	Refer Sig.	458.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Inst. Ratio	1.109		Ratio	1.105	
Ref. ratio	1.109		Internal Temp.	26.9	deg. C
Source Temp	46.0	deg. C	Gas Pressure	987	hPa
Up Pressure	947.0	hPa	Flow	59	l/h

Calibrate By :

Date:

Approve By :

Date:

Request No.

21-66/0381

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

MTC No. EEL-BP. 700366

Submitted by

Address

Calibrated at

Instrument Calibrated :

Description : Sound Level Calibrator

Manufacturer :

Model : 4230

Serial No. : 1351075

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : ((101.325 ± 1.500) kPa)

Standards used :

1. Digital Function Synthesizer NF Electronic DE-193A S/N 122037.

2. Measuring Amplifier Brüel&Kjaer 2636 S/N 1557484.

3. Programmable Attenuator Tanaqawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Kithley 2015 P S/N 4106495.

7. Condenser Microphone Brüel&Kjaer 4180 S/N 2889871.

Calibration Procedure:

CP-102-04 based on IEC 60942:2003. The sound pressure level of instrument was measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt

14 Mar. 2023

Date of Calibration

16 Mar. 2023

The results relate only to the items listed/calibrated in table enclosed.

Authorizing the Report/Certificate and validity of the results except in full are prohibited unless written permission is obtained from the Governor of TISTR.

Request No.

21-66/0381

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

MTC No. EEL-BP. 700366

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

Acoustic Output in dB re 20µPa, Corrected to Reference Conditions: 101.325 kPa, 23.0°C, and 50 %RH

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	93.78	-0.22	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	999.0	-1.0	± 1.5	±1.0%

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	1.05	± 0.50	±3.0%

Note :

1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

Date of Calibration

16 Mar. 2023

Date of Issue

17 Mar. 2023

The results relate only to the items listed/calibrated in table enclosed.

Authorizing the Report/Certificate and validity of the results except in full are prohibited unless written permission is obtained from the Governor of TISTR.

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 2 October, 2023

Certification No. : 340/23

Page : 1 of 6

Object : เครื่องวัดความเร็วลม

Manufacturer : DYACON

Type : Data Logger CM-1

Serial No. : 130129

ID No. : NWSDCMS1200128

Customer :

Calibration Condition : Temperature : 25.1 °C Barometric Pressure : 1008.7 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 SA 91563

HOOK GAGE NO 1425 : Wind Anemometer Board

N.I.S.T. Test Reference Number 731241460 : Standard Velocity at 20 - 30 m/sec

Model DA-650-3TV (sensor TR-90A-H)

Serial Number 110730029 (sensor 120629586)

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

STANDARD THERMOMETER : Theodor Friedrich : Dry No.839084 Wet No. 839094

: Thermochreiber No.918802



The Result of Calibration

Sensor Pressure Model TPH-1 C

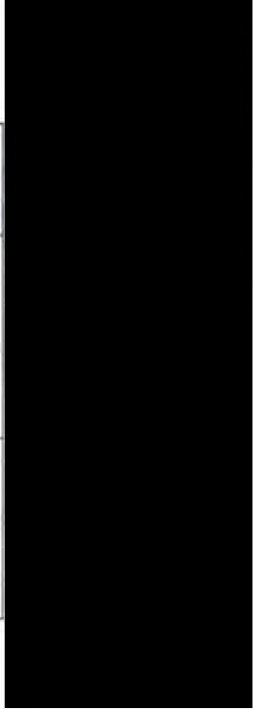
Certification No. 340/23

Serial No. 6235

2 October, 2023

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Standard Barometer Pressure	Tested Barometer Pressure	Correction
1006.63	1006.30	0.33
1006.25	1005.90	0.35
1006.22	1005.90	0.32
1006.54	1006.20	0.34
1006.88	1006.60	0.28
1007.36	1007.00	0.36
1007.58	1007.20	0.38
1007.52	1007.20	0.32
1006.60	1006.30	0.30
1006.84	1006.60	0.24
1006.28	1005.90	0.38
1006.60	1006.30	0.30
1007.07	1006.70	0.37
1007.26	1006.90	0.36
1007.38	1007.00	0.38
1006.60	1006.20	0.40
1006.83	1006.60	0.23
1006.56	1006.20	0.36
1007.21	1007.00	0.21
1007.01	1006.70	0.31



The Result of Calibration

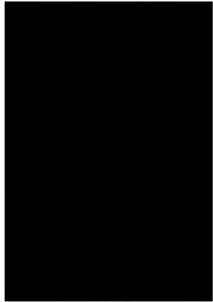
Sensor Temperature Model TPH-1 C

Certification No. 340/23

Serial No. 6235

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
46.2	46.2	0.0
31.1	31.1	0.0
15.8	15.8	-0.1



The Result of Calibration

2 October, 2023

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
80.2	95.6	0.6
82.4	92.1	0.3
45.6	45.4	0.2

ใบรับรอง

Date of Issue 2 October 2023

Certification No. 340/23

Page: 6 of 6

หนังสือฉบับนี้ถือครองว่า เครื่องวัดแบบ ชีตส์ Davis Instruments (แบบ) TIPPING
BUCKET Product No. [REDACTED] ทำการสอบเทียบกับแก้ววัด
ผ่านแบบหัววง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 71082 และสามารถนำไปใช้สำหรับวัดค่าของฝนและหิมะที่ตกลงหรือมี (0.2 mm/TIP)



Issued by : Calibration & Test Section : Meteorological Instruments Bureau
Date of Issue : 21 February, 2023
Certification No. 066/23
Page : 1 of 6

Object : เครื่องวัดทางอุตุนิยมวิทยา
Manufacturer : DYACON
Type : T Data Logger MS-100
Serial No. : 130151 ID No. : EWSDCMS1200151
Customer : EnviLab Co.,Ltd.(Head Office)
540,540/1 Soi Bangkhao 7, Bangkhao, Bangkok
Bangkok 10160, Thailand.
Calibration Condition : Temperature 25.1 °C Barometric Pressure 1011.2 hPa
NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 SN 91563
: HOOK GAGE NO 1425
N.I.S.T. Test Reference Number 731241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-550-STV (sensor TR-00A14)
Serial Number 110730029 (sensor 120629586)
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec
STANDARD THERMOMETER : Thorndor Friedrich : Dry No.839094 Wet No. 839394



The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 066/23
21 February, 2023 Serial No. 1225 Page : 2 of 6

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure mm Hg (kPa)	Vacuum mm Hg (kPa)	Velocity m/sec	Correction m/sec
1.00	-	-	1.0	0.00
3.02	-	-	3.0	0.02
5.00	-	-	5.0	0.00
7.04	-	-	7.0	0.04
9.02	-	-	9.0	0.02
11.01	-	-	11.0	0.01
13.01	-	-	13.0	0.01
15.01	-	-	14.9	0.11
17.02	-	-	17.0	0.02
20.02	-	-	20.0	0.02

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



The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6276

Certification No. 066/23

21 February, 2023

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1015.44	1014.50	0.94
1012.59	1012.00	0.59
1012.50	1011.70	0.80
1012.46	1011.60	0.86
1011.79	1010.90	0.89
1011.30	1010.40	0.90
1009.87	1009.00	0.87
1009.66	1008.80	0.86
1009.40	1008.50	0.90
1008.71	1007.80	0.91
1009.00	1008.10	0.90
1009.28	1008.40	0.88
1009.94	1009.00	0.94
1010.66	1009.70	0.95
1011.21	1010.30	0.91
1013.01	1011.90	1.11
1013.40	1012.40	1.00
1012.91	1011.90	1.01
1012.44	1011.40	1.04
1008.09	1007.10	0.99

The Result of Calibration

Sensor Temperature Model TTH-1 C

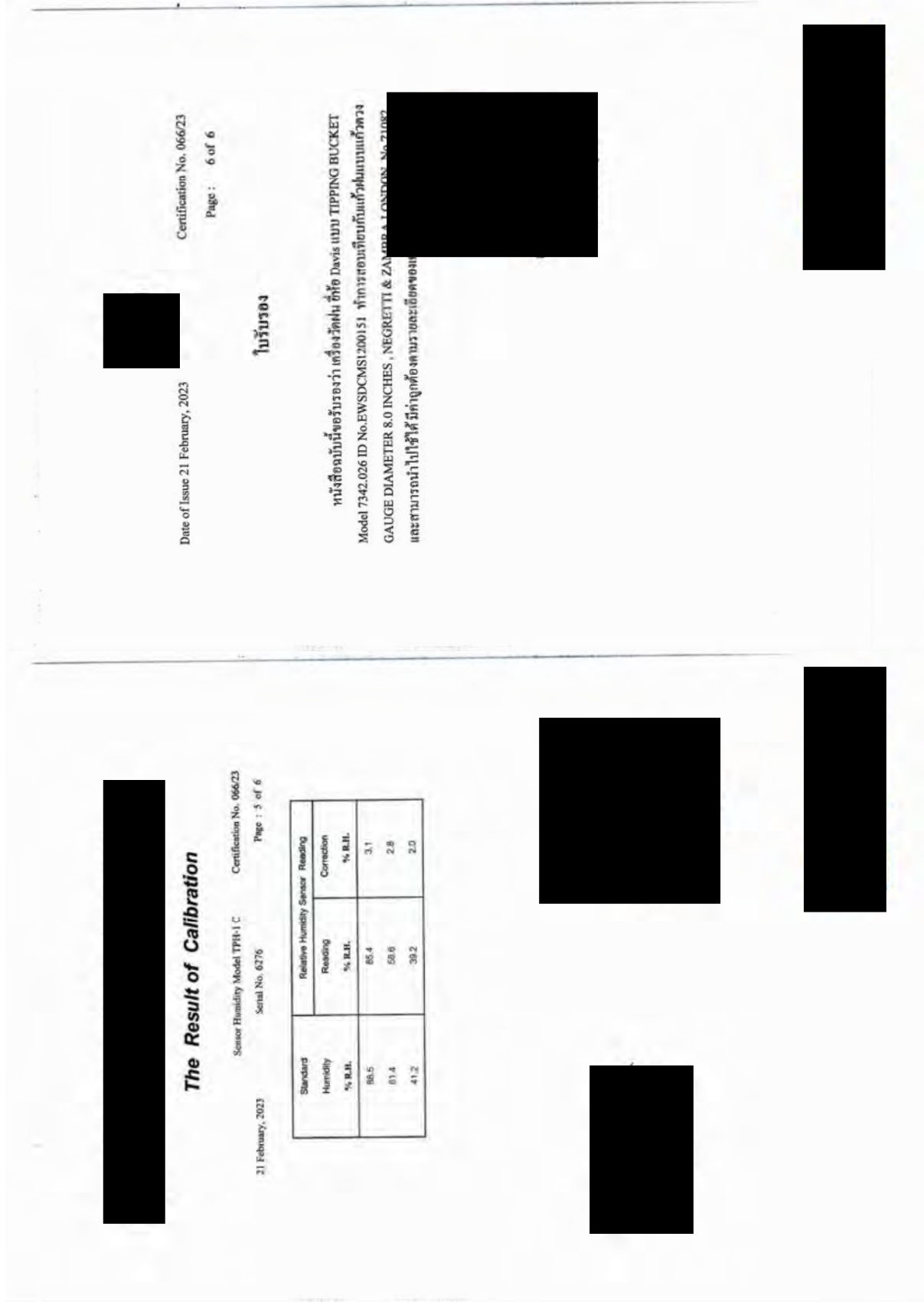
Certification No. 066/23

Serial No. 6276

Page : 4 of 6

21 February, 2023

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.1	44.8	0.3
30.2	30.0	0.2
15.6	15.4	0.2



**เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
สถานีรถไฟฟ้าชองนนทบุรี (อาคารโดมอันทาวเวอร์)
สถานีรถไฟฟ้าศาลาแดง (สถานีอาคารหอแว่น)
ครั้งที่ 4/2566
วันที่ตรวจวัด วันที่ 4-9 พฤษภาคม 2567**

TSP High Volume Sampler Calibration					
Verification Report No. SQA00117-E001 - TSP-DI					
<input type="checkbox"/> PM	<input type="checkbox"/> Ozone	Size: BTS standard UTM: 41P151781 255271 Sampler: ETS9PM20 Recorder: EPCDCPR4169240	Date: 4 May 24 Technical: Anwariso K Approval: Wain R.		
CONDITIONS					
Barometric Press (hPa): 688.0 Temperature (deg C): 35.0 Average Press (hPa): 1013.0 Average Temp (deg C): 30.0		Corrected Pressure (mm Hg): 743.1 Temperature (deg F): 95.0 Corrected Avg Press (mm Hg): 759.8 Average Temp (deg F): 30.0			
CALIBRATION OFFICE					
Brand: Tech Environmental, Inc. Model: TE-5025A Serial#: 4411		Gold Slope: Gold Intercept: Date Certified:		2.02024 -0.0567 9 Feb 2024	
CALIBRATIONS					
Plate or Test #	HQO (in)	Gold (m3/min)	I ² (char) ²	IC (corrected)	LINEAR REGRESSION
1	12.32	1.701	58.0	54.39	Slope = 25.8349 Intercept = 4.0179 Corr. coeff = 0.9992
2	10.02	1.535	52.0	50.51	
3	7.96	1.370	46.0	44.68	
4	5.20	1.110	36.0	36.91	
5	2.95	0.839	30.0	29.14	# of Observations: 5
					Range of Cal'n at 1 - 1.7 m3/min
					58
					56



Calibrated by:

Approved by:

TSP High Volume Sampler Calibration		Verification Report No. SQ2400117-E001 -TSP- 02																															
<div> <div> <input type="checkbox"/> PM <input checked="" type="checkbox"/> Ozone </div> <div> Site: 015 #14544 UTM: 47P 1515107 666670 Sampler: ET159435 Recorder: ECHOZPR16640 </div> </div> <div> Date: 4 May 24 Technical: Aarshdeep K. Approval: Waim R. </div>		Verification Report No. SQ2400117-E001 -TSP- 02																															
<div>CONDITIONS</div> <div> Barometric Press. (hPa): 888.0 Temperature (deg C): 23.0 Humidity (%RH): 55.0 Corrected Avg. Press. (mm Hg): 759.8 Average Temp. (deg C): 20.0 </div>		<div> Qstad Style: 3-2020A Qstad Interlock: -0.09607 Date Certified: 9 Feb 2024 </div>																															
<div>CALIBRATIONS</div> <table border="1"> <thead> <tr> <th>Plate or Test #</th> <th>H2O</th> <th>Qstad (m3/min)</th> <th>J (gram)</th> <th>IC (corrected)</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>11.06</td> <td>1.611</td> <td>54.0</td> <td>52.48</td> </tr> <tr> <td>2</td> <td>9.07</td> <td>1.591</td> <td>48.0</td> <td>46.82</td> </tr> <tr> <td>3</td> <td>13.31</td> <td>1.315</td> <td>44.0</td> <td>42.74</td> </tr> <tr> <td>4</td> <td>3.36</td> <td>0.894</td> <td>33.0</td> <td>31.08</td> </tr> <tr> <td>5</td> <td>2.35</td> <td>0.734</td> <td>30.0</td> <td>29.14</td> </tr> </tbody> </table>		Plate or Test #	H2O	Qstad (m3/min)	J (gram)	IC (corrected)	1	11.06	1.611	54.0	52.48	2	9.07	1.591	48.0	46.82	3	13.31	1.315	44.0	42.74	4	3.36	0.894	33.0	31.08	5	2.35	0.734	30.0	29.14	<div> LINEAR REGRESSION Slope = 26.6455 Intercept = 8.3445 Cor. coeff = 0.9939 # of Observations: 5 Range of Obs'd val = 1.7 m3/min, 55 </div>	
Plate or Test #	H2O	Qstad (m3/min)	J (gram)	IC (corrected)																													
1	11.06	1.611	54.0	52.48																													
2	9.07	1.591	48.0	46.82																													
3	13.31	1.315	44.0	42.74																													
4	3.36	0.894	33.0	31.08																													
5	2.35	0.734	30.0	29.14																													



Calibrated by :

Approved by:

PM10 High Volume Sampler Calibration

Verification Report No.
SQ2400117-E001 -PM 01

L

PM

E

Circle

Site

BTS สีลมบุรี

Date

4 May 24

UTM

47P 157761 665371

Technical

Arnothep K.

Sampler

EPM10M30

Approval

Wasin R.

Recorder

ECRDS018122

CONDITIONS

Barometric Press. (hPa) 988.0
Temperature (deg C) 35.0
Corrected Avg Press. (mm Hg) 759.6
Average Temp. (deg C) 30.0

Corrected Pressure (mm Hg) 741.1
Temperature (deg K) 309.0
Corrected Avg Press. (mm Hg) 759.8
Average Temp. (deg K) 303.0

CALIBRATION OFFICE

Brand Tech Environmental, Inc.
Model TE-5025A
Serial# 5411

Qtd Slope 1.2654
Qtd Intercept -0.01667
Date Certified 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (m)	Qs (m3/min)	I (chart)	IC (corrected)
1	10.05	1.628	56.0	32.23
2	8.53	1.501	48.0	36.84
3	6.47	1.369	40.0	25.79
4	3.26	0.853	32.0	20.63
5	2.85	0.873	30.0	19.34

LINEAR REGRESSION

Slope = 17.2492
Intercept = 4.2438
Corr coeff = 0.9933
SFR = 1.178
SSP = 38.69
of Observations 5
Range of Chart at SFR ±10% 36 40

Calibrated by

4 May 2024

Approved by

4 May 2024

PM10 High Volume Sampler Calibration

Verification Report No.
SQ2400117-E001 -PM 02

L

PM

E

Circle

Site

BTS สีลมบุรี

Date

4 May 24

UTM

47P 1518187 665670

Technical

Arnothep K.

Sampler

EPM10M30

Approval

Wasin R.

Recorder

ECRDS0181128

CONDITIONS

Barometric Press. (hPa) 988.0
Temperature (deg C) 35.0
Corrected Avg Press. (mm Hg) 759.8
Average Temp. (deg C) 30.0

Corrected Pressure (mm Hg) 741.1
Temperature (deg K) 309.0
Corrected Avg Press. (mm Hg) 759.8
Average Temp. (deg K) 303.0

CALIBRATION OFFICE

Brand Tech Environmental, Inc.
Model TE-5025A
Serial# 5411

Qtd Slope 1.2654
Qtd Intercept -0.01667
Date Certified 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (m)	Qs (m3/min)	I (chart)	IC (corrected)
1	10.22	1.640	56.0	32.23
2	8.49	1.498	48.0	30.94
3	7.84	1.440	44.0	28.37
4	3.74	0.968	30.0	19.34
5	2.65	0.843	28.0	18.05

LINEAR REGRESSION

Slope = 19.1120
Intercept = 1.2465
Corr coeff = 0.9916
SFR = 1.178
SSP = 38.65
of Observations 5
Range of Chart at SFR ±10% 34 39

Calibrated by

4 May 2024

Approved by

4 May 2024



Verification Test Report

Report No.:
SO2400117-E001-SLM 01

☐ PM ☒ Onsite UTM : 47P-1517751-665360

Calibrated Date: 4 May 2024

Site : BTS อารีย์

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1865

Environment: Temperature 34 °C Humidity 54 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230 Bruel&Kjaer

Serial No 1351075

Date of Calibration : 14 Apr 2024

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.72	94.10	0.38	93.72

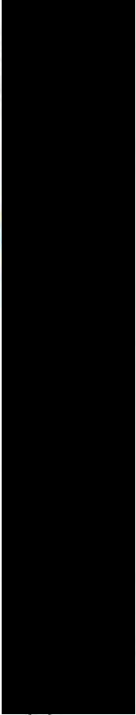
Calibrated By:

Date:

Approve By:

Date:

4 May 2024



Verification Test Report

Report No.:
SO2400117-E001-SLM 02

☐ PM ☒ Onsite UTM : 47P-1518197-665865

Calibrated Date: 4 May 2024

Site : BTS อารีย์

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1374

Environment: Temperature 34 °C Humidity 54 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230 Bruel&Kjaer

Serial No 1351075

Date of Calibration : 14 Apr 2024

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.72	94.00	0.28	93.72

Calibrated By:

Date:

Approve By:

Date:

4 May 2024



Calibration Certification Information			
Cal. Date:	February 9, 2024	Rootmeter S/N:	438320
Operator:	Jim Tisch	Ta:	295
Calibration Model #:	TE-5025A	Pi:	749.0
			mm Hg
			°K

Run	Vol. Inlet (m3)	Vol. Final (m3)	AVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3950	3.2	2.00
2	3	4	1	0.9849	6.4	4.00
3	5	6	1	0.8790	7.9	5.00
4	7	8	1	0.8430	8.8	5.50
5	9	10	1	0.6940	12.7	8.00

Data Tabulation					
Vstd (m3)	Qstd (m3/min)	$\sqrt{\Delta H \cdot \left(\frac{P_{std}}{P_{atm}} \times \frac{T_{atm}}{T_{std}} \right)}$	Va	Qa	$\sqrt{\Delta H \cdot \left(\frac{T_{atm}}{P_{atm}} \right)}$
0.5914	0.7106	1.4111	0.9957	0.7138	0.8875
0.8671	1.0082	1.9956	0.9915	1.0076	1.2551
0.9831	1.1207	2.2312	0.9895	1.1257	1.4033
0.9839	1.1672	2.3401	0.9883	1.1723	1.4718
0.9787	1.4103	2.8222	0.9830	1.4165	1.7750
QSTD	m= 2.02024	QA	m= 1.76504	b= -0.01677	r= 0.99993
	b= -0.02667				
	r= 0.99993				

Calculations			
$V_{std} = \Delta V_{Vol}(P_{std}/P_{atm})(T_{std}/T_a)$	$V_{std} \Delta V_{Vol}(P_{std}/P_{atm})$	$V_{std} \Delta V_{Vol}(P_{std}/P_{atm})$	$V_{std} \Delta V_{Vol}(P_{std}/P_{atm})$
$Q_{std} = V_{std}/\Delta Time$	$Q_{std} = V_{std}/\Delta Time$	$Q_{std} = V_{std}/\Delta Time$	$Q_{std} = V_{std}/\Delta Time$
For subsequent flow rate calculations:			
$Q_{std} = 1/m \left(\sqrt{\Delta H \left(\frac{P_{std}}{P_{atm}} \times \frac{T_{atm}}{T_{std}} \right)} \right) \cdot b$	$Q_{std} = 1/m \left(\sqrt{\Delta H \left(\frac{T_{atm}}{P_{atm}} \right)} \right) \cdot b$		

Standard Conditions	
Tstd	298.15 °K
Pstd	760 mm Hg
Key	
ΔH	ΔH: calibrator manometer reading (in H2O)
ΔP	ΔP: rootmeter manometer reading (mm Hg)
Ta	Ta: actual absolute temperature (°K)
Pa	Pa: actual barometric pressure (mm Hg)
b	b: intercept
m	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, 9.2.1.7, page 30	

Tech Environmental, Inc.
45 South Miami Avenue
Village of Cleves, OH 45002
www.tech-env.com
TOLL FREE: (877) 953-7610
FAX: (513) 467-9009

Certificate of Calibration

Page : 1 of 2

Certificate No. : 67-200034-1

Submitted by :

Equipment :

Electronic Balance

Manufacturer : Sartorius

Model : SECURA224-1S

Serial No. : 0034803270

ID No. : ELABBALANCEN04

Capacity : 220 g

Resolution : 0.0001 g

Environment :

On site calibration was carried out at the Balance Room, Envislab Co., Ltd.

Ambient Temperature : (22.8 to 23.6) °C

Relative Humidity : (44.6 to 45.3) %

Air Pressure : 1014.0 mbar

Date of Received :

01 February 2024

Date of Calibration :

01 February 2024

Date of Issue :

06 February 2024

Calibrated by :

Akaradith Thippachai

Calibration Method :

In-house method CAL-M2001 based on UKAS Publication ref : LAB 14

Edition 7 - November 2022

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Weights

ID No.

E261-E264

Cert. No.

C02212098

Due Date

08 Nov 2024

Traceability

National Institute of Metrology (Thailand), (NIMT)

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705005
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100E	Manufacturer API SIN: ESOA100E01106
--	--

Page: 1/2

Calibration System

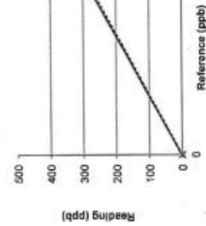
Dilutor Model ESA WGC101 SIN: 702 ZERO AIR Generator ZNG7001 SIN: 644	Standard Gas NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31, 2026 EBD160267
--	---

Environment: Temperature 25.3 °C Humidity 55 %RH

Calibration Report

Status	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Span Reading (ppb)	Drift%
Before	0.0	2.1	2.1	400.0	410.0	1.2
After	0.0	0.5	0.5	400.0	402.0	0.2

Single Point Calibration Chart



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705005
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Test Function Value	Nominal range	Unit	Before	After	Note
Date	2 May 24				
Time	13:10				
Range	50 - 2000	PPB	500	500	
Stability (Zero Gas)	± 0.2	PPB	0.6	0.2	
Sample Flow	150 (± 10)	cc/min	98.3	105.8	
PMT Detector	0 - 5000	mV	34.3	34.3	
Norm PMT Detector	0 - 5000	mV	34.3	32.8	
NPFS	100-800 constant	V	719	848	
DCPS	2500 (± 200)	mV	-	-	
ROCELL TEMP	35 (± 1)	°C	50	50	
NOX TEMP	35-40	°C	34.1	32.7	
PM TEMP	1000-1600	°C	3.0	3.0	
UV Lamp	305-320	nm	4054.0	4054.0	
Lamp Ratio	7 (± 1)	%	114.0	114.0	
BTR Light (Zero Gas)	± 100	PPB	29	29	
Dark PMT	500 (± 200)	mV	44.7	44.7	
Dark Lamp	500 (± 200)	mV	5.1	5.1	
SAMP PRES	20-30 constant	hPa	26.1	27.8	
Electric Test/Opic Test					
PMT Vols	2000 (± 500)	mV	2054	2000	
SO2 Conc	1000 (± 250)	PPB	1002	1019	
SO2 Slope	1 (± 0.3)	-	0.820	0.866	
SO2 Offset	± 250	mV	65	130.1	
Stability at Zero	± 0.2	PPB	0.1	0.1	
Stability at Span	± 2 ppb @ 400 ppb	PPB	0.6	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	2.1	0.5	
Span Gas (400 PPB)	400	ppb	410.0	402.0	± 5% of Range

Calibrate By :

Date: 2 May-24

Approve By :

Date: 2 May-24

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705007

Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100E	Manufacturer: ARI S/N: ES0A100E01218
--	---

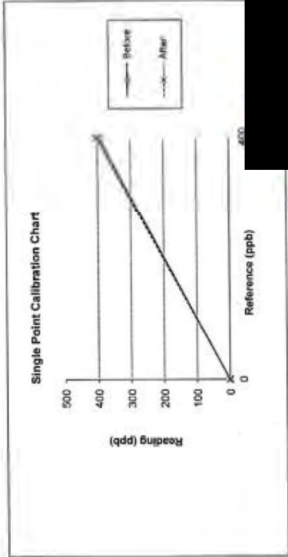
Calibration System

Dilutor Model: ESA MGC101 S/N: 702 ZERO AIR Generator ZAG7001 S/N: 644	Standard Gas NOx Conc: 45.50 PPM NO Conc: 45.50 PPM SO2 Conc: 45.59 PPM CO Conc: 4500 PPM Expire Date: Mar 31, 2026 EBO1610267
---	--

Environment: Temperature: 25.3 °C Humidity: 55 %RH

Calibration Report

Status	Zero		Span	
	Reference (ppb)	Reading (ppb)	Reference (ppb)	Drift (%)
Before	0.0	0.9	400.0	-0.5
After	0.0	0.4	403.0	0.4



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705007

Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Test Function Value	Normal range	Unit	Before	After	Note
Date	2-May-24				
Time	13:10				
Range	50 - 2000	PPB	500	500	
Stability (Zero Gas)	± 0.2	PPB	0.6	0.2	
Sample Flow	450 (± 50)	c/min	463	458	
PMT Detector	0 - 5000	mV	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
HVPS	400-900 constant	V	718	648	
DCPS	2500 (± 200)	mV	-	-	
RCCELL TEMP	30 (± 1)	°C	50	50	
BOX TEMP	35-40	°C	34.1	32.7	
PMT TEMP	7 (± 1)	°C	8.0	8.0	
UV Lamp	1000-4000	mV	4034.0	4034.0	
Lamp Ratio	36-120	%	114.0	114.0	
STR Light (Zero Gas)	<100	PPB	26	29	
Dark PMT	<500 (± 200)	mV	44.7	44.7	
Dark Lamp	<500 (± 200)	mV	5.1	5.1	
SAMP PRES	20-30 constant	IN-Hg-A	28.1	27.8	
Electric Test/Optic Test					
PMT Volts	2000 (± 500)	mV	2054	2026	
SO2 Conc	1000 (± 250)	PPB	1002	1010	
SO2 Slope	1 (± 0.3)	-	0.800	0.866	
SO2 Offset	± 200	mV	65	130.1	
Stability at Zero	± 0.2	PPB	0.1	0.1	
Stability at Span	± 2 ppb @ 400 ppb	PPB	0.6	0.2	
Gas Test Response					
Zero Gas (0.00 PPM)	0	ppb	0.8	0.4	
Span Gas (400 PPM)	400	ppb	395.7	403.0	± 1% of Range

Calibrate By: [Redacted]

Date: [Redacted]

Approve By: [Redacted]

Date: [Redacted]

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6705001
Calibrated Date: 2-May-24

Page:1/1

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NONOX/NOx Analyzer Model: T200	Manufacturer API SIN: ENOMT20003573
--	--

Calibration System

Dilutor Model ESA100C101 SIN: 792 ZERO AIR Generator ZAG7001 SIN: 644	Standard Gas NOx Conc 48.50 PPM NO Conc 48.50 PPM SO ₂ Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31 2026 EBU160267
--	---

Environment: Temperature 25.2 °C Humidity 55 %RH

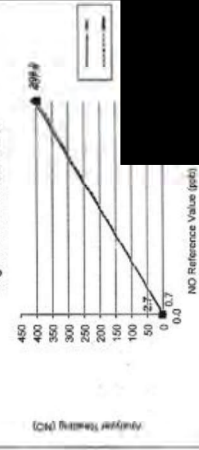
Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO _x	2.3	0.0	2.3	390.5	400.0	-1.2
NO ₂	0.4	0.0	0.4	7.5	0.0	1.0
NO _x	2.7	0.0	2.7	398.0	400.0	-0.3

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO _x	0.5	0.0	0.5	405.0	400.0	0.6
NO ₂	0.2	0.0	0.2	2.0	0.0	0.2
NO _x	0.7	0.0	0.7	407.0	400.0	0.9

Single Point Calibration Chart



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6705001
Calibrated Date: 2-May-24

Page:1/1

☒ PM ☐ Onsite

Test Function Value	Normal range	Unit	Before	After	Note
Date	2-May-24				
Time	9:25				
Purge	0.05 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	± 0.2	PPB	0.5	0.2	
Sample Flow	500± 50	cc/min	491	485	
Carrier Flow	100-900	cc/min	80	90	
PMT Detector	0-5000	mV	85.0	25.0	
AZERO	30-100	mV	94.1	14.5	
HYPER	400-600 constant	V	73.4	75.4	
ICPRS	2500 ± 200	mV	-	-	
ICELL TEMP	204± 1	°C	50	50	
BOX TEMP	25-35	°C	24.7	33.6	
PMT TEMP	7 ± 1	°C	7.0	7.0	
Z25 TEMP	50± 1	°C	-	-	
MOLY Temp	315 ± 1.5	°C	314.9	314.9	
ICELL PRES	14-10 constant	mmHg-A	5.0	5.0	
SAMP PRES	20-30 constant	mmHg-A	28.8	27.9	
NO Slope	1 ± 0.3	1.135	1.135	1.197	
NOx Slope	1 ± 0.3	1.260	1.260	1.114	
NO Offset	-18 to + 150	mV	0.8	-3.8	
NOx Offset	-19 to + 150	mV	-2.6	6.1	
Span and Cal Value**					
Zero Value	0	ppb	2.3	0.8	
Span Value	9	ppb	2.7	0.7	
Span Value	400	ppb	390.5	405.0	
Span Value	400	ppb	398.0	407.0	

Calibrate By:

Approve By:

Date: 2-May-24

Date: 2-May-24

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6705008
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: CO Analyzer	Manufacturer: Environnement SA, France
Model: CO12E	SIN: NC0ESACO12E356

Page: 1/2

Calibration System

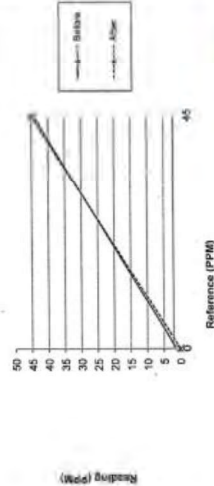
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NO Conc 44.68 PPM
SIN: 792	SO2 Conc 45.34 PPM
ZERO AIR Generator ZAGT001	CO Conc 4500 PPM
SIN: 644	Expire Date: Feb 19, 2024 EBO140762

Environment: Temperature 26.1 °C Humidity 55 %RH

Calibration Report

Status	Zero		Span	
	Reference (ppm)	Reading (ppm)	Reference (ppm)	Drift (%)
Before	0.0	1.237	45.0	-0.8
After	0.0	0.073	45.0	0.0

Single Point Calibration Chart



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6705006
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Analyzer Signal Values			
Date	2-May-24	Time	10:09:00
Power Supplies			
Option	0.0	mV	+5 V Sensor
+3.3 V	3.3	V	+24 V
+12 V	11.8	V	+5 V
+24 V	1.1	mV	
Optical Bench			
IR current ratio	884.7	mA	Phase current
Optical T	46.0	deg.C	Phase T
Measure sig	506.4	mV	Refer Sig
Min sig	845.0	mV	Max Sig
Sample			
Inlet Ratio	1.109		Ratio
Ref. Ratio	1.109		Internal Temp.
Source Temp	-46.0	deg.C	Gas Pressure
Inj Pressure	147.0	hPa	Flow

Calibrate By : [Redacted]

Date: 2-May-24

Approve By : [Redacted]

Date: 2-May-24

neediss
Neediss Supply Instrument Co., Ltd.

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C8705001
Calibrated Date: 2-May-24

<input checked="" type="checkbox"/>	PM	<input type="checkbox"/>	Onsite
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Instruments Information

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environment SA, France S/N: NCOESACO12E355
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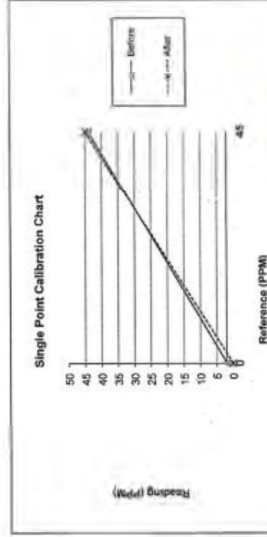
Calibration System

Generation System	Calibrator Unit	Standard Gas
	Dilutor Model ESA MGC101	NOX Conc 40 50 PPM
	S/N: 792	NO Conc 48 50 PPM
	ZERO AIR Generator ZAG7001	SO2 Conc 45 59 PPM
	S/N: 644	CO Conc 4507 PPM
		Expire Date: Mar 31 2026/57

Environment: Temperature 25.5 °C Humidity 56 %RH

Calibration Report

Status	Zero			Span		
	Reference gas	Reading gas	Drift gas	Reference gas	Reading gas	Drift%
Before	0.0	1.903	1.9	45.0	44.01	-1.1
After	0.0	0.034	0.0	45.0	45.02	0.0



CO Analyzer Verification Test Report

Calibration Report No.: ES-C6705001
Calibrated Date: 2-May-24

	PM	Onsite
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Page: 2/2

Analyzer Signal Values			
Date	2 May-24	Time	10:09:00
Power Supplies			
Opdon	0.0	mV	+5 V Sensor
+3.3 V	3.3	V	+24 V
+12 V	11.8	V	+5 V
+24 V	3.3	mV	
Optical Bench			
IR current ratio	884.7	mA	Phase current
Optical T.	46.0	deg C	Phase T.
Measure sig.	506.4	mV	Polar Sig.
Mini sig.	943.0	mV	Max Sig.
Sample			
Inst. Ratio	1.109		Ratio
Ref ratio	1.109		Internal Temp.
Source Temp.	46.0	deg C	Gas Pressure
No Pressure	947.0	nPa	Flow
			55
			1.105
			28.8
			957
			hPa
			deg C
			hPa
			l/h

Calibrate By :

Approve By :

Date: 2-May-24

Date: 2-May-24

Issued By : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 6 April, 2024 Certification No. 170/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิอากาศ

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130150 ID No. : EWSDCMS200150

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.7 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Aloft Plotting Board

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

N.I.S.T. Test Reference Number 731/241480 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-450-3TV (sensor TA-90AH)

Serial Number 110730029 (sensor 120528586)

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

STANDARD THERMOMETER : Theodor Friedrich : Qty No. 8390/034 Wet No. 8339/034

The Result of Calibration

6 April, 2024
Sensor Pressure Model TPH-1 C
Serial No. 6275
Certification No. 17024
Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1009.69	1009.1	0.49
1009.45	1009.0	0.45
1010.10	1009.6	0.50
1010.94	1010.5	0.44
1011.46	1011.0	0.46
1011.84	1011.5	0.34
1012.06	1011.6	0.46
1013.04	1012.6	0.44
1013.16	1012.7	0.48
1012.89	1012.4	0.49
1013.20	1012.8	0.40
1013.44	1013.0	0.44
1013.81	1013.4	0.41
1014.19	1013.6	0.59
1015.96	1015.5	0.46
1016.23	1015.7	0.53
1015.64	1015.2	0.44
1015.23	1014.7	0.53
1012.87	1012.3	0.57
1013.63	1013.1	0.53

The Result of Calibration

6 April, 2024
Sensor Temperature Model TPH-1 C
Serial No. 6275
Certification No. 17024
Page : 4 of 6

Standard Temp. °C	Temperature Sensor	
	Reading °C	Correction °C
45.6	45.6	0.0
30.1	30.1	0.0
15.4	15.5	-0.1

The Result of Calibration

6 April, 2024

Sensor Humidity Model TPH-1 C
Serial No. 6275

Standard Humidity % R.H.	Relative Humidity Sensor	
	Reading % R.H.	Reading Correction % R.H.
85.2	82.5	2.7
62.4	60.2	2.2
41.5	40.1	1.4

Certification No. 170/24
Page : 5 of 6

Date of Issue: 6 April, 2024

Certification No. 170/24
Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีต้อ Davis Instruments แบบ TIPPING BUCKET Product No. ได้รับการสอบเทียบกับแก้ววัดฝนแบบแก้ววง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No. 71082 และสามารถนำไปใช้ได้ มีค่าจุดต่อจนรายละเอียดของเครื่องมือ (0.2 mm/TIP)

รายงานการติดตามตรวจสอบภาพสิ่งแวดล้อมประจำปี 2566
โครงการระบบขนส่งมวลชนกรุงเทพมหานคร (ครั้งที่ 2)

บริษัท ระบบขนส่งมวลชนกรุงเทพ จำกัด (มหาชน)

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 3 October, 2023 Certification No. 341/23

Page : 1 of 5

Object : เครื่องวัดความเร็วลมอัตโนมัติ

Manufacturer : DYACON

Type : Data Logger MS-1100

Serial No. : 130152 ID No. : NWSDCMS200152

Customer :

Calibration Condition : Temperature : 25.1 °C Barometric Pressure : 1008.9 hPa

NATIONAL STANDARD WIND TUNNEL : Micromanometer Theodor Friedrichs FQV14 Serial 8310119

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

NIST Test Reference Number 731241460

Model DA-65N-3TV (Sensor TR-90AH)

Serial Number 110730028 (Sensor 120629566)

JAPAN QUALITY ASSURANCE ORGANIZATION

: Theodor Friedrichs : Dry No.8390194 Wet No. 8389504

STANDARD THERMOMETER

The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 341/23

Serial No. 1226

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER		
	Pressure mmHg	Vacuum mmHg	Velocity m/sec	Velocity m/sec	Correction m/sec	
1.00	-	-	-	0.7	0.30	
3.02	-	-	-	2.9	0.12	
5.00	-	-	-	5.0	0.00	
7.04	-	-	-	7.0	0.04	
9.02	-	-	-	9.1	-0.06	
11.01	-	-	-	11.0	0.01	
13.01	-	-	-	13.1	-0.09	
15.01	-	-	-	14.9	0.11	
17.02	-	-	-	17.0	0.02	
20.02	-	-	-	20.0	0.02	

Wind Aloft Plotting Board

US DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRECTION		TESTED WIND DIRECTION	
0		0	
90		90	
180		180	



The Result of Calibration

Sensor Temperature Model TPH-1 C Certification No. 341/23
2 October, 2023 Serial No. 6277 Page : 3 of 5

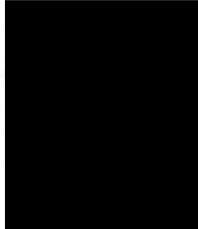
Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.2	45.2	0.0
31.1	31.2	-0.1
15.8	15.8	0.0



The Result of Calibration

Sensor Humidity Model TPH-1 C Certification No. 341/23
3 October, 2023 Serial No. 6277 Page : 4 of 5

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
86.2	82.4	-3.8
62.4	59.8	-2.6
45.6	44.2	-1.4



Request No. 21-6770391

MTC No. FEL BP 3000467

CALIBRATION CERTIFICATE

Submitted by

Address

Calibrated at

Certification No. 341/23

Page: 5 of 5

Date of Issue 2 October, 2023

ใบรับรอง

Instrument Calibrated :

[illegible]

Manufacturer : Bruel & Kjaer

Model : 4230

Serial No. : 1351075

Ambient Environment

Temperature
= (23 + 1) °CRelative Humidity = $(50 + 15) \%$ Ambient Pressure $-(101.325 + 1.500) \text{ kPa}$

Standards used:

1. Digital Function Synthesizer NF Electronic DE-193A S/N 122037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tammagawa TPA-303A S/N OW 2214.
4. Digital Multimeter Agilent 3440A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB30 S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N14106495.
7. Condenser Microphone B&K 4180 S/N 2840871.

Calibration Procedure: CP-102-04 based on IEC 60942:2003. The sound pressure level generated by sound calibrator under test shall be measured by standard microphones using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt : 9 Apr. 2024

Date of Calibration : 10 Apr. 2024

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

หนังสือพิมพ์ชื่อปรองว้าง เครื่องวัดน้ำ ชื่อ Davis Instruments แบบ TIPPING
BUCKET Product No. [REDACTED] ทำการสอบเทียบกันแก้ววัด
ส่วนแบบที่วาง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 19082 และปรองว้างไป [REDACTED] มีค่าคงที่ตามรายละเอียดของเครื่องวัด (0.2 mm/TIP)

Request No. 21-670391

MTC No. EEL BP. 300467

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

Acoustic Output in dB re 20µPa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Briel&Kjaer 4180	93.72	-0.28	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Briel&Kjaer 4180	994.9	-5.1	± 1.5	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Briel&Kjaer 4180	1.25	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by

Date of Calibration : 10 Apr. 2024

Date of Issue : 11 Apr. 2024

End of Certificate

The results relate only to the items
Advertising the Report/Certificate and publicity of the results except in full and

ภาคผนวกที่ 5-3
เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
ครั้งที่ 3/2566
สถานีโรงเรียนกรุงเทพคริสเตียนวิทยาลัย
สถานีโรงพยาบาลเซนต์หลุยส์
วันที่ตรวจวัดวันที่ 10-15 กุมภาพันธ์ 2567

TSP High Volume Sampler Calibration

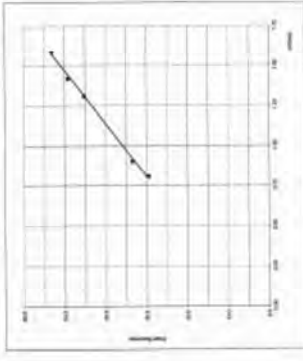
Verification Report No.
SC0400031-E001 -TSP 01

☐ PM ☒ Onsite
Site: สถานีรถไฟฟ้าหมอชิต
UTM: 47P1517352 664629
Sample: NTSF#
Recorder: ECHO994169240
Date: 10 Feb 24
Technical Approval: [Signature]

CONDITIONS	
Barometric Press. (hPa):	1002.0
Corrected Pressure (mm Hg):	751.6
Temperature (deg C):	32.0
Corrected Temperature (deg K):	305.0
Average Press. (hPa):	1013.0
Corrected Avg Press. (mm Hg):	759.8
Average Temp. (deg C):	30.0
Corrected Average Temp. (deg K):	303.0

CALIBRATION OFFICE	
Brand:	Tech Environmental, Inc
Model:	TE-5025A
Serial#:	5411
Old Scope:	2.0024
Old Intercept:	-0.00607
Date Certified:	9 Feb 24

CALIBRATIONS			
Plate or Test #	H2O (ml)	Old (m/min)	IC (corrected)
1	10.46	1.587	54.0
2	8.35	1.419	50.0
3	7.09	1.269	46.0
4	5.86	0.905	34.0
5	2.86	0.810	30.0
Linear Regression			Slope = 30.3423 Intercept = 5.4769 Corr. coeff = 0.9985
# of Observations:			5
Range of Chart			40
at 1.1 - 1.7 m/min			58



Calibrated by: [Signature]
Approved by: [Signature]
10 February 2024
10 February 2024

TSP High Volume Sampler Calibration

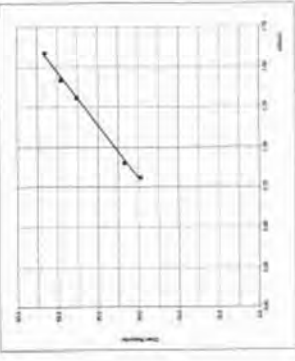
Verification Report No.
SC0400031-E001 -TSP 02

☐ PM ☒ Onsite
Site: สถานีรถไฟฟ้าหมอชิต
UTM: 47P1517371 554903
Sample: ETSF#43
Recorder: ECHANG15315224
Date: 10 Feb 24
Technical Approval: [Signature]

CONDITIONS	
Barometric Press. (hPa):	1002.0
Corrected Pressure (mm Hg):	751.6
Temperature (deg C):	32.0
Corrected Temperature (deg K):	305.0
Average Press. (hPa):	1013.0
Corrected Avg Press. (mm Hg):	759.8
Average Temp. (deg C):	30.0
Corrected Average Temp. (deg K):	303.0

CALIBRATION OFFICE	
Brand:	Tech Environmental, Inc
Model:	TE-5025A
Serial#:	5411
Old Scope:	2.0024
Old Intercept:	-0.00607
Date Certified:	9 Feb 24

CALIBRATIONS			
Plate or Test #	H2O (ml)	Old (m/min)	IC (corrected)
1	10.38	1.581	50.0
2	8.65	1.444	46.0
3	7.59	1.309	42.0
4	3.16	0.878	34.0
5	2.42	0.770	30.0
Linear Regression			Slope = 23.8016 Intercept = 11.6266 Corr. coeff = 0.9920
# of Observations:			5
Range of Chart			39
at 1.1 - 1.7 m/min			52



Calibrated by: [Signature]
Approved by: [Signature]
10 February 2024
10 February 2024

PM10 High Volume Sampler Calibration

Verification Report No.
SC2400031-E001 -PM 01

PM

Onsite

Site: สถานีหมอชิต

UTM: 47P 1517262 664629

Sampler: NPM#12

Recorder: ECHO501818124

Date: 10 Feb 24

Technical Approver

CONDITIONS

Barometric Press. (hPa): 1002.0
Temperature (deg C): 32.0
Average Press. (hPa): 1002.0
Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 753.6
Temperature (deg K): 309.0
Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

CALIBRATION OFFICE

Brand: Tech Environmental, Inc
Model: TE-5025A
Serial#: 5411

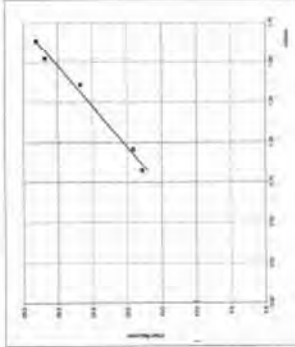
Slope: 1.26504
Intercept: -0.01677
Date Certified: 9 Feb 24

CALIBRATIONS

Plate or Test #	H2O (in)	Gas (ml/min)	I (chart)	IC (corrected)
1	10.45	1.641	50.0	31.13
2	9.02	1.526	45.0	28.85
3	7.15	1.360	40.0	26.16
4	5.32	0.895	30.0	18.11
5	2.55	0.824	20.0	17.94

LINEAR REGRESSION

Slope = 19.6912
Intercept = 0.8926
Corr. coeff = 0.9904
SFR = 1.190
SSP = 36.95
of Observations: 5
Range of Chart at SFR $\pm 10\%$: 34 46



Calibrated by: [Redacted]

Approved by: [Redacted]

10 February 2024

10 February 2024

PM10 High Volume Sampler Calibration

Verification Report No.
SC2400031-E001 -PM 02

PM

Onsite

Site: สถานีหมอชิต

UTM: 47P 1517271 554603

Sampler: EPM#24

Recorder: ECHO501818125

Date: 10 Feb 24

Technical Approver

CONDITIONS

Barometric Press. (hPa): 1004.0
Temperature (deg C): 34.0
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 753.1
Temperature (deg K): 307.0
Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

CALIBRATION OFFICE

Brand: Tech Environmental, Inc
Model: TE-5025A
Serial#: 5411

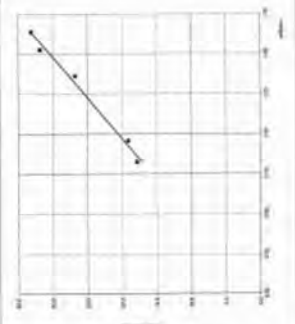
Slope: 1.26504
Intercept: -0.01677
Date Certified: 9 Feb 24

CALIBRATIONS

Plate or Test #	H2O (in)	Gas (ml/min)	I (chart)	IC (corrected)
1	10.09	1.616	50.0	31.92
2	8.60	1.493	46.0	29.37
3	6.03	1.342	40.0	25.54
4	3.42	0.947	30.0	19.15
5	2.48	0.808	20.0	17.68

LINEAR REGRESSION

Slope = 17.5114
Intercept = 3.0364
Corr. coeff = 0.9902
SFR = 1.155
SSP = 36.44
of Observations: 5
Range of Chart at SFR $\pm 10\%$: 34 30



Calibrated by: [Redacted]

Approved by: [Redacted]

10 February 2024

10 February 2024

Verification Test Report

Report No.:
SO2400031-E001-SLM 01

☐ PM

☒ Onsite UTM

47P 1517396 64660

Calibrated Date: 10 February 2024
Site : โรงเรียนกรุงเทพคริสเตียน

Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 2199

Environment: Temperature 25 °C Humidity 72 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230 Bruel&Kjaer
Serial No. 1351075
Date of Calibration : 16 March 2023

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.57	-0.21	93.78

Calibrated By:

Date: 10 February 2024

Approve By:

Date: 10 February 2024

Verification Test Report

Report No.:
SO2400031-E001-SLM 02

☐ PM

☒ Onsite UTM

47P 1517254 664907

Calibrated Date: 10 February 2024
Site : โรงเรียนบางเขนวิทย

Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1988

Environment: Temperature 25 °C Humidity 72 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230 Bruel&Kjaer
Serial No. 1351075
Date of Calibration : 16 March 2023

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.52	-0.26	93.78

Calibrated By:

Date: 10 February 2024

Approve By:

Cal. Date: February 9, 2024
Operator:
Calibration Model #: TE-5025A

Rootmeter S/N: 438320
Calibrator S/N: 5411

Tax: 295
Pa: 749.0
mm Hg

°K

Run

Vol. Init
(m3)

Vol. Final
(m3)

ΔVol.
(m3)

ΔTime
(min)

ΔP
(mm Hg)

ΔH
(in H2O)

1

1

2

1

1.3950

3.2

2.00

2

3

4

1

0.9840

6.4

4.00

3

5

6

1

0.8790

7.9

5.00

4

7

8

1

0.8435

8.8

5.50

5

9

10

1

0.6940

12.7

8.00

Data Tabulation

Vstd
(m3)

Qstd
(pascals)

$\sqrt{\frac{P_a \times V_{std}}{P_{std} \times V_a}}$
(y-axis)

Va
(pascals)

Qa
(y-axis)

$\sqrt{\frac{\Delta H(T_a/P_a)}{\Delta H(T_{std}/P_{std})}}$
(y-axis)

0.9914

0.7106

1.4111

0.8957

0.7138

0.8875

0.9871

1.0092

1.9956

0.9935

1.0076

1.2551

0.9851

1.1207

2.2311

0.9895

1.1257

1.4033

0.9839

1.1672

2.3401

0.9883

1.1723

1.4718

0.9787

1.4103

2.8221

0.9830

1.4165

1.7750

QSTD

m=

b=

r=

QA

m=

b=

r=

2.02024

-0.02667

0.99993

1.26504

-0.01677

0.99993

Calculations

Vstd=ΔVol[(Pa·ΔP)/Pstd]/(Tstd/Ta)
Qstd=Vstd/ΔTime

Va=ΔVol[(Pa·ΔP)/Pa]
Qa=Va/ΔTime

For subsequent flow rate calculations:

$Qstd = 1/m \left(\sqrt{\frac{P_a}{P_{std}}} \times \frac{V_{std}}{V_a} \right) - b$
 $Qa = 1/m \left(\sqrt{\frac{\Delta H(T_a/P_a)}{\Delta H(T_{std}/P_{std})}} \right) - b$

Standard Conditions

1std

298.15 °K

Key

ΔH: calibrator manometer reading (in H2O)

ΔP: rootmeter manometer reading (mm Hg)

Va: actual absolute temperature (°K)

Pa: actual barometric pressure (mm Hg)

b: intercept

m: slope

760 mm Hg

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

Certificate of Calibration

Certificate No. : 67-200034-1

Submitted by :

Equipment : Electronic Balance

Environment :

Manufacturer : Satorius

Serial No. : 0034803270

Capacity : 220 g

Ambient Temperature : (22.8 to 23.6) °C

Relative Humidity : (44.6 to 45.3) %

Air Pressure : 1014.0 mbar

Model : SECURA224-IS

ID No. : ELABBALANCEN04

Resolution : 0.0001 g

Date of Received : 01 February 2024

Date of Calibration : 01 February 2024

Date of Issue : 06 February 2024

Calibrated by : Akaradith Thippichai

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref: LAB 14 Edition 7 - November 2022

Reference Standard Instruments : This certification is traceable to the International System of Units

Standard Weights

ID No.

Cert. No.

Due Date

Traceability

E261-E2624

C02232088

08 Nov 2024

National Institute of Metrology (Thailand), (NIMT)

Page : 1 of 2

Certificate of Calibration

Certificate No. : 67-200034-1

Result of Calibration : Without Adjustment

UVC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty ± (g)
0.01	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00038

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

This 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%.



Eccentric error	Load test	50 g	A	B	C	D	E
			-0.0001	-0.0001	-0.0001	0.0000	0.0000

Repeatability	Load test	200 g	g
	Stddev	0.00005	g

CERTIFICATE OF ANALYSIS
Grade of Product: EPA PROTOCOL STANDARD

Customer:

Part Number: EPO162267
Cylinder Number: 124 Painsleville - PA
Lot Number: A1202
PGVP Number: CO.NO.XOX.S02.BALN
Gas Code:

Reference Number: 160-402835-487-1
Cylinder Volume: 144.0 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 550
Certification Date: Mar 31, 2023
Expiration Date: Mar 31, 2028

Calibration performed in accordance with EPA Transmittance Method for Assay and Certificate of Gas Analysis Standards (May 2017) accurate EPA
method. The results are based on the standard uncertainty of 1.0%. There are no significant impurities which affect the gas of this cylinder. The results are
uncertainty as stated below with a confidence level of 95%. The results are only valid for the use of this cylinder. The results are not valid for
metals. The results are only valid for the use of this cylinder. The results are only valid for the use of this cylinder. The results are only valid for the use of this cylinder.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Date
NOX	45.00 PPM	46.50 PPM	G1	+/- 1.4% NIST Traceable	03/24/2023, 03/31/2023
NITRIC OXIDE	45.00 PPM	46.50 PPM	G1	+/- 1.4% NIST Traceable	03/24/2023, 03/31/2023
SULFUR DIOXIDE	45.00 PPM	45.50 PPM	G1	+/- 1.0% NIST Traceable	03/24/2023, 03/31/2023
CARBON MONOXIDE	4500 PPM	4507 PPM	G1	+/- 1.4% NIST Traceable	03/24/2023
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NITROGEN	210807-22	C279687	49.41 PPM NITROGEN DIOXIDE/NITROGEN	+/- 1.7%	Sep 21, 2025
NOX	0306	0807880	50.1 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.3%	Feb 22, 2022
NOX	0306	0807880	50.1 PPM NITROGEN DIOXIDE/NITROGEN	+/- 2.3%	Feb 22, 2022
NITROGEN	160110-01	C0473186	49.50 PPM SULFUR DIOXIDE/NITROGEN	+/- 2.3%	Feb 21, 2025
NOX	072125220109	180141209	50.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.2%	Dec 31, 2028
CO	200008	C2744166	2501.8 PPM CARBON MONOXIDE/NITROGEN	+/- 0.1%	Sep 30, 2028

Instrument Make/Model	Analytical Principle	Last Multi-point Calibration
SIEMENS ULTRAMAT 6 N1R2079	NDIR	Mar 07, 2023
NOVA 850 FTIR ALP2010245 NQ	FTIR	Mar 09, 2023
NOVA 850 FTIR ALP2010245 NQ2	FTIR	Mar 23, 2023
Accel 550 FTIR ALP2010245 S02	FTIR	Mar 16, 2023

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-58702002
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer	Manufacturer API
Model: T100	S/N: ESCAT10002034

Page:12

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA NGC5101	NOx Conc 45.50 PPM
S/N: 792	NO Conc 45.50 PPM
ZERO AIR Generator ZAG7001	SO2 Conc 43.98 PPM
S/N: 644	CO Conc 4500 PPM
Expire Date: Mar 31, 2026	EB0160267

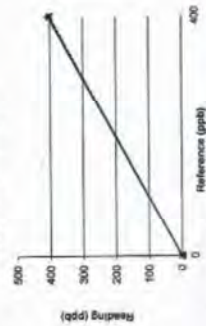
Humidity: 64 %RH

Environment: Temperature: 26.9 °C

Calibration Report

Status	Zero		Span	
	Reference (ppb)	Reading (ppb)	Reference (ppb)	Drift%
Before	0.0	0.5	400.0	0.6
After	0.0	0.1	401.0	0.1

Single Point Calibration Chart



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-58702002
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Page:22

Date	Time	1-Feb-24	11:50				
Range	50 - 20000	PPB	500				500
Stability (Zero Gas)	± 0.2	PPB	0.5				0.2
Sample Flow	650 (± 50)	cc/min	650				619
PMT Detector	0 - 5000	mV	34.7				26.4
Norm PMT Detector	0 - 5000	mV	44.0				25.9
WPPS	400-800 constant	V	723				723
DCPS	2500 (± 200)	mV	-				-
RGCELL TEMP	50 (± 1)	Dragees C	50				50
BOX TEMP	30-40	Dragees C	35.5				33.8
PMT TEMP	7 (± 1)	Dragees C	8.0				8.0
UV Lamp	1000-4000	mV	2132.0				2132.0
Lamp Ratio	30-120	%	114.0				114.0
STR Light (Zero Gas)	4100	PPB	19				19
Dark PMT	(-50) - (-200)	mV	64.5				64.5
Dark Lamp	(-50) - (-200)	mV	-15.1				-15.1
SAMP PRES	20-30 constant	IN-Hg-A	27.4				27.6
PMT Vols	2000 (± 500)	mV	2012				2008
SO2 Conc	1000 (± 250)	PPB	1000				1004
SO2 Slope	1 (± 0.3)	-	0.959				0.959
SO2 Offset	± 250	mV	30.3				1
Stability at Zero	± 0.2	PPB	0.1				17.7
Stability at Span	± 2 ppb @ 400 ppb	PPB	0.5				0.2
Zero Gas (0.00 PPB)	0	ppb	0.5				0.1
Span Gas (400 PPB)	400	ppb	405.0				401.0
							± 5% of Range

Calibrate By : _____

Approve By : _____

Date: 1-Feb-24

Date: 1-Feb-24

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6702004

Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer	Manufacturer API
Model: 100E	S/N: ESOA100ED1225

Page:1/2

Calibration System

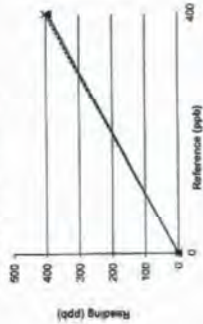
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NOx Conc 48.50 PPM
S/N: 782	NO Conc 48.50 PPM
ZERO AIR Generator ZAG7001	SO2 Conc 43.99 PPM
S/N: 644	CO Conc 4507 PPM
Expire Date: Mar 31, 2026	EB0160267

Environment: Temperature 26.6 °C Humidity 82 %RH

Calibration Report

Status	Zero		Span	
	Reference (ppb)	Reading (ppb)	Reference (ppb)	Drift's (ppb)
Before	0.0	0.9	400.0	-0.8
After	0.0	0.6	400.0	0.2

Single Point Calibration Chart



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6702004

Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Page:2/2

Date	1-Feb-24
Time	13:10
Range	50 - 2000
Stability (Zero Gas)	PPB
Sample Flow	< 0.2
PMT Detector	650 (+/- 50)
Norm PMT Detector	38.5
mV	34.5
Norm PMT Detector	34.1
mV	32.8
WPS	648
DCPS	400-900 constant
2500 (+/- 200)	-
RCCELL TEMP	mV
50 (+/- 1)	-
BOX TEMP	Dragee C
34.1	50
PMT TEMP	Dragee C
7 (+/- 1)	32.7
UV Lamp	8.0
1000-4000	4034.0
Lamp Ratio	mV
30-120	114.0
STR Light (Zero Gas)	%
<100	28
Dark PMT	PPB
(-50) - (-200)	44.7
Dark Lamp	mV
(-50) - (-200)	5.1
SAMP PRES	28.1
20-30 constant	27.8
PMF Value	2004
2000 (+/- 200)	2020
SO2 Conc	mV
1000 (+/- 250)	1002
SO2 Slope	1 (+/- 0.3)
SO2 Offset	85
Stability at Zero	mV
< 0.2	130.1
Stability at Span	PPB
< 2 ppb @ 400 ppb	0.1
Zero Gas (0.00 PPB)	0.6
Span Gas (400 PPB)	0.8
400	394.0
± 5% of Range	402.0

Calibrate By :

1-Feb-24

Approve By :

1-Feb-24

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702002
Calibrated Date: 1-Feb-24
Page: 1/1

	PM	Onsite
<input checked="" type="checkbox"/>	<input type="checkbox"/>	

Instruments Information

Analyzer Type: NO/NO ₂ /NO _x Analyzer Model: 200E	Manufacturer API S/N: EN0AIZ00E01526
--	---

Calibration System

Generator / System	Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101		NOx Conc 48.50 PPM
S/N: 792		NO Conc 48.50 PPM
ZERO AIR Generator ZAG7001		SO2 Conc 45.59 PPM
S/N: 944		CO 4507 PPM
		Expire Date: Mar 31-2025
		EB0160267

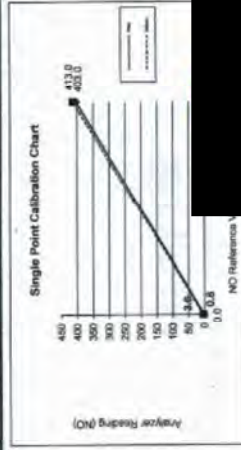
Environment: Temperature 26.6 °C Humidity 64 %RH

Calibration Check (Before adjust)

GAS	Zero		Span		Drift%
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)	
NO	2.8	0.0	410.0	400.0	1.2
NO ₂	0.8	0.0	0.8	0.0	0.4
NO _x	3.6	0.0	413.0	400.0	1.6

Calibration Check (After adjust)

Calibration Check (After adjustment)		Zero		Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift (%)
GAS						
NO	0.4	0.0	0.4	401.0	400.0	0.1
NO ₂	0.4	0.0	0.4	2.0	0.0	0.2
NO _x	0.8	0.0	0.8	403.0	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N8702002
Calibrated Date: 1-Feb-24
Page: 1/1

	PM	Onsite
✓	<input checked="" type="checkbox"/>	<input type="checkbox"/>

Page: 2/2

Date		1-Feb-24			
Time		13:30			
Range		0.00 - 500.00 PPB			
Stability (Zero Gas)		± 0.2		PPB	500.0
Sample Flow		500ml ± .50		PPB	0.8
Ozone Flow		103-90		column	470.0
				column	870.0
				column	76.0
SWT Detector		0.5000		mV	19.6
AZZERO		20-160		mV	11.7
14PDS		400-800 constant		V	714.0
DCPS		2500 ± 200		mV	-
RGCELL TEMP		50±1.1		Dreogan C	50.3
RCK TEMP		20-35		Dreogan C	28.0
PMT TEMP		7 ±1.1		Dreogan C	7.7
L2S TEMP		50±1.4		Dreogan C	-
MOLY Temp		315 ±1.5		Dreogan C	315.0
RGCEL PHES		4-10 constant		7.30	7.30
SAMP PRES		20-200 constant		B4-Hg-A	31.4
				B4-Hg-A	31.3
N2O Slope		1 ±1 0.3		0.647	0.663
Next Slope		1 ±1 0.3		0.652	0.640
N2O Offset		10 to + 150		mV	8.60
N2O Offset		10 to + 150		mV	24.10
					12.70
Zero Value	NO	0		ppb	0.4
Span Value	NOx	0		ppb	0.8
Span Value	NO	400		ppb	401.0
Span Value	NOx	600		ppb	403.0

Calibrate By

Approve By : _____

Date: 1-Feb-24

1-Feb-24

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702001

Page:1/1

Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NONOX2NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT2002469
--	--

Calibration System

Calibrator Unit Dilutor Model ESA MGC101 S/N: 702 ZERO AIR Generator ZAG7001 S/N: 644	Standard Gas NOx Conc 48.50 PPM NO Conc 48.50 PPM SO ₂ Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31,2025 EBO160287
---	---

Environment: Temperature 24.7 °C Humidity 55 %RH

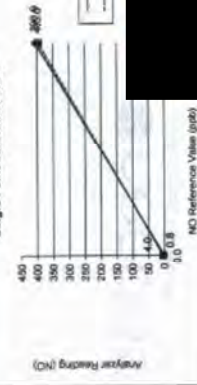
Calibration Check (Before adjust)

GAS	Zero		Span		Drift%
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)	
NO	2.7	0.0	396.6	400.0	-1.7
NO ₂	1.3	0.0	9.4	0.0	1.2
NOx	4.0	0.0	399.0	400.0	-0.5

Calibration Check (After adjust)

GAS	Zero		Span		Drift%
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)	
NO	0.6	0.0	403.0	400.0	0.4
NO ₂	0.2	0.0	2.0	0.0	0.2
NOx	0.8	0.0	405.0	400.0	0.6

Single Point Calibration Chart



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6702001

Page:1/1

Calibrated Date: 1-Feb-24

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Test Function Value		Measured Range	Unit	Before	After	Note
Date		1-Feb-24				
Time		13:30:07 AM				
Range		0.00 - 500.00 PPM	PPM	500	500	
Stability (Zero Gas)		< 0.2	PPM	0.5	0.2	
Sample Flow		500 +/- 50	cc/min	505	480	
Carrier Flow		60-80	cc/min	79	72	
AMT Detector		0-5000	mV	26.2	29.3	
AZTRIO		0-5100	mV	56.0	55.0	
MYPS		400-800 constant	V	735	755	
DOPS		2500 +/- 200	mV	-	-	
ICECL TEMP		50 +/- 1	Degrees C	50	50	
BOX TEMP		20-35	Degrees C	30.2	32.0	
PMI TEMP		7 +/- 1	Degrees C	7.2	7.2	
GSZ TEMP		50 +/- 4	Degrees C	-	-	
MCILY Temp		315 +/- 5	Degrees C	315.0	315.0	
ICECL PRES		4.10 constant	IN-HgA	4	5	
RAMP PRES		20-30 constant	IN-HgA	29	29	
NO Scope		1 +/- 0.3		0.890	1.118	
NO ₂ Scope		1 +/- 0.3		0.811	1.048	
NO Offset		10 to + 150	mV	12.9	2.2	
NOx Offset		-10 to + 150	mV	-2.4	9.1	
Span and Cal Value						
Zero Value		0	ppb	2.7	0.6	
NO ₂ Value		0	ppb	4.0	0.8	
Span Value		400	ppb	396.6	403.0	
NOx Value		400	ppb	399.0	405.0	

Calibrate By:

Approve By:

Date: 1-Feb-24

Date: 1-Feb-24

CO Analyzer Verification Test Report

Calibration Report No.: ES-C5702004

Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: CO Analyzer	Manufacturer: Environment SA, France
Model: CO12E	SIN: EC0ESAO012E204

Calibration System

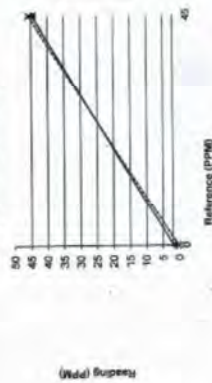
Calibrator Unit	Standard Gas
Dilutor Model ESA MGCT01	NOx Conc 45.50 PPM
SIN: 792	NO Conc 45.50 PPM
ZERO AIR Generator ZA37001	SO ₂ Conc 45.59 PPM
SIN: 644	CO Conc 4507 PPM
Expire Date: Mar 31, 2026	EB0160267

Environment: Temperature 27.2 °C Humidity 88 %RH

Calibration Report

Status	Reference (ppm)	Reading (ppm)	Drift (ppm)	Reference (ppm)	Span Reading (ppm)	Drift (%)
Before	0.0	1.765	1.8	45.0	44.67	-0.4
After	0.0	0.354	0.4	45.0	45.77	0.8

Single Point Calibration Chart



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C5702004

Calibrated Date: 1-Feb-24

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Date	1-Feb-24	Time	10:09:00
Option	0.0	mV	+5 V Sensor
+3.3 V	3.3	V	+24 V
+12 V	11.8	V	+5 V
+24 V	1.1	mV	
IR current mV	884.7	mA	Pulse current
Optical T.	46.0	deg C	Pose T.
Measure sig.	506.4	mV	Refer Sig.
Min sig.	945.0	mV	Max Sig.
Inst. Ratio	1.109		Ratio
Ref. mV	1.109		Internal Temp.
Source Temp.	46.0	deg C	Gas Pressure
Up Pressure	947.0	hPa	Flow

Calibrate By :

Date:

Approve By :

Date:

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6702003
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type	Model	Manufacturer	Environment
CO Analyzer	CO12E	ECOESACO12E205	SA, France

Page:1/2

Calibration System

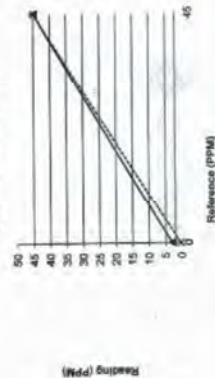
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 40.50 PPM NO Conc 40.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM
ZERO AIR Generator ZAG7001 S/N: 644	Expire Date: Mar 31 2026 EBO160267

Environment: Temperature 27.2 °C Humidity 67 %RH

Calibration Report

Status	Reference (ppm)	Reading (ppm)	Drift (ppm)	Reference (ppm)	Reading (ppm)	Drift (%)
Before	0.0	2.985	3.0	45.0	44.95	0.0
After	0.0	0.397	0.4	45.0	45.02	0.0

Single Point Calibration Chart



CO Analyzer Verification Test Report

Calibration Report No.: ES-C6702003
Calibrated Date: 1-Feb-24

☒ PM ☐ Onsite

Page:2/2

Date	1-Feb-24	Time	10:09:00		
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
IR current ratio	894.7	mA	Phase current	618.2	mV
Optical T.	46.0	deg C	Phase T.	-24.2	deg C
Measure sig.	506.4	mV	Refer Sig.	458.4	mV
Min sig.	945.0	mV	Max Sig.	2640	mV
Inst. Ratio	1.109		Ratio	1.105	
Ref. ratio	1.109		Internal Temp.	28.9	deg C
Source Temp.	46.0	deg C	Gas Pressure	997	hPa
Up Pressure	947.0	hPa	Flow	59	l/h

Calibrate By : _____ Approve By : _____

Date: 1-Feb-24 Date: 1-Feb-24

Request No. 21-66/0381

MTC No. EEL BP. 700366

Submitted by

Address

Calibrated at

Instrument Calibrated :

Description : Sound Level Calibrator

Manufacturer

Model : 4230

Serial No. : 1351075

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

Standards used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

2. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

3. Programmable Attenuator Tama-gawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Keithley 2015 P S/N 4106495.

7. Condenser Microphone Brüel&Kjær 4180 S/N 2889871.

Calibration Procedure:

CP-103-04 based on IEC 60942:2003. The sound pressure level of instrument was measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the measured values only.

Date of Receipt 14 Mar. 2023

Date of Calibration 16 Mar. 2023

1/2

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

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

Request No. 21-66/0381

MTC No. EEL BP. 700366

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor k = 2, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

Acoustic Output in dB re 20µPa, Corrected to Reference Conditions : 101.325 kPa, 23.0°C and 50 %RH

1. Sound Pressure Level

Standard Microphone	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit
1/2 inch Brüel&Kjær 4180	93.78	-0.22	± 0.10	±0.40 dB

2. Frequency

Standard Microphone	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit
1/2 inch Brüel&Kjær 4180	999.0	-1.0	± 1.5	±1.0%

3. Total distortion

Standard Microphone	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit
1/2 inch Brüel&Kjær 4180	1.05	± 0.50	±3.0%

Note :

1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by

Appr

Date of Calibration 16 Mar. 2023

Date of Issue 17 Mar. 2023

End of Certificate 2/2

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

ผ5-89

Issued by : Calibration & Test Section : Meteorological Instruments Bureau
Date of Issue : 2 October, 2023
Certification No. 337/23
Page : 1 of 6

Object : เครื่องมือวัดความเร็วลม
Manufacturer : Novallynx
Type : Data Logger 110-WS-25DL-D
Serial No. : EWSNV110WS2508
Customer : [REDACTED]

Calibration Condition : Temperature : 25.1 °C Barometric Pressure : 1008.5 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 SN 91563
: HOOK GAGE NO 1425 : Wind Anemometer Board
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-650-3TV (Sensor TR-60AH)
Serial Number 110730020 (Sensor 120628686)
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec
STANDARD THERMOMETER : Teedlor Friedrich : Dry No 8390/94 Wet No 8389/94

The Result of Calibration

Sensor model : EWSNV110WS2508
Certification No. 337/23
2 October, 2023
Page : 2 of 6

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure mm-Hg	Vacuum mm-Hg	Velocity m/sec	Correction m/sec
1.00	-	-	0.4	0.60
3.02	-	-	3.0	0.02
5.00	-	-	4.7	0.30
7.04	-	-	7.0	0.04
9.02	-	-	9.7	-0.68
11.01	-	-	11.1	-0.09
13.01	-	-	12.9	0.11
15.01	-	-	15.0	0.01
17.02	-	-	16.9	0.12
20.02	-	-	20.1	-0.08

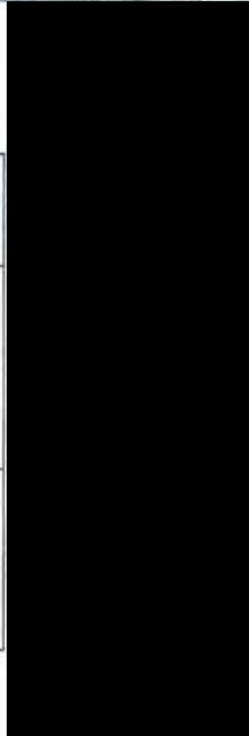
Wind Anemometer Board	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	88
180	179



The Result of Calibration

Sensor model EWSNV110WS2508
Certification No. 337/23
2 October, 2023
Page : 3 of 6

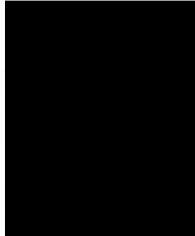
Standard Barometer Pressure	Tested Barometer Pressure	Correction
1005.63	1005.12	0.51
1006.25	1005.85	0.40
1006.22	1006.01	0.41
1006.54	1006.00	0.54
1006.66	1006.30	0.59
1007.38	1006.80	0.56
1007.56	1007.12	0.46
1007.52	1007.13	0.39
1006.60	1006.16	0.44
1006.64	1006.41	0.43
1006.28	1006.05	0.43
1006.60	1006.18	0.42
1007.07	1006.67	0.40
1007.26	1006.66	0.40
1007.38	1006.92	0.46
1005.50	1004.99	0.52
1006.83	1006.43	0.40
1006.55	1006.17	0.36
1007.31	1006.96	0.45
1007.01	1006.64	0.37



The Result of Calibration

Sensor model EWSNV110WS2508
Certification No. 337/23
2 October, 2023
Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
-45.2	45.4	-0.2
31.1	31.2	-0.1
15.8	15.9	-0.1





The Result of Calibration

2 October, 2023 Sensor model EWSNV110W/S250H Certification No. 337/23 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
86.2	81.6	-4.6
62.4	59.2	-3.2
45.6	42.8	-2.8

Calibrated



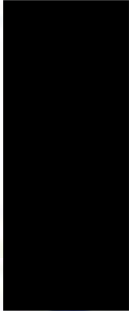
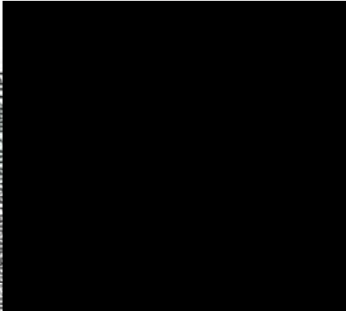
Date of Issue 2 October, 2023

Certification No. 337/23

Page: 6 of 6

ใบรับรอง

หนังสือใบนี้ขอรับรองว่า เครื่องวัดฝน ชื่อ Davi Instruments รุ่น TIPPING
BUCKET Product No. [REDACTED] ทำการสอบเทียบกันแก้ววัด
ผ่านแบบแก้ววง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 71082 และผ่านการนำไปใช้จริงได้ มีค่าถูกต้องตามความละเอียดของเครื่องวัด (0.2 mm(TIP))



Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 2 October, 2023

Certification No. 338/23

Object : เครื่องวัดความเร็วลม

Manufacturer : Novallynx

Type : Data Logger 110-WS-25DL-D

Serial No. : EWSNV110WS2509

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.8 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 SN 91563

HOOK GAGE NO 1425 : Wind Audit Plotting Board

N.I.S.T. Test Reference Number 731(24146) : Standard Velocity at 20 - 30 m/sec

Model DA-650-3TV (sensor TR-90A-1)

Serial Number 110730029 (sensor 120626568)

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

STANDARD THERMOMETER : Treasder Friedrich : Dry No. 839034 Wet No. 838934

The Result of Calibration

Sensor model : EWSNV110WS2509

Certification No. 338/23

2 October, 2023

Page : 2 of 6

Standard	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure mm Hg	Vacuum mm Hg	Velocity m/sec	Correction m/sec
1.00	-	-	0.4	0.60
3.02	-	-	2.7	0.32
5.00	-	-	4.5	0.50
7.04	-	-	7.0	0.04
9.02	-	-	9.0	0.02
11.01	-	-	11.0	0.01
13.01	-	-	13.0	0.01
15.01	-	-	15.0	0.01
17.02	-	-	17.0	0.02
20.02	-	-	20.1	-0.08

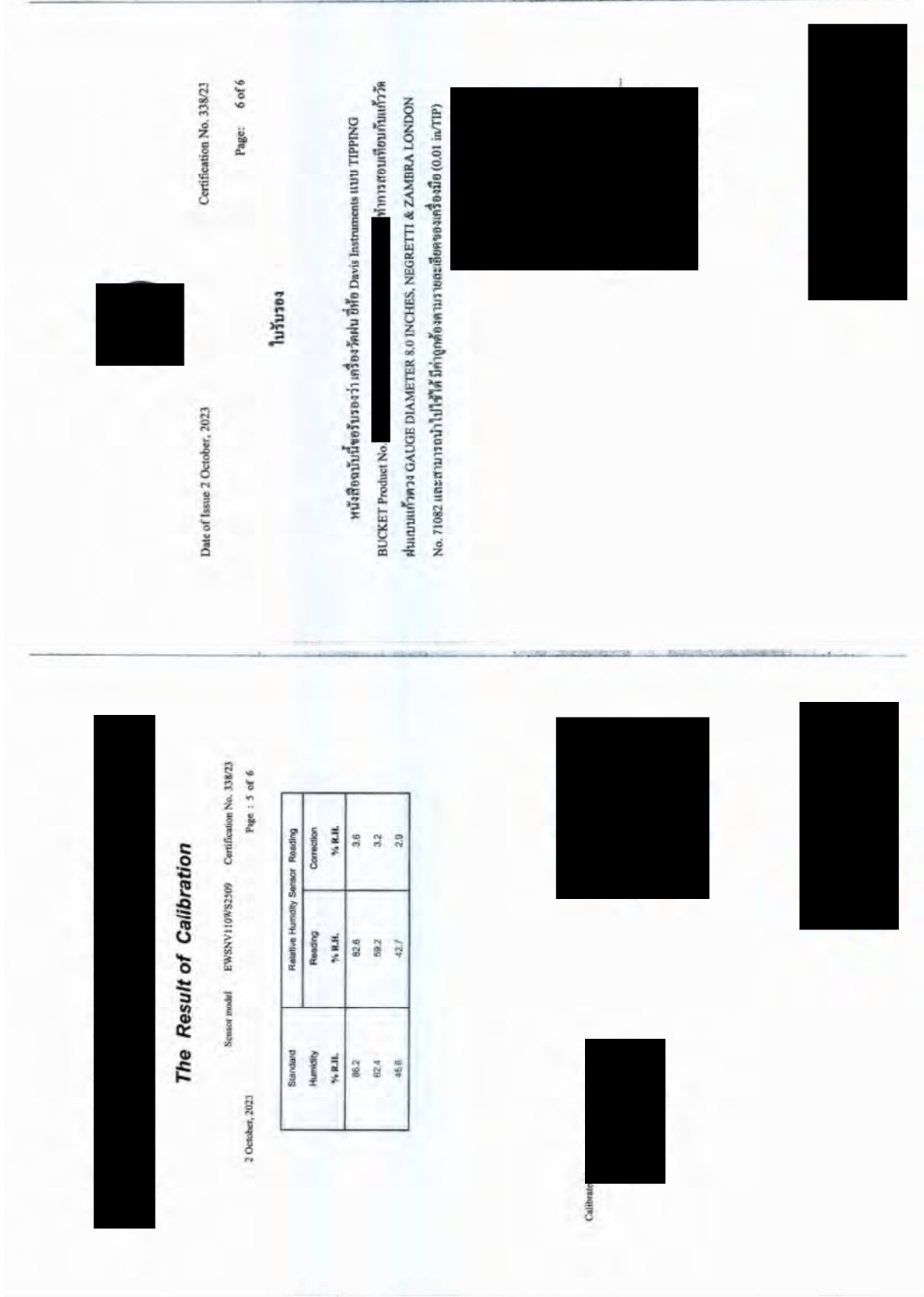
Wind Audit Plotting Board

US.DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	89
180	175

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

ผ5-93




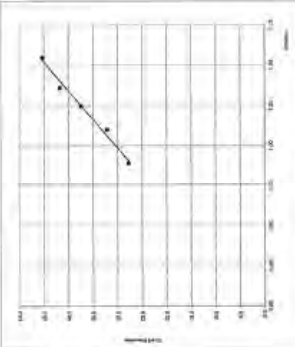


เอกสารผลการสอบเทียบเครื่องมือตรวจวัด


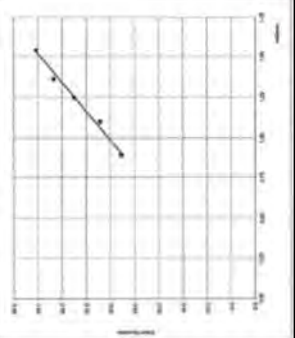
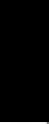

สถานีโรงพยาบาลเซนต์หลุยส์

สถานีโรงเรียนกรุงเทพคริสเตียนวิทยาลัย

ครั้งที่ 4/2566

วันที่ตรวจวัดวันที่ 4-9 พฤษภาคม 2567

TSP High Volume Sampler Calibration	
Verification Report No. SC2400116-E001-TSP-01	
<input type="checkbox"/> PM <input checked="" type="checkbox"/> Ozone	Site: กรุงเทพมหานคร UTM: 47P 1517302 644628 Sampler: ETS-PM32 Recorder: ECHAN015315274 Date: 4 May 24 Technical Approval: 
CONDITIONS Barometric Press. (hPa): 759.0 Corrected Pressure (mm Hg): 598.3 Temperature (deg C): 37.0 Corrected Avg Press. (mm Hg): 758.8 Average Temp. (deg C): 30.0	
CALIBRATION OFFICE Brand: Teich Environmental, Inc. Model: TE-5025A Serial#: 5411 Qtd Slope: 2.0024 Qtd Intercept: -0.0267 Date Certified: 9 Feb 2024	
Plots of Test #	Qtd (m3/min)
CALIBRATIONS	
1	12.63 1.545 52.0 45.37
2	9.82 1.364 46.0 41.79
3	8.20 1.247 43.0 37.44
4	5.40 1.103 37.0 32.21
5	4.20 0.856 32.0 27.66
LINEAR REGRESSION Slope = 28.2452 Intercept = 2.1419 Corr. coeff = 0.9927 # of Observations: 5 Range of Chart at 1.1 - 1.7 m3/min: 57	
	
Calibrated by:  4 May 2024	
Approved by:  4 May 2024	

TSP High Volume Sampler Calibration	
Verification Report No. SC2400116-E001-TSP-02	
<input type="checkbox"/> PM <input checked="" type="checkbox"/> Ozone	Site: กรุงเทพมหานคร UTM: 47P 1517271 554803 Sampler: ETS-PM35 Recorder: ECHAN000310372 Date: 4 May 24 Technical Approval: 
CONDITIONS Barometric Press. (hPa): 759.0 Corrected Pressure (mm Hg): 598.3 Temperature (deg C): 37.0 Corrected Avg Press. (mm Hg): 759.6 Average Temp. (deg C): 30.0	
CALIBRATION OFFICE Brand: Teich Environmental, Inc. Model: TE-5025A Serial#: 5411 Qtd Slope: 2.0024 Qtd Intercept: -0.0267 Date Certified: 9 Feb 2024	
Plots of Test #	Qtd (m3/min)
CALIBRATIONS	
1	12.60 1.543 51.0 44.40
2	10.30 1.396 45.0 38.18
3	6.70 1.128 41.0 35.70
4	4.10 0.886 33.0 28.73
5	2.10 0.638 26.0 12.64
LINEAR REGRESSION Slope = 23.1439 Intercept = 8.2473 Corr. coeff = 0.9932 # of Observations: 5 Range of Chart at 1.1 - 1.7 m3/min: 54	
	
Calibrated by:  4 May 2024	
Approved by:  4 May 2024	

PM10 High Volume Sampler Calibration

Verification Report No. SQ2400116-E001 -PM 01

PM

Onsite

Site: กรุงเทพมหานคร

UTM: 47P1517352 664629

Sampler: EPA108B1

Recorder: ECRAN00004599

Date: 4 May 24

Technical Approve

CONDITIONS

Barometric Press. (hPa): 759.0
Temperature (deg C): 37.0
Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0

CALIBRATION OFFICE

Bands: Tech Environmental, Inc.
Model: TE-5025A
Serial#: 5411

Qstd Slope: 1.2654
Qstd Intercept: -0.01667
Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H ₂ O (in)	Q ₁ (m3/min)	I (chart)	IC (corrected)
1	10.20	1.826	49.0	35.24
2	7.50	1.376	40.0	28.77
3	6.10	1.417	33.0	23.73
4	3.70	1.106	20.0	14.38
5	2.60	0.964	10.0	7.19

LINEAR REGRESSION

Slope = 31.9371
Intercept = -22.1182
Corr. coeff = 0.9944
SFR = 1.466
SSRP = 34.33
of Observations: 5
Range of Chart: 30
at SFR ±10%: 39

Calibrated by: [Redacted]

Approved by: [Redacted]

4 May 2024

PM10 High Volume Sampler Calibration

Verification Report No. SQ2400116-E001 -PM 02

PM

Onsite

Site: กรุงเทพมหานคร

UTM: 47P1517271 554603

Sampler: EPA108B

Recorder: ECRD515448814

Date: 4 May 24

Technical Approve

CONDITIONS

Barometric Press. (hPa): 754.0
Temperature (deg C): 37.0
Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0

CALIBRATION OFFICE

Bands: Tech Environmental, Inc.
Model: TE-5025A
Serial#: 5411

Qstd Slope: 1.2654
Qstd Intercept: -0.01667
Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H ₂ O (in)	Q ₁ (m3/min)	I (chart)	IC (corrected)
1	10.10	1.837	49.0	35.56
2	7.50	1.565	42.0	30.49
3	6.30	1.453	32.0	23.23
4	4.70	1.257	21.0	15.25
5	2.60	0.936	2.0	1.45

LINEAR REGRESSION

Slope = 36.2883
Intercept = -34.3250
Corr. coeff = 0.9909
SFR = 1.464
SSRP = 33.52
of Observations: 5
Range of Chart: 29
at SFR ±10%: 38

Calibrated by: [Redacted]

Approved by: [Redacted]

4 May 2024

Verification Test Report

Report No.:
SO2400116-EQ01 -SLM 01

☐ PM ☒ Onsite UTM : 47P 1517392 846803

Calibrated Date: 4 May 2024

Site : โรงเรียนเทพศิรินทร์

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1900

Environment: Temperature 34 °C Humidity 54 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230 Brüel&Kjær

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test			
Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.72	94.10	0.38	93.72

Calibrated By 4 May 2024

Date:

Approve By 4 May 2024

Date:

Verification Test Report

Report No.:
SO2400116-EQ01 -SLM 02

☐ PM ☒ Onsite UTM : 47P 1517254 864907

Calibrated Date: 4 May 2024

Site : โรงเรียนเทพศิรินทร์

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 2198

Environment: Temperature 34 °C Humidity 54 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230 Brüel&Kjær

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test			
Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.72	94.00	0.28	93.72

Calibrated By 4 May 2024

Date:

Approve By 4 May 2024

Date:

Calibration Certification Information					
Cal. Date:	February 9, 2024	Instrument S/N:	438130	Ta:	295 °K
Operator:				Po:	748.0 mm Hg
Calibration Model R:	TL-S025A	Calibrator S/N:	5411		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3950	3.2	2.00
2	2	3	1	1.9940	6.4	4.00
3	3	4	1	0.9940	6.4	4.00
4	4	5	1	0.8790	7.5	5.00
5	5	6	1	0.8430	8.8	5.50
6	6	7	1	0.6940	12.7	8.00

Data Tabulation			
Vold (m3)	Qstd (g/sec)	Qa (g/sec)	√ΔH (Pa/Pa)
0.9914	0.7106	1.4111	0.9957
0.9871	1.0032	1.9956	0.9915
0.9851	1.1207	2.2312	0.9895
0.9839	1.1872	2.9401	0.9883
0.9787	1.4103	2.8227	0.9930
QSTD	m= 2.02024	QA	m= 1.26594
	b= -0.02667		b= -0.01677
	r= 0.99993		r= 0.99993

Calculations	
Vstd = ΔVold / (Pstd - Pamb) / (Tstd / Ta)	Vstd = ΔVold / (Pstd - Pamb) / (Tstd / Ta)
Qstd = Vstd / ΔTime	Qstd = Vstd / ΔTime
For subsequent flow rate calculations:	
Qstd = Vold * (Pstd / Pamb) * (Tstd / Ta)	Qa = Vold * (Pstd / Pamb) * (Tstd / Ta)

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH:	Calibrator manufacturer's reading (in H2O)
Qstd:	Calibrator manufacturer's reading (in Hg)
Tstd:	Actual ambient temperature (°K)
Pstd:	Actual barometric pressure (mm Hg)
b:	Intercept
r:	Slope

Yach Environmental, Inc.
45 South Miami Avenue
Village of Oakes, OH 43002
www.yachenv.com
TOLL FREE: (877) 268-7610
FAX: (513) 467-9009

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, § 2.17, page 30.

Certificate of Calibration

Page: 1 of 2

Certificate No.:

67-200034-1

Submitted by:

Equipment:

Electronic Balance

Manufacturer:

Sartorius

Model:

SECURA224-1S

Serial No.:

0014803270

ID No.:

ELABBALANCE04

Capacity:

220 g

Resolution:

0.0001 g

Environment:

Ambient Temperature:

(22.8 to 23.6) °C

Relative Humidity:

(44.6 to 45.3) %

Air Pressure:

1014.0 mbar

Date of Received:

01 February 2024

Date of Calibration:

01 February 2024

Date of Issue:

06 February 2024

Calibrated by:

Calibration Method:

Edition 7 - November 2022

Reference Standard Instruments: This certification is traceable to the International System of Units

Standard Weights

ID No.

Cert. No.

Due Date

Traceability

E261-E264

C02212088

08 Nov 2024

National Institute of Metrology (Thailand), (NIMT)

Certificate of Calibration

Certificate No. : 67-200034-1

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty ± (g)
0.01	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00018

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.06$, providing a level of confidence of approximately 95%.



Excentric error	Load test : 50 g
A	B C D E
-0.0001	-0.0001 -0.0001 0.0001 0.0000 g

Repeatability	Load test : 200 g
Stdev.	: 0.00005 g

CERTIFICATE OF ANALYSIS
Grade of Product: EPA PROTOCOL STANDARD

Customer:

Part Number: E841000E15A00V3
Cylinder Number: E841000E15A00V3
Lot Number: 1244
Purity: 99.9999%
Purity Number: A12023
Gas Code: CO, NO, NO2, SO2, BALN

Reference Number: 160-020685487-1
Cylinder Volume: 144.0 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 650
Certification Date: Mar 31, 2023
Expiration Date: Mar 31, 2024

Certification performed in accordance with EPA Method 100/101 for the analysis of Carbon Dioxide, Nitrogen Dioxide, Nitrogen Monoxide, and Sulfur Dioxide. The reported values are the average of three separate analyses. The reported values are the average of three separate analyses. The reported values are the average of three separate analyses.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Assay Dates
NOX	45.00 PPM	45.50 PPM	GT	03/24/2023, 03/25/2023
NITRIC DIOXIDE	45.00 PPM	45.50 PPM	GT	03/24/2023, 03/25/2023
SULFUR DIOXIDE	45.00 PPM	45.50 PPM	GT	03/24/2023, 03/25/2023
CARBON MONOXIDE	45.00 PPM	45.50 PPM	GT	03/24/2023, 03/25/2023
NITROGEN	45.00 PPM	45.50 PPM	GT	03/24/2023, 03/25/2023
CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No.	Concentration	Uncertainty
NTSM	210607-22	CC700037	48.41 PPM NITRIC DIOXIDE/NITROGEN	±1.5%
PM	12395	D067683	4.81 PPM NITROGEN DIOXIDE/AIR	±1.2%
GAES	12406669104	CC022238	4.328 PPM NITROGEN DIOXIDE/AIR	±1.2%
NTSM	16010-01	CC047196	46.00 PPM SULFUR DIOXIDE/NITROGEN	±1.2%
GAES	07210228108	E80141208	50.00 PPM SULFUR DIOXIDE/NITROGEN	±1.8%
CO	220608	CC744188	2501.8 PPM CARBON MONOXIDE/NITROGEN	±1.0%
The above listed gases are listed as impurities in the sample and are not part of the sample.				
ANALYTICAL EQUIPMENT				
Analytical Principle				
Last Multipoint Calibration				
Mar 07, 2023				
Mar 09, 2023				
Mar 23, 2023				
Mar 16, 2023				

Triad Data Available Upon Request

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S8705006
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer	Manufacturer API
Model: 100E	S/N: ESCA110CE01226

Page: 1/2

Calibration System

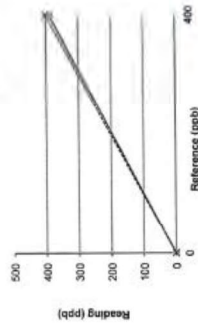
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NOx Conc 48.50 PPM
S/N: 792	NO Conc 48.50 PPM
ZERO AIR Generator ZAG7001	SO2 Conc 48.59 PPM
S/N: 644	CO Conc 4507 PPM
Expire Date: Mar 31 2026	EB0160267

Environment: Temperature 25.3 °C Humidity 55 %RH

Calibration Report

Status	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.9	0.9	400.0	390.0	+1.3
After	0.0	0.3	0.3	400.0	400.9	0.1

Single Point Calibration Chart



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S8705006
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Test Function Value	Normal range	Unit	Before	After	Note
Date	2-May-24				
Time	13:10				
Range	0.3 - 20000	PPPB	500	500	
Stability (Zer Gas)	< 0.2	PPPB	0.8	0.2	
Sample Flow	550 (+/- 50)	cc/min	663	658	
PMT Detects	0 - 5000	mV	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.6	
H2PS	400-900 constant	V	718	648	
DOPS	0 - 500 (+/- 200)	mV	-	-	
ROCELL TEMP	80 (+/- 1)	Drumage C	80	50	
BOX TEMP	30-40	Drumage C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Drumage C	8.0	8.0	
UV Temp	1000-4800	mV	4034.0	4034.0	
Lamp Ratio	36-120	%	114.0	114.0	
STR Light (Zero Gas)	<100	PPPB	29	29	
Dark PMT	4-500 (+200)	mV	44.7	44.7	
Dark Lamp	4-500 (+200)	mV	5.1	5.1	
SO2MP PRESS	0.0-30.0 constant	Hz-Hg-A	28.1	27.8	
Electric Test/Opic Test					
PMT Volls	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPPB	1002	1019	
SO2 Slope	1 (+/- 0.3)	-	0.900	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPPB	0.6	0.2	
Gas Test Responses					
Zero Gas (0.00 PPM)	0	ppb	0.8	0.3	
Span Gas (400 PPM)	400	ppb	390.0	400.9	0.5% of Range

Calibrate By : _____

Date: 2-May-24

Approve By : _____

Date: 2-May-24

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705002
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer	Manufacturer API
Model: T100	S/N: ESQA110002034

Page:1/2

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NOx Conc 45.50 PPM
S/N: 762	NO Conc 45.50 PPM
SO2 Conc 46.59 PPM	
CO Conc 4500 PPM	
S/N: 644	
ZERO AIR Generator ZAG7001	
Expire Date: Mar 31, 2025	E30160287

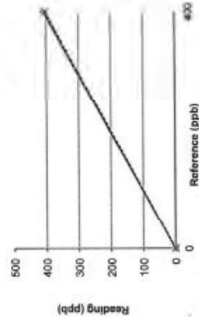
Environment: Temperature: 25.4 °C

Humidity: 55 %RH

Calibration Report

Status	Reference (ppb)	Reading (ppb)	Drift (ppb)	Span Reference (ppb)	Span Reading (ppb)	Drift%
Before	0.0	1.5	1.5	400.0	405.0	1.0
After	0.0	0.3	0.3	400.0	402.5	0.3

Single Point Calibration Chart



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705002
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Test Function Value	Nominal range	Unit	Before	After	Note
Date	2-May-24				
Time	11:50				
Range	50 - 20000	PPM	500	500	
Stability (Zero Gas)	± 0.2	PPM	0.5	0.2	
Sample Flow	500 (±1-350)	column	650	619	
PMT Detector	1 - 5000	mV	34.7	26.4	
Norm PMT Detector	0 - 5000	mV	44.0	25.9	
HYPS	400-900 constant	V	72.5	72.3	
ICPDS	200 (±1-200)	mV	-	-	
ICPDS TEMP	50 (±1-1)	Drumage C	50	50	
BOX TEMP	20-40	Drumage C	35.5	33.9	
PMT TEMP	7 (±1-1)	Drumage C	8.0	8.0	
UV Lamp	1000-4800	mV	2132.0	2132.0	
Lamp Ratio	50-120	%	114.0	114.0	
STR Light (Zero Gas)	100	PPM	19	19	
Dark PMT	±0.01 - (±0.03)	mV	64.5	64.5	
Dark Lamp	±0.01 - (±0.03)	mV	-15.1	-15.1	
SAMP PREES	20-30 constant	PPM-ppm	27.4	27.4	
Electric Test/Optic Test					
PMT Value	2012 (±1-500)	mV	2012	2006	
SO2 Conc	1000 (±1-250)	PPM	1006	1004	
SO2 Slope	1 (±1-0.3)	-	0.859	0.855	
SO2 Offset	± 250	mV	30.3	1	
Stability at Zero	± 0.2	PPM	0.1	0.2	
Stability at Span	± 2 ppm @ 100 ppm	PPM	0.3	0.2	
Gas Test Management					
Zero Gas (0.00 PPM)	18	ppb	1.5	0.3	
Span Gas (400 PPM)	400	ppb	406.0	402.5	± 5% of Range

Calibrate By:

Date: 2-May-24

Approve By:

Date: 2-May-24

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6705002
Calibrated Date: 2-May-24

Page:1/1

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NOINO2NOx Analyzer	Manufacturer API
Model: 200E	S/N: ENCAU200E00579

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGCT01	NOx Conc 48.50 PPM
S/N: 782	NO Conc 48.50 PPM
ZERO AIR Generator ZAG7001	SO2 Conc 45.59 PPM
S/N: 644	CO Conc 4507 PPM
Expire Date: Mar 31, 2026	ES0160267

Environment: Temperature: 25.2 °C Humidity: 55 %RH

Calibration Check (Before adjust)

Gas	Zero		Span		Drift%
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)	
NO	5.5	0.0	410.0	400.0	1.2
NO ₂	0.8	0.0	3.0	0.0	0.4
NOx	6.3	0.0	413.0	400.0	1.6

Calibration Check (After adjust)

Gas	Zero		Span		Drift%
	Reading Value (ppb)	Expected Value (ppb)	Reading Value (ppb)	Expected Value (ppb)	
NO	0.7	0.0	406.0	400.0	0.7
NO ₂	0.6	0.0	3.0	0.0	0.4
NOx	1.3	0.0	409.0	400.0	1.1

Single Point Calibration Chart



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6705002
Calibrated Date: 2-May-24

Page:1/1

☒ PM ☐ Onsite

Test Function Value	Normal range	Unit	Before	After	Note
Time	13:25				
Range	0.00 - 500.00 PPM	PPM	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPM	0.5	0.2	
Sample Flow	500±1.50	cc/min	474.0	441.0	
Carrier Flow	60-80	cc/min	76.0	76.0	
PMT Detector	0-5000	nV	24.5	62.2	
AVERNO	20-150	nV	8.6	87.3	
AVRIS	400-500 constant	V	839.0	838.0	
OCVTS	2000 ±1.20%	nV	-	-	
OCVCL TEMP	50±1.1	°C	50.0	50.0	
OCVTEMP	30-35	°C	34.2	30.6	
PAT TEMP	7 ±1.1	°C	7.0	7.1	
OCVCL Temp	50±1.4	°C	-	-	
OCVCL FUEL	315 ±1.5	°C	313.0	314.4	
OCVCL FUEL	4-10 constant	ppm-A	4.20	7.90	
OCVCL FUEL	20-50 constant	ppm-A	28.9	28.6	
NO Slope	1 ±1.0.3		1.256	1.032	
NO Slope	1 ±1.0.3		1.202	1.048	
NO Offset	-10 to +150	nV	4.50	6.90	
NOx Offset	-10 to +150	nV	-3.00	-1.50	

Calibrate By:

Approve By:

Date: 2-May-24

Date: 2-May-24

NOx Analyzer Verification Test Report

Calibration Report No.: AP-NET/05003
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NGRNO2NOx Analyzer Model: T200	Manufacturer AFI SIN: ENCAIT2000108
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Calibration System

Dilutor Model: ESA MGIC101 SIN: 712	Standard Gas NOx Conc: 48.50 PPM
ZERO AIR Generator: ZAG7001 SIN: 644	NO Conc: 48.50 PPM
	SO2 Conc: 45.59 PPM
	CO Conc: 4507 PPM
	Expire Date: Mar 31, 2026
	EB0190267

Environment: Temperature: 26.1 °C Humidity: 55.0 %RH

Calibration Check (Before adjust)

GAS	Zero				Span			
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Drift%	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Drift%
NO	2.5	0.0	2.5	-1.1	391.0	400.0	-9.0	-2.3
NO ₂	0.4	0.0	0.4	0.4	3.0	0.0	3.0	0.4
NOx	2.9	0.0	2.9	-0.8	394.0	400.0	-6.0	-1.5

Calibration Check (After adjust)

GAS	Zero				Span			
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Drift%	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Drift%
NO	0.5	0.0	0.5	0.4	403.0	400.0	3.0	0.7
NO ₂	0.2	0.0	0.2	0.2	2.0	0.0	2.0	0.2
NOx	0.7	0.0	0.7	0.6	405.0	400.0	5.0	1.2



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-NET/05003
Calibrated Date: 2-May-24

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Test Function Value	Nominal range	Unit	Before	After	Note
Cells	2-May-24				
Time	NO ₂				
Range	0.00 - 500.00 PPM	PPM	500	500	
Stability (Zero Gas)	± 0.2	PPM	0.5	0.2	
Sample Flow	500±50	cc/min	511	532	
Drifts Flow	100-90	cc/min	80	80	
PMT Detector	0-5000	mV	27.4	16.4	
NO ₂ Offset	20-150	mV	54.2	54.2	
NO ₂ Span	400-600 constant	V	819	818	
NO ₂ Offset	2500 ± 200	mV	-	-	
NO ₂ Span	50±1	Druggose C	50	50	
NO ₂ Temp	20-35	Druggose C	30.7	32.9	
NO ₂ Temp	7 ± 1	Druggose C	7.1	7.2	
NO ₂ Temp	50±4	Druggose C	-	-	
NO ₂ Temp	315 ± 5	Druggose C	314.4	315.0	
NO ₂ Temp	4-10 constant	NO ₂ Span	10	10	
NO ₂ Temp	20-30 constant	NO ₂ Span	29.0	29.4	
NO ₂ Temp	1 ± 0.3	NO ₂ Span	0.850	0.851	
NO ₂ Temp	1 ± 0.3	NO ₂ Span	0.848	0.813	
NO ₂ Temp	10 to 150	mV	10.2	10.3	
NO ₂ Temp	10 to 150	mV	-2.0	-1.4	
Span and Cal Values					
Span Value	NO	ppb	2.5	0.5	
Span Value	NO ₂	ppb	2.8	0.7	
Span Value	NO	ppb	391.0	403.0	
Span Value	NO ₂	ppb	394.0	405.0	

Calibrate By:
Date: 2-May-24

Approve By:
Date: 2-May-24

CO Analyzer Verification Test Report

Calibration Report No.: TD-C6705004
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: CO Analyzer	Manufacturer API
Model: T300	SIN: ECOAT3000058

Page:1/2

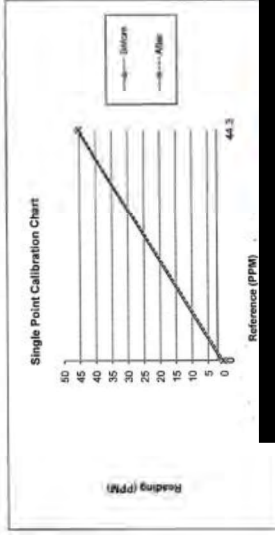
Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA TGA101	NOx Conc 45.50 PPM
S/N: 782	NO Conc 45.50 PPM
ZERO AIR Generator ZAG7001	SO ₂ Conc 45.59 PPM
S/N: 644	CO Conc 4507 PPM
Expire Date: Mar 31, 2026	EB0160287

Environment: Temperature 25.5 °C Humidity 55 %RH

Calibration Report

Status	Reference	Reading	Drift	Reference	Span
Before	0.0	0.9	0.9	44.3	45.2
After	0.0	0.2	0.2	45.6	45.2
					Drift%
					1.6
					-0.4



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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6705004
Calibrated Date: 2-May-24

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Page:2/2

Date	Detail	Range	Unit	Before	After	Note
Time		2-May-24				
Range		10.51				
Stability		0.1-1000 PPM	PPM	50	50	
		(0.1-2PPM)	ppm	0.04	0.2	
CO Measure		2500 - 4800 MV	mV	4465.6	4431.3	
CO Reference		2500 - 4800 MV	mV	3788.5	3730.2	
MR Ratio		1.2 +/- 0.5		1.19	1.20	
Sample Pressure		20 - 30 in-Hg-A	in-Hg-A	28.7	28.6	
Sample Flow		720 - 880 cc/min	cc/min	904	898	
Sample Temp		44 - 52 deg C	deg C	48.5	43.3	
Bench Temp		47 - 49 deg C	deg C	48	48	
Wheel Temp		68 - 70 deg C	deg C	88	88	
Box Temp		27 - 50 deg C	deg C	33.3	34.6	
PHT dline		250 - 4750 mV	mV	2912.3	2913.6	
Slope		0.800 - 1.200		1.197	1.138	
Offset		0.05 +/- 0.2		-0.015	-0.016	
Gas Test Response						
Zero Gas		0	PPM	0.5	0.2	
Span Gas		45	PPM	43.7	43.2	
						± 5% of Range

Calibrate By : _____

Approve By : _____

Date: _____

Date: _____

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6705005
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: CO Analyzer	Manufacturer: Environment SA, France
Model: CO12E	S/N: ECOESACO12E205

Page: 1/2

Calibration System

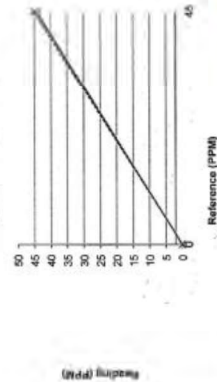
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NOx Conc 45.50 PPM
S/N: 792	NO Conc 45.50 PPM
ZERO AIR Generator ZAG7001	SO ₂ Conc 45.59 PPM
S/N: 644	CO Conc 4507 PPM
Expire Date: Mar 31, 2026	EB0150267

Environment: Temperature 26.1 °C Humidity 55 %RH

Calibration Report

Status	Reference	Reading	Drift	Reference	Reading	Drift%
Before	0.0	0.065	0.1	45.0	44.31	-0.8
After	0.0	0.032	0.0	45.0	45.09	0.1

Single Point Calibration Chart



CO Analyzer Verification Test Report

Calibration Report No.: ES-C6705005
Calibrated Date: 2-May-24

☒ PM ☐ Onsite

Page: 2/2

Analyzer Signal Values					
Date	2-May-24	Time	10:09:00		
Power Supplies					
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
Optical Bench					
IR current noise	894.7	nA	Pose current	618.2	mV
Optical T.	46.0	deg.C	Pose T.	-24.2	deg.C
Measure sig.	500.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
Inst. Ratio	1.108		Ratio	1.105	
Ref. ratio	1.108		Internal Temp.	28.9	deg.C
Source Temp.	46.0	deg.C	Gas Pressure	997	hPa
Up Pressure	947.0	hPa	Flow	59	l/h

Calibrate By : _____

Date: 2-May-24

Approve By : _____

Date: 2-May-24

รายงานการติดตามตรวจสอบภาพถ่ายสิ่งแวดล้อมประจำปี 2566
โครงการระบบขนส่งมวลชนกรุงเทพมหานคร (ครั้งที่ 2)

บริษัท ระบบขนส่งมวลชนกรุงเทพ จำกัด (มหาชน)

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau
Date of Issue : 6 April, 2024
Certification No. 169/24
Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิอากาศ
Manufacturer : DYACON
Type : Data Logger MS-100
Serial No. : 130149 ID No. : EWSDCMS1200149
Customer :
Calibration Condition : Temperature 25.1 ° C Barometric Pressure 1008.5 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Aft Plotting Board
: Micromanometer Theodor Friedrichs FC014 Serial No. 9910119 : HOOK GAGE NO 1425
N.I.S.T. Test Reference Number 731241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-450-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec
STANDARD THERMOMETER : Theodor Friedrich : Dry No. 8398/94 Wet No. 8398/94

The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 169/24
6 April, 2024 Serial No. 1223 Page : 2 of 6

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure inches Hg	Vacuum inches Hg	Velocity m/sec	Correction m/sec
1.00	-	-	1.0	0.00
3.02	-	-	3.0	0.02
5.00	-	-	5.0	0.00
7.04	-	-	7.0	0.04
9.02	-	-	9.0	0.02
11.01	-	-	11.0	0.01
13.01	-	-	13.0	0.01
15.01	-	-	15.0	0.01
17.02	-	-	17.0	0.02
20.02	-	-	20.0	0.02

Wind Aft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	89
180	18

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

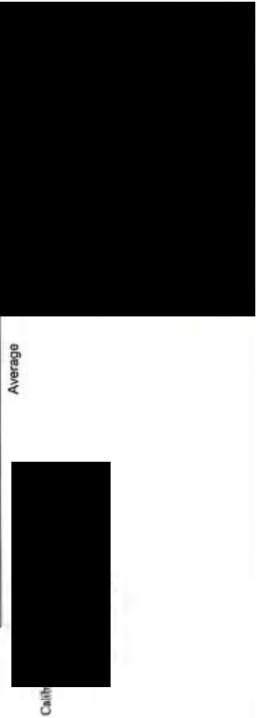
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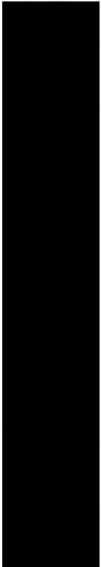
The Result of Calibration

Sensor Pressure Model TPH-1 C
Serial No. 6274
Certification No. 169/24
Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1009.59	1009.6	0.09
1009.45	1009.4	0.05
1010.10	1010.0	0.10
1010.94	1010.8	0.14
1011.46	1011.4	0.06
1011.84	1011.9	-0.06
1012.06	1012.0	0.06
1013.04	1013.0	0.04
1013.18	1013.1	0.08
1012.89	1012.8	0.09
1013.20	1013.1	0.10
1013.44	1013.4	0.04
1013.81	1013.9	-0.09
1014.19	1014.1	0.09
1015.96	1015.9	0.06
1016.23	1016.1	0.13
1015.64	1015.8	0.04
1015.23	1015.1	0.13
1012.87	1012.8	0.07
1013.63	1013.6	0.03
Average		



Calib-



The Result of Calibration

Sensor Temperature Model TPH-1 C
Serial No. 6274
Certification No. 169/24
Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	45.7	-0.1
30.1	30.1	0.0
15.4	15.5	-0.1



Calib-





The Result of Calibration

6 April 2024
Sensor Humidity Model TPH-1 C
Serial No. 6274

Certification No. 169/24

Page: 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.2	82.8	2.4
62.4	60.6	1.8
41.5	40.3	1.2

ใบรับรอง

หนังสือใบนี้ขอรับรองว่า เครื่องวัดความชื้น Davis Instruments แบบ TIPPING
BUCKET Product No. [REDACTED] ผ่านการสอบเทียบกับแก้ววัดฝน
แบบแก้วดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No.
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/TIP)



Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of time : 6 April, 2024

Certification No. 168/24

Page : 1 of 6

Object : เครื่องมือวัดความเร็วลม

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130148 ID No. : EWSOCMS1200148

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1006.2 hPa

NATIONAL STANDARD WIND TUNNEL (Wind Airt Polling Board
: Micromanometer Theodor Friedrichs FC014 Serial No. 8310119 : HOOK GAGE NO 1425
N.L.S.T. Test Reference Number 731241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-450-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120625586)
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec
STANDARD THERMOMETER : Theodor Friedrich : Dry No. 8330094 Wet No. 8330094

The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 168/24

6 April, 2024 Serial No. 1222 Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425		TESTED ANEMOMETER	
	Pressure inches H ₂ O	Vacuum inches Hg	Velocity m/sec	Correction m/sec
1.00	-	-	1.0	0.00
3.02	-	-	2.9	0.12
5.00	-	-	5.0	0.00
7.04	-	-	6.9	0.14
9.02	-	-	9.0	0.02
11.01	-	-	11.0	0.01
13.01	-	-	13.0	0.01
15.01	-	-	15.0	0.01
17.02	-	-	17.0	0.02
20.02	-	-	20.0	0.02

Wind Airt Polling Board.

US DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	
270	

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

ผ5-111



The Result of Calibration

Sensor Pressure Model TPH-1 C
Serial No. 6273
Certification No. 16824
Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1009.59	1009.1	0.49
1009.45	1009.0	0.45
1010.10	1008.5	0.60
1010.94	1010.5	0.44
1011.46	1010.8	0.56
1011.84	1011.5	0.54
1012.06	1011.8	0.46
1013.04	1012.8	0.44
1013.18	1012.8	0.68
1012.89	1012.3	0.59
1013.20	1012.8	0.40
1013.44	1012.9	0.54
1013.81	1013.3	0.51
1014.19	1013.6	0.59
1015.96	1015.4	0.56
1016.23	1015.8	0.43
1015.64	1015.1	0.54
1015.23	1014.8	0.43
1012.87	1012.3	0.57
1013.63	1013.1	0.53

Calibration	Average



The Result of Calibration

Sensor Temperature Model TPH-1 C
Serial No. 6273
Certification No. 16824
Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	45.7	-0.1
30.1	30.2	-0.1
15.4	15.3	0.1

Calibration	





The Result of Calibration

6 April, 2024
Sensor Humidity Model TPH-1 C
Serial No. 6273
Certification No. 168/24
Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.2	87.8	-2.6
62.4	65.2	-2.8
41.5	43.1	-1.6

ใบรับรอง

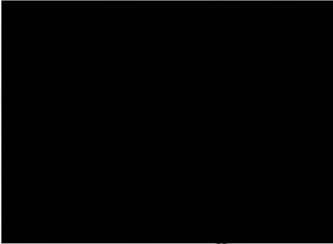
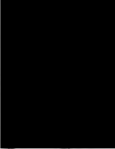
หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดความชื้น Davis Instruments แบบ TIPPING
BUCKET Product No. [REDACTED] ทำการสอบเทียบกับแก้ววัดฝน
แบบแก้วดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No.
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm./TIP)

Date of Issue

Page: 6 of 6



Calibrated



Request No.

21-670391

MTC No. EEL BP. 30/0467

CALIBRATION CERTIFICATE

Submitted by
Address
Calibrated at

Instrument Calibrated :

Description : Sound Level Calibrator
Manufacturer : Brüel & Kjær
Model : 4230
Serial No. : 1351075
Ambient Environment
Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.500) kPa

Standards used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.
3. Programmable Attenuator Tansgawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer: Keithley 2015-P S/N4106495.
7. Condense: Microphone B&K 4180 S/N 2889871.

Calibration Procedure: CP-102-44 based on IEC 60942-2003. The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

This instrument has been calibrated against standards maintained at Electrical and Electronic Standards Laboratory (EEL), which are traceable to the International System of Units through the National Institute of Metrology (Thailand).

The information on actual reading is attached herewith and the uncertainty limits quoted refer to the

Request No.

21-670391

MTC No. EEL BP. 30/0467

The reported expanded uncertainty is based upon a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95%.

Nominal Output of Unit Under Test = 94 dB re 20µPa at 1000 Hz

Acoustic Output in dB re 20µPa, Corrected in Reference Conditions: 101.325 kPa, 23.0 °C and 50 %RH.

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	93.72	-0.28	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	994.9	-5.1	± 1.5	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	1.25	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :