

ภาคผนวกที่ 7

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

ภาคผนวกที่ 7-1
เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
ครั้งที่ 3/2567
โรงเรียนแสงหิรัญ
และสถาบันการบินพลเรือน
วันที่ตรวจวัดวันที่ 5-10 กุมภาพันธ์ 2568

TSP High Volume Sampler Calibration

Verification Report No.
SO2500029-E001 -TSP 01

☐ PM ☒ Onsite
 Site: สถานีการเดินรถ
 UTM: 47P 1526248 667882
 Sampler: ETSP#40
 Recorder: ECRDCPR4169240

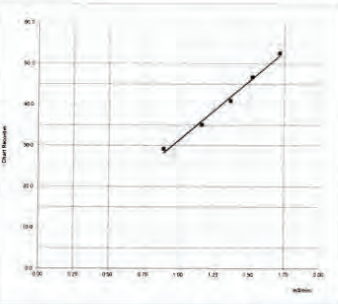
Date: 5 Feb 25
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS
 Barometric Press. (hPa): 989.0 Corrected Pressure (mm Hg): 741.8
 Temperature (deg C): 34.0 Temperature (deg K): 307.0
 Average Press. (hPa): 1013.0 Corrected Avg Press. (mm Hg): 759.8
 Average Temp. (deg C): 32.0 Average Temp. (deg K): 305.0

CALIBRATION ORIFICE
 Brand: Tisch Environmental, Inc Qstd Slope: 2.02024
 Model: TE-5025A Qstd Intercept: -0.02667
 Serial#: 5411 Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.49	1.716	54.0	52.56
2	9.82	1.523	48.0	46.72
3	7.89	1.367	42.0	40.88
4	5.68	1.161	36.0	35.04
5	3.31	0.890	30.0	29.20

LINEAR REGRESSION
 Slope = 28.7043
 Intercept = 2.6656
 Corr. coeff = 0.9949
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min: 36 / 52



Calibrated by: XXXXXXXXXX
 5 February 2025
 Approved by: XXXXXXXXXX
 5 February 2025

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Environmental responsibility with accuracy measurement.

TSP High Volume Sampler Calibration

Verification Report No.
SO2500029-E001 -TSP 02

☐ PM ☒ Onsite
 Site: โรงโม่แอสฟัลท์
 UTM: 47P 1516319 672895
 Sampler: ETSP#41
 Recorder: -

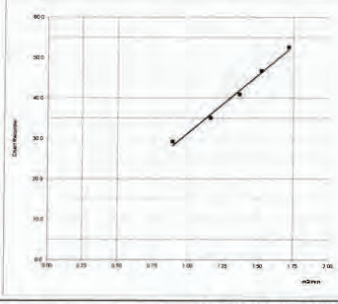
Date: 5 Feb 25
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS
 Barometric Press. (hPa): 989.0 Corrected Pressure (mm Hg): 741.8
 Temperature (deg C): 34.0 Temperature (deg K): 307.0
 Average Press. (hPa): 1013.0 Corrected Avg Press. (mm Hg): 759.8
 Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE
 Brand: Tisch Environmental, Inc Qstd Slope: 2.02024
 Model: TE-5025A Qstd Intercept: -0.02667
 Serial#: 5411 Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.50	1.717	54.0	52.56
2	10.20	1.552	48.0	46.72
3	7.19	1.305	44.0	42.83
4	4.67	1.054	34.0	33.09
5	3.02	0.850	28.0	27.25

LINEAR REGRESSION
 Slope = 28.7904
 Intercept = 3.1876
 Corr. coeff = 0.9929
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min: 36 / 53



Calibrated by: XXXXXXXXXX
 5 February 2025
 Approved by: XXXXXXXXXX
 5 February 2025

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PM10 High Volume Sampler Calibration

Verification Report No.
 SO2500029-E001-PM 01

L PM **E** Onsite
 Site: สถานีบางเขน
 UTM: 47P 1526248 667882
 Sampler: EPM10#46
 Recorder: ECRDS01618124

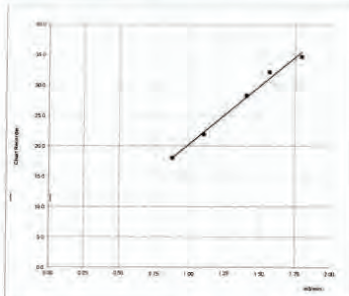
Date: 5 Feb 25
 Technical: [REDACTED]
 Approval: [REDACTED]

CONDITIONS
 Barometric Press. (hPa): 989.0 Corrected Pressure (mm Hg): 741.8
 Temperature (deg C): 34.0 Temperature (deg K): 307.0
 Average Press. (hPa): 1013.0 Corrected Avg. Press. (mm Hg): 759.8
 Average Temp. (deg C): 32.0 Average Temp. (deg K): 305.0

CALIBRATION ORIFICE
 Brand: Tisch Environmental, Inc Qstd Slope: 1.26504
 Model: TE-5025A Qstd Intercept: -0.01667
 Serial#: 5411 Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.30	1.797	54.0	34.74
2	9.35	1.568	50.0	32.17
3	7.50	1.406	44.0	28.31
4	4.58	1.101	34.0	21.87
5	2.90	0.879	28.0	18.01

LINEAR REGRESSION
 Slope = 19.0425
 Intercept = 1.3067
 Corr. coeff = 0.9953
 SFR = 1.165
 SSP = 36.52
 # of Observations: 5
 Range of Chart at SFR ±10%: 39



Calibrated by: [REDACTED]
 5 February 2025
 Approved by: [REDACTED]
 5 February 2025

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PM10 High Volume Sampler Calibration

Verification Report No.
 SO2500029-E001-PM 02

L PM **E** Onsite
 Site: โรงรับแสมรัง
 UTM: 47P 1516319 672895
 Sampler: EPM10#47
 Recorder: ECRDS01618125

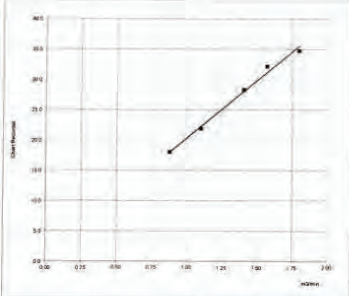
Date: 5 Feb 25
 Technical: [REDACTED]
 Approval: [REDACTED]

CONDITIONS
 Barometric Press. (hPa): 989.0 Corrected Pressure (mm Hg): 741.8
 Temperature (deg C): 34.0 Temperature (deg K): 307.0
 Average Press. (hPa): 1013.0 Corrected Avg. Press. (mm Hg): 759.8
 Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE
 Brand: Tisch Environmental, Inc Qstd Slope: 1.26504
 Model: TE-5025A Qstd Intercept: -0.01667
 Serial#: 5411 Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.00	1.775	52.0	33.45
2	9.29	1.563	50.0	32.17
3	7.84	1.437	44.0	28.31
4	4.20	1.055	34.0	21.87
5	2.80	0.864	28.0	18.01

LINEAR REGRESSION
 Slope = 17.6699
 Intercept = 3.1036
 Corr. coeff = 0.9907
 SFR = 1.173
 SSP = 37.04
 # of Observations: 5
 Range of Chart at SFR ±10%: 35



Calibrated by: [REDACTED]
 5 February 2025
 Approved by: [REDACTED]
 5 February 2025

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Verification Test Report

Report No.:
SO2500029-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 1526264 667888

Calibrated Date: 5 February 2025
Site : สถานีการนิคมเรือน
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1977

Environment: Temperature 34 °C Humidity 66 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230, Bruel&Kjaer
 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: [Redacted]

Date: 5 February 2025

Approve By: [Redacted]

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ประกาศใช้ 01/02/2566

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FE-MNT-01-22 Rev.01

Verification Test Report

Report No.:
SO2500029-E001 -SLM 02

☐ PM ☐ Onsite UTM : 47P 1516347 672862

Calibrated Date: 5 February 2025
Site : โรงเรียนแสงหิรัญ
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 2124

Environment: Temperature 34 °C Humidity 66 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230, Bruel&Kjaer
 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: [Redacted]

Date: 5 February 2025

Approve By: [Redacted]

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ประกาศใช้ 01/02/2566

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Environmental responsibility with accuracy measurement

FE-MNT-01-22 Rev.01

**RECALIBRATION
DUE DATE:
February 9, 2025**

Certificate of Calibration

Calibration Certification Information

Cal. Date: February 9, 2024	Rootsmeter S/N: 438320	Ta: 295 °K
Operator: Jim Tisch	Pa: 749.0 mm Hg	
Calibration Model #: TE-5025A 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	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 (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va (x-axis)	Qa (y-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9914	0.7106	1.4111	0.9957	0.7138	0.8875
0.9871	1.0032	1.9956	0.9915	1.0076	1.2551
0.9851	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

b= -0.02667

r= 0.99993

QA

m= 1.26504

b= -0.01677

r= 0.99993

Calculations

Vstd= ΔVol((Pa-ΔP)/Pstd)(Tstd/Ta)	Va= ΔVol((Pa-ΔP)/Pa)
Qstd= Vstd/ΔTime	Qa= Va/ΔTime

For subsequent flow rate calculations:

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

Standard Conditions

Tstd: 298.15 °K

Pstd: 760 mm Hg

Key

ΔH: calibrator manometer reading (in H2O)

ΔP: rootsmeter manometer reading (mm Hg)

Ta: actual absolute temperature (°K)

Pa: actual barometric pressure (mm Hg)

b: intercept

m: slope

RECALIBRATION

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

Tisch Environmental, Inc.

45 South Miami Avenue

Willage of Clevs, OH 45002

Certificate of Calibration

Page : 1 of 2

Certificate No. : 68-200034-1

Submitted by : [REDACTED]

Equipment : Electronic Balance

Manufacturer : Sartorius Model : SECURA224-1S

Serial No. : 0034803270 ID No. : ELABBALANCEN04

Capacity : 220 g Resolution : 0.0001 g

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

Ambient Temperature : (20.4 to 21.0) °C

Relative Humidity : (41.9 to 42.9) %

Air Pressure : 1014.0 mbar

Date of Received : 28 January 2025

Date of Calibration : 28 January 2025

Date of Issue : 30 January 2025

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.	Cert. No.	Due Date	Traceability
E261-E264	C02242009	07 Nov 2025	National Institute of Metrology (Thailand), (NIMT)

The Uncertainties are for a confidence probability of approximately 95%

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CAL-F0031-03

Certificate of Calibration

Certificate No. : 68-200034-1

Page : 2 of 2

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	0.0000	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

0.0004 0.0004 0.0005 0.0004 0.0000 g



Repeatability

Load test : 200 g

Sidev. : 0.00005 g

-o0o-

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:

Part Number: E04NI99E15A00V3
Cylinder Number: EB0160267
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12023
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 160-402685487-1
Cylinder Volume: 144.0 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Mar 31, 2023

Expiration Date: Mar 31, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
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	45.59 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				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	210607-22	CC708067	48.41 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%	Sep 21, 2025
PRM	12395	D887660	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 22, 2022
GMIS	12420589104	CC322509	4.326 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 21, 2025
NTRM	160610-01	CC473196	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Mar 22, 2028
GMIS	07212022B109	EB0141209	50.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Dec 21, 2026
CO	220608	CC744768	2501.8 PPM CARBON MONOXIDE/NITROGEN	+/-0.5%	Sep 30, 2028

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Mar 07, 2023
Nicolet ISSO FTIR AUP2010245 NO	FTIR	Mar 09, 2023
Nicolet ISSO FTIR AUP2010245 NO2	FTIR	Mar 23, 2023
Nicolet ISSO FTIR AUP2010245 SO2	FTIR	Mar 16, 2023

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg

Net Weight: 4.8 Kg

PO# 5223001123

Approved for Release

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6802003

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: 100U	Manufacturer API S/N: ESOA100U0056
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Calibration System

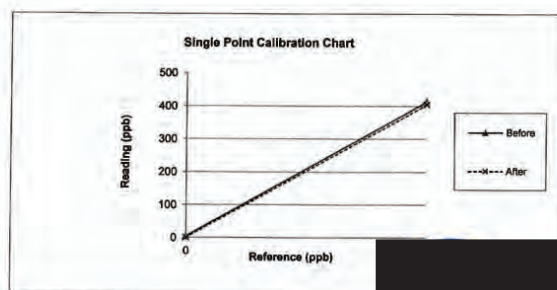
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 24.8 °C

Humidity: 57 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	4.3	4.3	400.0	413.2	1.6
After	0.0	0.1	0.1	400.0	404.5	0.6



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6802003

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-25				
Time	8:30				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	850 (+/- 50)	cc/min	868	862	
PMT Detector	0 - 5000	mV	24.3	28.2	
Norm PMT Detector	0 - 5000	mV	31.4	34.3	
HVPS	400-800 constant	V	725	725	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL TEMP	50 (+/- 1)	Dreagee C	50	50	
BOX TEMP	20-40	Dreagee C	32.6	35.1	
PMT TEMP	7 (+/-1)	Dreagee C	8.3	8.3	
UV lamp	1000-4900	mV	3251	3251	
Lamp Ratio	30-120	%	87.4	87.4	
STR. Light (Zero Gas)	<100	PPB	38.5	38.5	
Dark PMT	(-50) - (+200)	mV	27.6	27.6	
Dark lamp	(-50) - (+200)	mV	3.6	3.6	
SAMP PRES	20-30 constant	IN-Hg-A	26.9	27.3	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2010	2006	
SO2 Conc	1000 (+/- 250)	PPB	1005	1003	
SO2 Slope	1 (+/- 0.3)	-	1.054	1.053	
SO2 Offset	< 250	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 PPB)	0	ppb	4.3	0.1	
Span Gas (400 PPB)	400	ppb	413.2	404.5	± 5% of Range

Calibrate By: _____

Approve By: _____

Date: 1-Feb-25

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6802004

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: T100	Manufacturer API S/N: ES0AIT10002034
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Calibration System

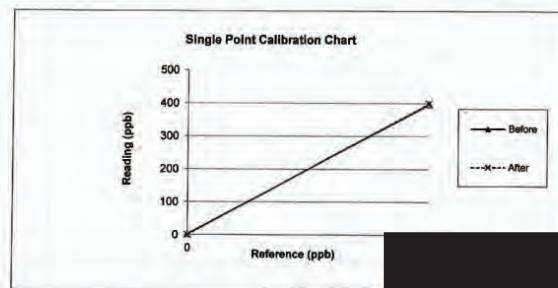
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 844	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 24.8 °C

Humidity: 57 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	2.2	2.2	400.0	397.0	-0.4
After	0.0	0.3	0.3	400.0	399.7	0.0



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6802004

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-25				
Time	11:50				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	850 (+/- 50)	cc/min	650	619	
PMT Detector	0 - 5000	mV	34.7	26.4	
Norm PMT Detector	0 - 5000	mV	44.0	25.9	
HVPS	400-900 constant	V	723	723	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL TEMP	50 (+/- 1)	Degree C	50	50	
BOX TEMP	20-40	Degree C	35.5	33.9	
PMT TEMP	7 (+/-1)	Degree C	8.0	8.0	
UV lamp	1000-4900	mV	2132.0	2132.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR Light (Zero Gas)	<100	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	27.8	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2012	2008	
SO2 Conc	1000 (+/- 250)	PPB	1006	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	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	2.2	0.3	
Span Gas (400 PPB)	400	ppb	397.0	399.7	± 5% of Range

Calibrate By: [Signature]

Approve By: [Signature]

Date: 1-Feb-25

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NOx Analyzer Verification Test Report

Calibration Report No.: N6802009

Page:1/1

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: AC32e	Manufacturer: Environnement SA, France S/N: ENOESAC32E2398
--	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 25.9 °C

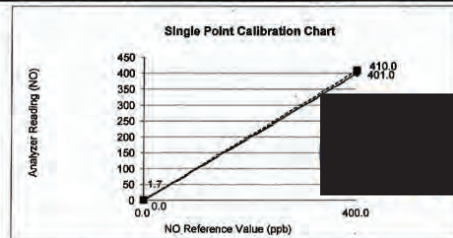
Humidity: 59 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.466	0.0	1.5	408.0	400.0	1.0
NO ₂	0.268	0.0	0.3	2.0	0.0	0.2
NOx	1.734	0.0	1.7	410.0	400.0	1.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.003	0.0	0.0	400.0	400.0	0.0
NO ₂	0.002	0.0	0.0	1.0	0.0	0.1
NOx	0.005	0.0	0.0	401.0	400.0	0.1



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NOx Analyzer Verification Test Report

Calibration Report No.: N6802009

Page:1/1

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Feb-25	Time	14:14		
Power Supplies					
Option	-13.52	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
I O3	82.74	mA			
Optical Bench					
Dark PM sig.	0.0	mV	PM NO sig.	84.28	mV
PM Nox sig.	107.0	mV	PM Ny sig.	86.71	mV
Sample					
Chamber T	60	deg.C	Internal Temp.	33.33	deg.C
Chamber P	1720.8	hPa	PM T.	1.46	deg.C
Flow	47.21	NI/h	Sample Pr.	993.2	hPa

Calibrate By: _____

Date: _____

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6802002

Page:1/1

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENOA1200E01170
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc: 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc: 45.30 PPM
	SO2 Conc: 45.05 PPM
	CO Conc: 45.28 PPM
	Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 25.5 °C

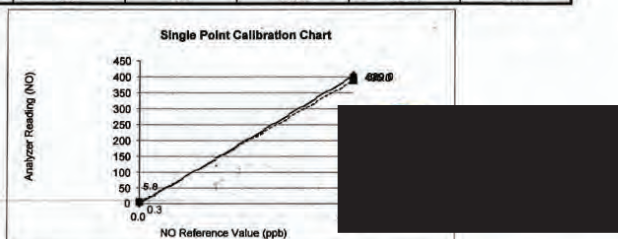
Humidity: 60 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.9	0.0	3.9	392.0	400.0	-1.0
NO ₂	1.9	0.0	1.9	-3.0	0.0	-0.4
NOx	5.8	0.0	5.8	389.0	400.0	-1.4

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.2	0.0	0.2	403.0	400.0	0.4
NO ₂	0.1	0.0	0.1	2.0	0.0	0.2
NOx	0.3	0.0	0.3	405.0	400.0	0.6



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6802002

Page:1/1

Calibrated Date: 1-Feb-25

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Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-25				
Time	10:10				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	500 +/- 50	cc/min	482	494	
Ozone Flow	80-90	cc/min	74	77	
PMT Detector	0-5000	mV	51	26	
AZERO	-20-150	mV	53.3	33.3	
HVPS	400-800 constant	V	821	821	
DCPS	2500 +/- 200	mV	2556	2556	
RCCELL TEMP	50 +/- 1	Drege C	50	50	
BOX TEMP	20-35	Drege C	30.2	32.8	
PMT TEMP	7 +/- 1	Drege C	7.5	7.5	
LS TEMP	50 +/- 4	Drege C	-	-	
MOLY Temp	315 +/- 5	Drege C	315.0	314.5	
RCCEL PRES	4-10 constant	IN-Hg-A	8.8	8.8	
SAMP PRES	20-30 constant	IN-Hg-A	30.2	31.8	
NO Slope	1 +/- 0.3		0.820	0.822	
Nox Slope	1 +/- 0.3		0.854	0.858	
NO Offset	-10 to + 150	mV	17.8	17.8	
NOx Offset	-10 to + 150	mV	5.0	5.0	
Span and Cal Values					
Zero Value	NO	0	ppb	3.9	0.2
	NOx	0	ppb	5.8	0.3
Span Value	NO	400	ppb	392.0	403.0
	NOx	400	ppb	389.0	405.0

Calibrate By : _____

Approve By : _____

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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6802003

Calibrated Date: 1-Feb-25

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Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: T300	Manufacturer API S/N: ECOAIT30000098
---	---

Calibration System

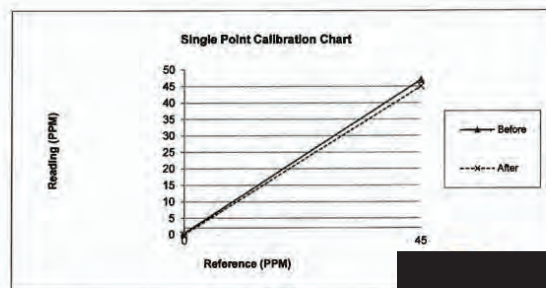
Calibrator Unit	Standard Gas
Dilutor Model ESA MGA101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 45.28 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 25.5 °C

Humidity: 52 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.4	0.4	45.0	47.0	2.2
After	0.0	0.0	0.0	45.0	45.0	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6802003

Calibrated Date: 1-Feb-25

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Page:2/2

Detail	Range	Unit	Before	After	Note
Date	1-Feb-25				
Time	10:51				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.04	0.2	
CO Measure	2500 - 4800 MV.	mV	4465.6	4431.3	
CO Reference	2500 - 4800 MV.	mV	3768.5	3730.2	
MR Ratio	1.2 +/- 0.5		1.19	1.20	
Sample Pressure	26 - 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	66 - 70 deg.C	deg.C	68	68	
Box Temp	27 - 50 deg.C	deg.C	33.3	34.8	
PHT drive	250 - 4750 mv.	mV	2912.3	2913.5	
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	0.4	0.0	
Span Gas	45	PPM	47.0	45.0	± 5% of Range

Calibrate

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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6802004

Calibrated Date: 1-Feb-25

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Instruments Information

Page:1/2

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

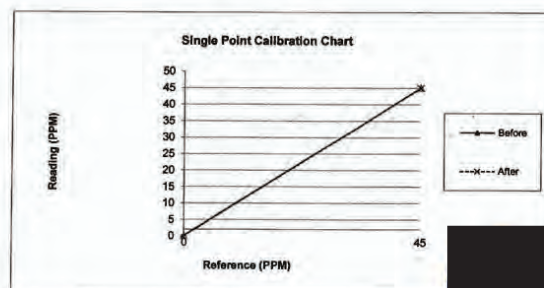
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.30 PPM
	SO2 Conc 45.05 PPM
	CO Conc 4528 PPM
	Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 24.3 °C

Humidity: 48 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.2	0.2	45.0	45.1	0.2
After	0.0	0.0	0.0	45.0	45.0	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6802004

Calibrated Date: 1-Feb-25

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Page:2/2

Detail	Range	Unit	Before	After	Note
Date	1-Feb-25				
Time	14:57				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.22	0	
CO Measure	2500 - 4800 MV.	mV	3793.2	3836.5	
CO Reference	2500 - 4800 MV.	mV	3143.6	3179.5	
MR Ratio	1.2 +/- 0.5		1.215	1.215	
Sample Pressure	26 - 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	
PHT drive	250 - 4750 mv.	mV	3015	3018.6	
Slope	0.800 - 1.200		0.867	0.875	
Offset	0.05 +/- 0.2		0.006	0.005	
Gas Test Response					
Zero Gas	0	PPM	0.2	0.0	
Span Gas	45	PPM	45.1	45.0	± 5% of Range

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Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 6 April, 2024

Certification No. 168/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิ

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130148

ID No. : EWSDCIMS1200148

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.2 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 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

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

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

The Result of Calibration

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

6 April, 2024

Serial No. 1222

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacumm	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	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 Aloft Plotting Board.

US.DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRETION	TESTED WIND DIRECTION
0	0
90	90
180	182
270	

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

๗7-14

The Result of Calibration

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

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

Date of Issue 6 April, 2024

Certification No. 168/24

Page: 6 of 6

ใบรับรอง

หนังสือฉบับขอรับรองว่า เครื่องวัดคัน ชื่อ Davis Instruments แบบ TIPPING
BUCKET Product No. [REDACTED] ทำการสอบเทียบกับแก้ววัดคัน
แบบแก้วคัน 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 24 October, 2024

Certification No. 356/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2510

Customer :



Calibration Condition : Temperature 25.1 °C Barometric Pressure 1010.1 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

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

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

: Thermoschneider No.918802

STANDARD BAROMETER : Barometer Vaisala



The Result of Calibration

Sensor model EWSNV110WS2510

Certification No. 356/24

24 October, 2024

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.6	0.40
7.04	-	-	-	6.7	0.34
9.02	-	-	-	9.1	-0.08
11.01	-	-	-	10.7	0.31
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.8	0.21
17.02	-	-	-	17.1	-0.08
20.02	-	-	-	20.3	-0.28

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



[Redacted]			[Redacted]		
The Result of Calibration			The Result of Calibration		
Sensor model		EWSNV110WS2510	Sensor model		EWSNV110WS2510
24 October, 2024		Certification No. 356/24	24 October, 2024		Certification No. 356/24
		Page : 3 of 6			Page : 4 of 6
Standard Barometer		Tested Barometer	Standard		Temperature Sensor Reading
Pressure		Pressure	Temp.	Reading	Correction
1010.12		1009.88	°C	45.9	-0.3
1010.35		1010.05		30.4	-0.2
1010.56		1010.24		15.2	-0.1
1010.85		1010.65			
1011.05		1010.84			
1011.46		1011.25			
1011.82		1011.54			
1011.95		1011.65			
1012.15		1011.85			
1012.54		1012.21			
1012.81		1012.53			
1010.25		1010.01			
1010.14		1009.94			
1009.95		1009.75			
1009.84		1009.57			
1009.45		1009.13			
1009.32		1009.02			
1009.11		1008.86			
1009.56		1009.21			
1009.86		1009.53			
Average					
[Redacted]		[Redacted]	[Redacted]		



The Result of Calibration

Sensor model EWSNV110WS2510 Certification No. 356/24

24 October, 2024 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
92.5	95.5	-3.0
65.4	68.2	-2.8
45.2	46.4	-1.2



Date of Issue 24 October, 2024

Certification No. 356/24

Page: 6 of 6

ใบรับรอง

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



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No.** EEL. BP. 65/0168

CALIBRATION CERTIFICATE

Submitted by
Address
Calibrated at

Instrument Calibrated :
Description : Acoustic Calibrator
Manufacturer : Pulsar
Model : 103
Serial No. : 98971

Ambient Environment
Temperature : $(23 \pm 3) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$
Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

Standards used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa 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 Panasonic VP-7722A S/N 041477D122.
7. Condenser Microphone B&K 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 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 : 10 Jan. 2025
Date of Calibration : 17 Jan. 2025

The results relate only to the items tested/calibrated or value assigned.
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No.** EEL. BP. 65/0168

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 20 μ Pa at 1000 Hz

Acoustic Output in dB re 20 μ Pa , Corrected to Reference Conditions : 101.325 kPa , 23.0 $^\circ$ 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 Bruel&Kjaer 4180	93.93	-0.07	± 0.10	$\pm 0.40 \text{ dB}$

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1000.4	0.4	± 1.5	$\pm 1.0\%$

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.40	± 0.50	$\pm 3.0\%$

Note :

1. No adjustment.
2. The calibrator pressure correction was not included.
3. The microphone volume correction was not included.

Date of Calibration : 17 Jan. 2025

2 / 3

The results relate only to the items tested/calibrated or value assigned.
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152

MTC No. EEL. BP. 65/0168

Nominal Output of Unit Under Test = 114 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 Bruel&Kjaer 4180	114.01	0.01	± 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 Bruel&Kjaer 4180	1000.3	0.3	± 1.5	±3.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	2.05	± 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 : 17 Jan. 2025

Date of Issue : 20 Jan. 2025

End of Certificate

The results relate only to the items tested/calibrated in this document.
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เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
โรงเรียนแสงหิรัญและสถาบันการบินพลเรือน
ครั้งที่ 4/2567
ตรวจวัดวันที่ 3-8 พฤษภาคม 2568

TSP High Volume Sampler Calibration

Verification Report No.
SO2500127-E001 -TSP_01

☐ PM ☒ Onsite
 Site: สถานีการันตผลเรือ
 UTM: 47P 667882 m E 1526248 m N
 Sampler: ETSP#44#2621
 Recorder: NCRG1500903157

Date: 3 May 25
 Technical: [REDACTED]
 Approval: [REDACTED]

CONDITIONS

Barometric Press. (hPa): 1008.0	Corrected Pressure (mm Hg): 756.1
Temperature (deg C): 33.2	Temperature (deg K): 306.2
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

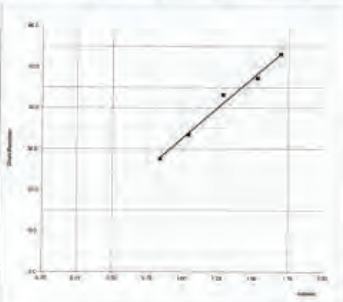
CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc	Qstd Slope: 2.06933
Model: TE-5025A	Qstd Intercept: -0.02615
Serial#: 2067	D: [REDACTED]

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.52	1.696	54.0	53.13
2	10.21	1.533	48.0	47.23
3	7.19	1.289	44.0	43.29
4	4.67	1.041	34.0	33.45
5	3.02	0.840	28.0	27.55

Slope = 29.4428
Intercept = 3.2533
Corr. coeff = 0.9928

of Observations: 5
Range of Chart at 1.1 - 1.7 m3/min: 54



Calibrated by: [REDACTED]

Approved by: [REDACTED]

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โทรศัทพ์ 01-0221566

TSP High Volume Sampler Calibration

Verification Report No.
SO2500127-E001 -TSP_02

☐ PM ☒ Onsite
 Site: สถานีการันตผลเรือ
 UTM: 47P 672895 m E 1516319 m N
 Sampler: NTS#2143638
 Recorder: NCR1500904867

Date: 3 May 25
 Technical: [REDACTED]
 Approval: [REDACTED]

CONDITIONS

Barometric Press. (hPa): 1008.4	Corrected Pressure (mm Hg): 756.4
Temperature (deg C): 33.4	Temperature (deg K): 306.4
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

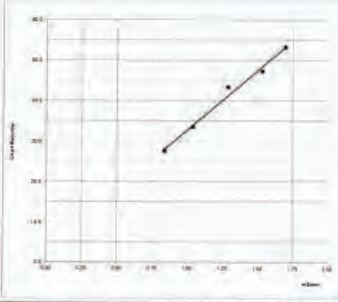
CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc	Qstd Slope: 2.06933
Model: TE-5025A	Qstd Intercept: -0.02615
Serial#: 2067	Date Certified: 4 Mar 25
	Due Date: 03-Mar-26

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.49	1.594	54.0	53.13
2	9.82	1.503	48.0	47.22
3	7.89	1.349	42.0	41.32
4	5.68	1.147	36.0	35.42
5	3.31	0.879	30.0	29.52

Slope = 29.4018
Intercept = 2.6773
Corr. coeff = 0.9949

of Observations: 5
Range of Chart at 1.1 - 1.7 m3/min: 53



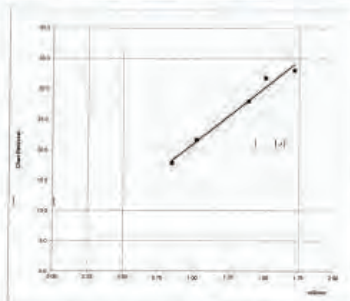
Calibrated by: [REDACTED]

Approved by: [REDACTED]

www.evltesting.com

โทรศัทพ์ 01-0221566

PM10 High Volume Sampler Calibration				
				Verification Report No. SQ2500127-E001-PM 01
L	PM	E	Onsite	
Site: สถานีการันตนา		Date: 3 May 25		
UTM: 47P 667862 m E 1526248 m N		Technical: [Redacted]		
Sampler: EPM33W2993		Approval: [Redacted]		
Recorder: NCR105143068				
CONDITIONS				
Barometric Press. (hPa): 1006.0		Corrected Pressure (mm Hg): 756.1		
Temperature (deg C): 33.2		Temperature (deg K): 306.2		
Average Press. (hPa): 1013.0		Corrected Avg Press. (mm Hg): 759.6		
Average Temp. (deg C): 30.0		Average Temp. (deg K): 303.0		
CALIBRATION ORIFICE				
Brand: Tisch Environmental, Inc		Slope: 1.29578		
Model: TE-5025A		Intercept: -0.01772		
Serial#: 2067		Date Certified: 4 Mar 25		
		Due Date: 3 Mar 26		
CALIBRATIONS				
Plate or Test #	H2O (l)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.01	1.716	52.0	33.09
2	9.29	1.511	50.0	31.82
3	7.84	1.389	44.0	28.00
4	4.21	1.021	34.0	21.64
5	2.89	0.849	26.0	17.82
LINEAR REGRESSION				
Slope = 18.3002				
Intercept = 2.7382				
Corr. coeff = 0.9901				
SFR = 1.146				
SSP = 37.30				
# of Observations: 5				
Range of Chart: 35				
at SFR ±10%: 40				

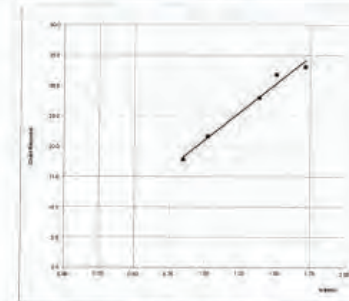


Calibrated by:

Approved by:

วันที่ 01/03/2566

PM10 High Volume Sampler Calibration				
				Verification Report No. SQ2500127-E001-PM 02
L	PM	E	Onsite	
Site: สถานีการันตนา		Date: 3 May 25		
UTM: 47P 672895 m E 1516319 m N		Technical: [Redacted]		
Sampler: EPM11W44546		Approval: [Redacted]		
Recorder: NCRAN030004601				
CONDITIONS				
Barometric Press. (hPa): 1008.4		Corrected Pressure (mm Hg): 756.4		
Temperature (deg C): 33.4		Temperature (deg K): 306.4		
Average Press. (hPa): 1013.0		Corrected Avg Press. (mm Hg): 759.6		
Average Temp. (deg C): 30.0		Average Temp. (deg K): 303.0		
CALIBRATION ORIFICE				
Brand: Tisch Environmental, Inc		Slope: 1.29578		
Model: TE-5025A		Intercept: -0.01772		
Serial#: 2067		Date Certified: 4 Mar 25		
		Due Date: 3 Mar 26		
CALIBRATIONS				
Plate or Test #	H2O (l)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.65	1.761	50.0	31.82
2	9.63	1.536	46.0	29.28
3	7.61	1.386	44.0	28.00
4	4.58	1.055	34.0	21.64
5	2.87	0.846	26.0	17.82
LINEAR REGRESSION				
Slope = 15.6761				
Intercept = 5.0347				
Corr. coeff = 0.9909				
SFR = 1.148				
SSP = 36.18				
# of Observations: 5				
Range of Chart: 34				
at SFR ±10%: 38				



Calibrated by:

Approved by:

วันที่ 01/03/2566

Verification Test Report

Report No.:

Test Data -SLM 01

☐ PM ☒ Onsite UTM : 47P 667904 m E 1526266 m N

Calibrated Date: 3 May 2025

Site : สถาบันการบินพลเรือน

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : ESMPUMD44N1865

Environment: Temperature 25 °C Humidity 69 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 103 ,Pulsar

Serial No.98971

Date of Calibration : 17 Jan 2025

Uncertainty : 0.10 dB

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.93	93.80	-0.13	93.93
Error After Adjust (dB)	Total Error (dB)	Acceptant value	Pass/Fail Judgment
0.00	0.10	±1.0 dB	Pass

Calibrated By:

Date:

Approve By:

Date:

ประกาศใช้ 01/02/2566

Verification Test Report

Report No.:

Test Data -SLM 02

☐ PM ☒ Onsite UTM : 47P 672882 m E 1516339 m N

Calibrated Date: 3 May 2025

Site : โรงเรียนแสงหิวง

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 45

Serial : ESMPUMD45N0012

Environment: Temperature 25 °C Humidity 69 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 103 ,Pulsar

Serial No.98971

Date of Calibration : 17 Jan 2025

Uncertainty : 0.10 dB

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.93	94.10	0.17	93.93
Error After Adjust (dB)	Total Error (dB)	Acceptant value	Pass/Fail Judgment
0.00	0.10	±1.0 dB	Pass

ประกาศใช้ 01/02/2566

Certificate of Calibration

Certificate No. : 68-200034-1 **Page : 1 of 2**

Submitted by : [REDACTED]

Equipment : Electronic Balance
Manufacturer : Sartorius **Model :** SECURA224-1S
Serial No. : 0034803270 **ID No. :** ELABBALANCEN04
Capacity : 220 g **Resolution :** 0.0001 g

Environment : [REDACTED]

Relative Humidity : (41.9 to 42.9) %
Air Pressure : 1014.0 mbar

Date of Received : 28 January 2025
Date of Calibration : 28 January 2025
Date of Issue : 30 January 2025
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

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02242009	07 Nov 2025	National Institute of Metrology (Thailand), (NIMT)

The Uncertainties are for a confidence probability of approximately 95%
 This certificate may not be reproduced other than in full except with the prior

CAL-P0031-03

Certificate of Calibration

Certificate No. : 68-200034-1 **Page : 2 of 2**

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	0.0000	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 $k = 2.05$,
 providing a level of confidence of approximately 95%.

Eccentric error:

Load test	50 g
A	0.0004
B	0.0004
C	0.0005
D	0.0004
E	0.0000

g

Repeatability

Load test	200 g
Sdev.	0.00005

g

o0o

Certificate of Calibration

Calibration Certification Information				
Cal. Date:	March 4, 2025	Rootsometer S/N:	438320	Ta: 294 °K
Operator:	Jlin Tisch	Pac:	746.0	mm Hg
Calibration Model #:	TE-5025A	Calibrator S/N:	2067	

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4220	3.2	2.00
2	3	4	1	1.0090	6.4	4.00
3	5	6	1	0.9030	8.0	5.00
4	7	8	1	0.8610	8.8	5.50
5	9	10	1	0.7090	12.8	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \times \frac{Tstd}{Ta} \right)}$ (y-axis)	Va (x-axis)	Qa (y-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9907	0.6967	1.4106	0.9957	0.7002	0.8878
0.9864	0.9776	1.9949	0.9914	0.9826	1.2556
0.9843	1.0900	2.2304	0.9893	1.0955	1.4038
0.9832	1.1419	2.3393	0.9882	1.1477	1.4723
0.9779	1.3792	2.8212	0.9828	1.3862	1.7756
QSTD		m= 2.06933	QA		m= 1.29578
		b= -0.02815			b= -0.01772
		r= 0.99997			r= 0.99997

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

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

RECALIBRATION
US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 5.2.17, page 30

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

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:	BANGKOK INDUSTRIAL	Reference Number:	160-402685487-1
Part Number:	GAS CO LTD	Cylinder Volume:	144.0 CF
Cylinder Number:	E04N199E15A00V3	Cylinder Pressure:	2015 PSIG
Laboratory:	124 - Plumsteadville - PA	Valve Outlet:	.660
PGVP Number:	A12023	Certification Date:	Mar 31, 2023
Gas Code:	CO,NO,NOX,SO2,BALN		

Expiration Date: Mar 31, 2026

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2013) document EPA 820/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a listed analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mass/volume basis unless otherwise noted. The results relate only to the items listed. The report shall not be reproduced except in full without approval of the laboratory. On Not Use This Cylinder below 100 psig, i.e. 6.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	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	45.59 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				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	210607-22	CC708067	48.41 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%	Sep 21, 2025
PRM	12395	DR87660	9.81 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 22, 2022
GMIS	124206889104	CC322509	4.326 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 21, 2025
NTRM	180610-01	CC473196	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Mar 22, 2028
GMIS	072120228109	E06141209	50.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Dec 21, 2026
CO	220608	CC744768	2501.8 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Sep 30, 2028

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS LA TRAMAT E NTKD578	NDIR	Mar 07, 2023
Nicolet iSSO FTIR AUP2010245 NO	FTIR	Mar 09, 2023
Nicolet iSSO FTIR AUP2010245 NO2	FTIR	Mar 23, 2023
Nicolet iSSO FTIR AUP2010245 SO2	FTIR	Mar 16, 2023

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg
Net Weight: 4.8 Kg
PDF 5223001123



Approved for Release

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805007

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: ECOESACO12E201
--	---

Calibration System

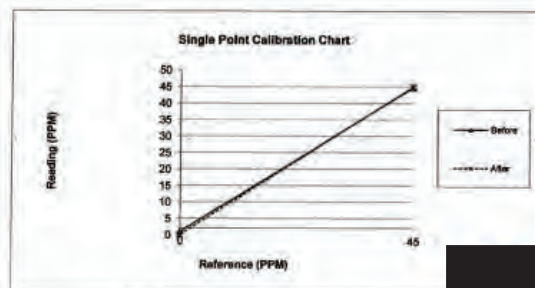
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.30 PPM
	SO2 Conc 45.05 PPM
	CO Conc 45.28 PPM
	Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature 25.2 °C

Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.003	1.0	45.0	44.78	-0.2
After	0.0	0.068	0.1	45.0	45.01	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805007

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	2-May-25	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 ratio	884.7	mA	Pbse current	616.2	mV
Optical T.	46.0	deg.C	Pbse T.	-24.2	deg.C
Measure sig.	506.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
Inst. Ratio	1.109		Ratio	1.105	
Ref. ratio	1.109		Internal Temp.	28.9	deg.C
Source Temp.	46.0	deg.C	Gas Presum	997	hPa
Up Pressure	947.0	hPa	Flow	59	l/h

Calibrate By: [Redacted]

Date: 2-May-25

Approve By: [Redacted]

Date: 2-May-25

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805005

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

Calibration System

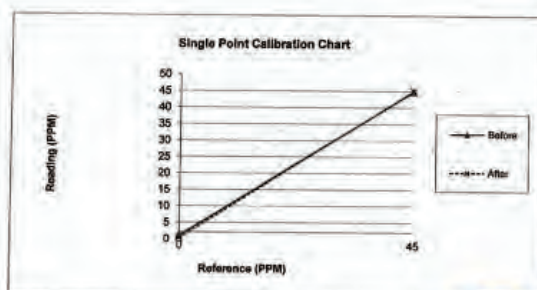
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.30 PPM
	SO2 Conc 45.05 PPM
	CO Conc 45.28 PPM
	Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 25.4 °C

Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.005	1.0	45.0	44.80	-0.2
After	0.0	0.216	0.2	45.0	45.04	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805005

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	2-May-25	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 ratio	884.7	mA	Pbase current	618.2	mV
Optical T.	46.0	deg.C	Pbase T.	-24.2	deg.C
Measure sig.	508.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
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 :

Date: 2-May-25

Approve By :

Date: 2-May-25

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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6805009

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

Analyzer Type: SO2 Analyzer Model: AF22e	Manufacturer: Environnement SA, France S/N: ESOESAF22E2506
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Calibration System

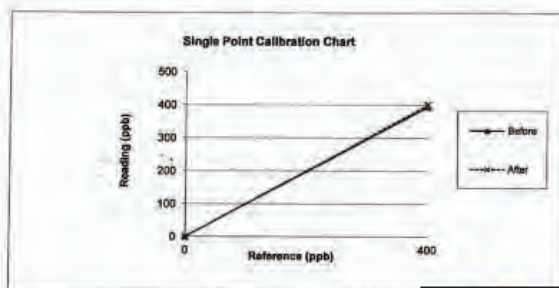
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature 23.4 °C

Humidity: 54 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.6	0.6	400.0	395.0	-0.6
After	0.0	0.2	0.2	400.0	401.0	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6805009

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page: 2/2

Analyzer Signal Values					
Date	2-May-25	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	I UV lamp	44.3	mA
+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	Inst. mass	22.8	ppb
I UV Lamp	44.7	mA	HV PM	2626.80	mV
Sample					
Internal Temp.	31.8	deg.C	Chamber T.	50	deg.C
Gas Pr.	970	hPa	Pump Pr.	355.5	hPa
Flow	18.7	l/h			

Calibrate By:

Date: 2-May-25

Approve By:

Date: 2-May-25

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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6805008

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

Analyzer Type: SO2 Analyzer Model: AF22e	Manufacturer: Environnement SA, France S/N: ESOESAF22E2503
---	---

Calibration System

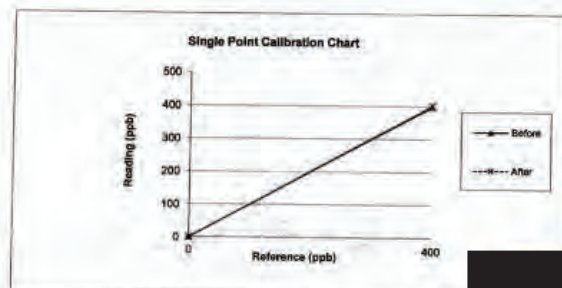
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 762 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature 23.4 °C

Humidity: 54 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.5	0.5	400.0	398.4	-0.2
After	0.0	0.3	0.3	400.0	402.0	0.2



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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6805008

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page: 2/2

Analyzer Signal Values					
Date	2-May-25	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	I UV lamp	44.3	mA
+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		Meas ratio	0.34	
Mean sig.	0.7		Raw trend	11	
Raw sig.	24.4	ppb	Inst meas.	22.8	ppb
I UV Lamp	44.7	mA	HV 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: [Signature]

Date: 2-May-25

Approve By: [Signature]

Date: 2-May-25

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NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6805007

Page:1/1

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: AC32e	Manufacturer: Environnement SA, France S/N: ENOESAC32E2401
--	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 28.8 °C

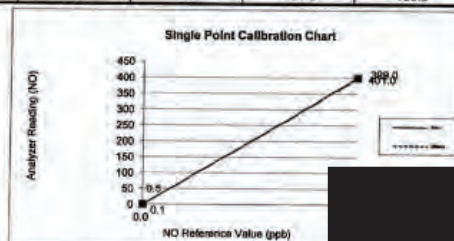
Humidity: 58 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.457	0.0	0.5	395.0	400.0	-0.6
NO ₂	0.064	0.0	0.1	4.0	0.0	0.5
NOx	0.521	0.0	0.5	399.0	400.0	-0.1

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.067	0.0	0.1	399.0	400.0	-0.1
NO ₂	0.022	0.0	0.0	2.0	0.0	0.3
NOx	0.089	0.0	0.1	401.0	400.0	0.1



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NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6805007

Page:1/1

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	2-May-25	Time	14:14		
Power Supplies					
Option	-13.52	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
I O3	82.74	mA			
Optical Bench					
Dark PM sig.	0.0	mV	PM NO sig.	84.28	mV
PM NOx sig.	107.0	mV	PM Ny sig.	86.71	mV
Sample					
Chamber T	60	deg.C	Internal Temp.	33.33	deg.C
Chamber P	1720.8	hPa	PM T.	1.46	deg.C
Flow	47.21	NI/h	Sample Pr.	993.2	hPa

Calibrate By:

Approve By:

Date: 2-May-25

Date: 2-May-25

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NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6805008

Page:1/1

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: AC32e	Manufacturer: Environnement SA, France S/N: ENOESAC32E2404
--	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4526 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 26.5 °C

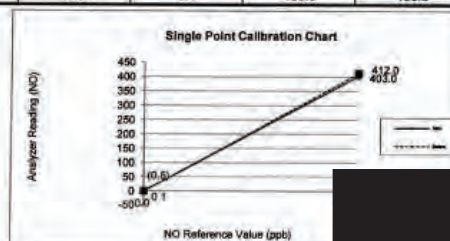
Humidity: 67 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-0.338	0.0	-0.3	409.3	400.0	1.1
NO ₂	-0.112	0.0	-0.1	2.7	0.0	0.3
NOx	-0.450	0.0	-0.5	412.0	400.0	1.5

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.055	0.0	0.1	400.0	400.0	0.0
NO ₂	0.031	0.0	0.0	3.0	0.0	0.4
NOx	0.086	0.0	0.1	403.0	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6805008

Page:1/1

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	2-May-25	Time	14:14		
Power Supplies					
Option	-13.52	mV	+5 V Sensor	4.99	V
+3.3 V	-3.3	V	+24 V	23.95	V
+12 V	11.86	V	+5 V	4.99	V
+4 V	3974.3	mV	I+ 24V	2.4	A
I Q3	82.74	mA			
Optical Bench					
Dark PM sig.	0.0	mV	PM NO sig.	64.28	mV
PM Nox sig.	107.0	mV	PM Ny sig.	66.71	mV
Sample					
Chamber T	80	deg.C	Internal Temp.	33.33	deg.C
Chamber P	1720.8	hPa	PM T.	1.46	deg.C
Flow	47.21	l/h	Sample Pr.	993.2	hPa

Calibrate By:

Approve By:

Date: 2-May-25

Date: 2-May-25

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No. EEL. BP.** 65/0168

CALIBRATION CERTIFICATE

Submitted by [REDACTED]
Address [REDACTED]
Calibrated at [REDACTED]

Instrument Calibrated : **Ambient Environment**
 Description : Acoustic Calibrator Temperature : $(23 \pm 3) ^\circ\text{C}$
 Manufacturer : Pulsar Relative Humidity : $(50 \pm 15) \%$
 Model [REDACTED] 00) kPa
 Serial No. [REDACTED]

Standards used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa 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 Panasonic VP-7722A S/N 041477D122.
7. Condenser Microphone B&K 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 : 10 Jan. 2025
Date of Calibration : 17 Jan. 2025

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

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No. EEL. BP.** 65/0168

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 20 μ Pa at 1000 Hz

Acoustic Output in dB re 20 μ Pa , Corrected to Reference Conditions : 101.325 kPa , 23.0 $^\circ$ 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 Bruel&Kjaer 4180	93.93	-0.07	± 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 Bruel&Kjaer 4180	1000.4	0.4	± 1.5	$\pm 1.0\%$

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.40	± 0.50	$\pm 3.0\%$

Note :

1. No adjustment.
2. The calibrator pressure correction was not included.
3. The microphone volume correction was not included.

Date of Calibration : 17 Jan. 2025

The results relate only to the items tested/calibrated or value assigned.
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 MTC No. EEL. BP. 65/0168

Nominal Output of Unit Under Test = 114 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 Bruel&Kjaer 4180	114.01	0.01	± 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 Bruel&Kjaer 4180	1000.3	0.3	± 1.5	±3.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	2.05	± 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 : [Redacted] Approved : [Redacted]

Electronics Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 17 Jan. 2025
Date of Issue : 20 Jan. 2025

Ref : 2011268011000116001
End of Certificate 3 / 3

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

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 24 October, 2024 Certification No. 356/24
Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิอากาศ

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2510

Customer : [Redacted]

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1010.1 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563
: HOOK GAGE NO 1425 : Wind Aloft Plotting Board
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)

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

STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94
Thermocouples No.018902



The Result of Calibration

Sensor model EWSNV110WS2510 Certification No. 356/24
24 October, 2024 Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer					
m/sec	Inches H2O	Inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.6	0.40
7.04	-	-	-	6.7	0.34
9.02	-	-	-	9.1	-0.08
11.01	-	-	-	10.7	0.31
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.8	0.21
17.02	-	-	-	17.1	-0.08
20.02	-	-	-	20.3	-0.28

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

Calib



The Result of Calibration

Sensor model EWSNV110WS2510

Certification No. 356/24

24 October, 2024

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.12	1009.88	0.24
1010.35	1010.05	0.30
1010.58	1010.24	0.32
1010.85	1010.65	0.20
1011.05	1010.84	0.21
1011.48	1011.26	0.21
1011.82	1011.54	0.28
1011.95	1011.85	0.30
1012.15	1011.85	0.30
1012.54	1012.21	0.33
1012.81	1012.53	0.28
1010.25	1010.01	0.24
1010.14	1009.94	0.20
1009.95	1009.75	0.20
1009.84	1009.57	0.27
1009.45	1009.13	0.32
1009.32	1009.02	0.30
1009.11	1008.86	0.25
1009.66	1009.21	0.35
1009.66	1009.53	0.33

Average

Calibra

The Result of Calibration

Sensor model EWSNV110WS2510 Certification No. 356/24
24 October, 2024 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
15.1	15.2	-0.1

The Result of Calibration

Sensor model EWSNV110WS2510 Certification No. 356/24
24 October, 2024 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
92.5	95.5	-3.0
65.4	68.2	-2.8
45.2	46.4	-1.2

Date of Issue 24 October, 2024

Certification No. 356/24

Page: 6 of 6

ใบรับรอง

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

ถึงชื่อ...

วิศวกรชำนาญการ

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 24 October, 2024

Certification No. 359/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2511

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1009.2 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

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

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

: Thermoschneider No.8390/94

STANDARD BAROMETER : Barometer Vaisala

The Result of Calibration

Sensor model EWSNV110WS2511 Certification No. 359/24

24 October, 2024

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer					
m/sec	inches H ₂ O	inches H ₂ O	m/sec	m/sec	m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.0	0.02
11.01	-	-	-	11.0	0.01
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 Aloft Plotting Board.

U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	

Calibration

The Result of Calibration

Sensor model EWSNV110WS2511

Certification No. 359/24

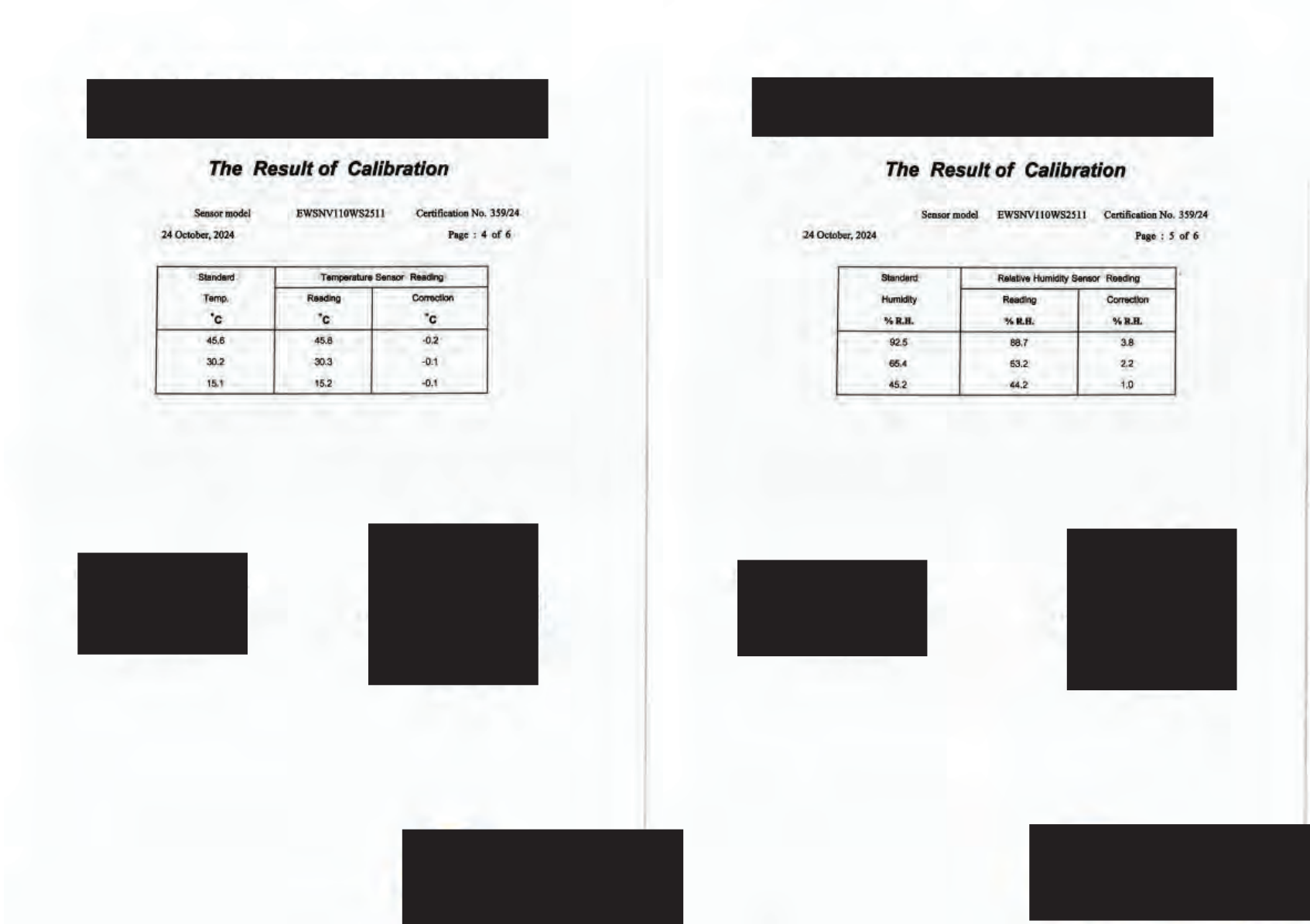
24 October, 2024

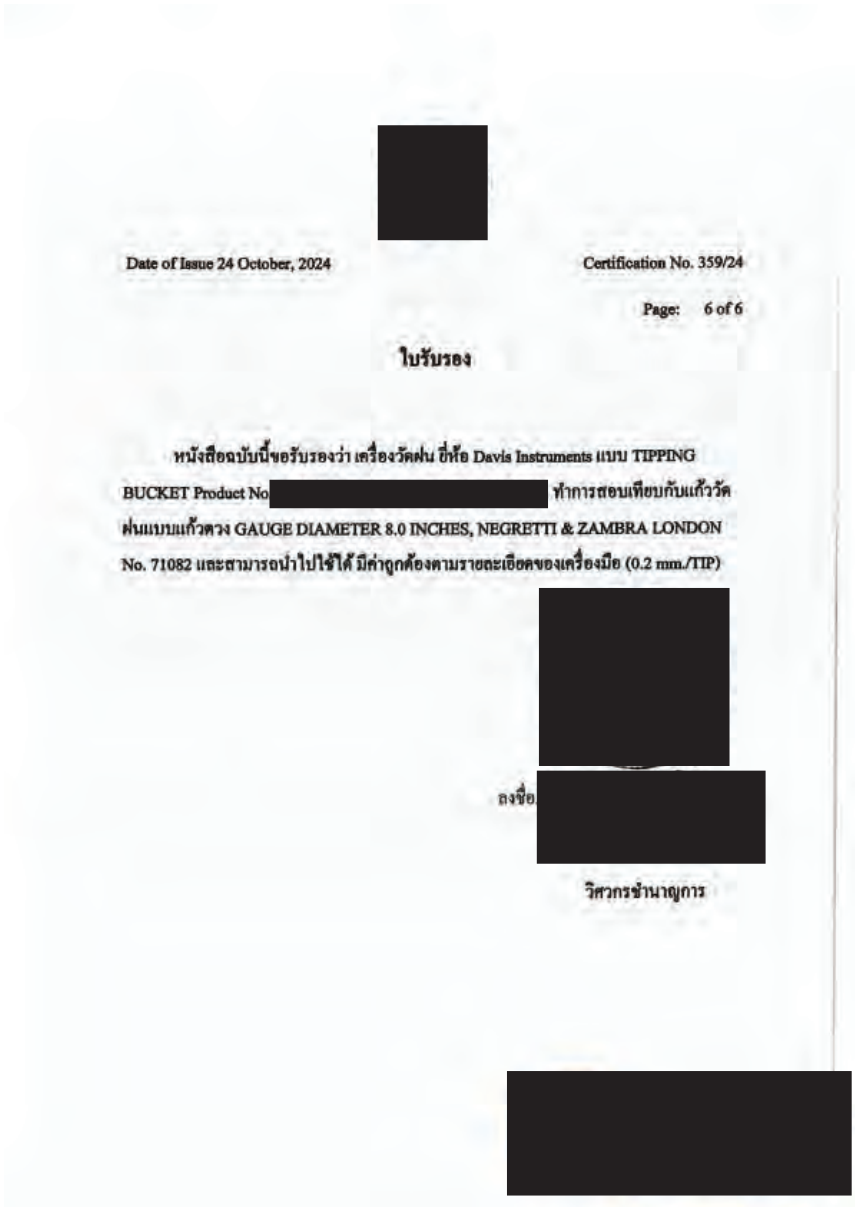
Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.12	1009.36	0.76
1010.35	1009.53	0.82
1010.58	1009.72	0.84
1010.85	1010.12	0.73
1011.05	1010.24	0.81
1011.46	1010.69	0.77
1011.82	1010.86	0.87
1011.95	1011.15	0.80
1012.15	1011.32	0.83
1012.54	1011.68	0.86
1012.81	1012.01	0.80
1010.25	1009.37	0.88
1010.14	1009.35	0.79
1009.95	1009.16	0.79
1009.84	1008.91	0.93
1009.45	1008.68	0.77
1009.32	1008.54	0.78
1009.11	1008.28	0.83
1008.56	1008.64	0.92
1008.66	1008.95	0.91

Average

Calibration





ภาคผนวกที่ 7-2

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
สถานีรถไฟฟ้าชองนนทบุรี (อาคารโดมอันทาวเวอร์)
และสถานีรถไฟฟ้าศาลาแดง (สถานีอาคารหอแว่น)
ครั้งที่ 3/2567
วันที่ตรวจวัด วันที่ 5-10 กุมภาพันธ์ 2568

TSP High Volume Sampler Calibration

Verification Report No.
SO2500028-E001-TSP 01

☐ PM ☒ Onsite
 Site: BTS ศาลาแดง
 UTM : 47P 1518197 665860
 Sampler: ETSP#42
 Recorder: ECRDCPR4169240

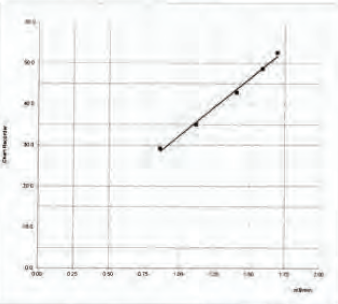
Date: 5 Feb 25
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS
 Barometric Press. (hPa): 989.0 Corrected Pressure (mm Hg): 741.8
 Temperature (deg C): 34.0 Temperature (deg K): 307.0
 Average Press. (hPa): 1013.0 Corrected Avg. Press. (mm Hg): 759.8
 Average Temp. (deg C): 32.0 Average Temp. (deg K): 305.0

CALIBRATION ORIFICE
 Brand: Tisch Environmental, Inc. Qstd Slope: 2.02024
 Model: TE-5025A Qstd Intercept: -0.02867
 Serial#: 5411 Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.20	1.696	54.0	52.56
2	10.71	1.590	50.0	48.57
3	8.37	1.407	44.0	42.83
4	5.28	1.120	36.0	35.04
5	3.12	0.864	30.0	29.20

LINEAR REGRESSION
 Slope = 27.9606
 Intercept = 4.3175
 Corr. coeff. = 0.9969
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min.
 37
 53



Calibrated by : XXXXXXXXXX
 5 February 2025
 Approved by : XXXXXXXXXX
 5 February 2025

www.evltesting.com
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Environmental responsibility with accuracy measurement

TSP High Volume Sampler Calibration

Verification Report No.
SO2500028-E001-TSP 02

☐ PM ☒ Onsite
 Site: BTS บางนาแบริ
 UTM : 47P 1517300 664905
 Sampler: ETSP#43
 Recorder: ECRDCPR4169244

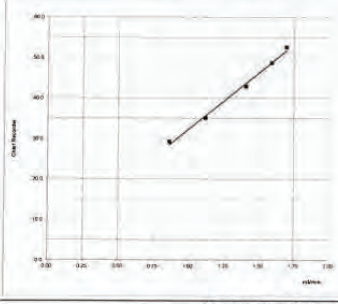
Date: 5 Feb 25
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS
 Barometric Press. (hPa): 989.0 Corrected Pressure (mm Hg): 741.8
 Temperature (deg C): 34.0 Temperature (deg K): 307.0
 Average Press. (hPa): 1013.0 Corrected Avg. Press. (mm Hg): 759.8
 Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE
 Brand: Tisch Environmental, Inc. Qstd Slope: 2.02024
 Model: TE-5025A Qstd Intercept: -0.02867
 Serial#: 5411 Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.62	1.725	54.0	52.56
2	10.40	1.567	48.0	46.72
3	7.69	1.349	42.0	40.88
4	4.27	1.009	34.0	33.09
5	3.03	0.852	28.0	27.25

LINEAR REGRESSION
 Slope = 27.5978
 Intercept = 4.2158
 Corr. coeff. = 0.9967
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min.
 36
 52



Calibrated by : XXXXXXXXXX
 5 February 2025
 Approved by : XXXXXXXXXX
 5 February 2025

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Environmental responsibility with accuracy measurement

PM10 High Volume Sampler Calibration

Verification Report No.
 SO2500028-E001-PM 01

L PM **E** Onsite
 Site: BTS ศาลาแดง
 UTM: 47P 1518197 665860
 Sampler: EPM10#33
 Recorder: ECRDS01618124

Date: 5 Feb 25
 Technical: [REDACTED]
 Approval: [REDACTED]

CONDITIONS

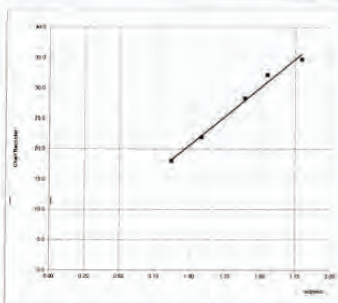
Barometric Press. (hPa): 989.0	Corrected Pressure (mm Hg): 741.8
Temperature (deg C): 34.0	Temperature (deg K): 307.0
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 32.0	Average Temp. (deg K): 305.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc	Qstd Slope: 1.26504
Model: TE-5025A	Qstd Intercept: -0.01667
Serial#: 5411	Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.30	1.797	54.0	34.74
2	9.15	1.551	50.0	32.17
3	7.35	1.392	44.0	28.31
4	4.43	1.084	34.0	21.87
5	2.84	0.870	28.0	18.01

LINEAR REGRESSION
 Slope = 18.8618
 Intercept = 1.7683
 Corr. coeff = 0.9940
 SFR = 1.165
 SSP = 36.91
 # of Observations: 5
 Range of Chart at SFR ±10%: 34 / 39



Calibrated by: [REDACTED]
 5 February 2025
 Approved by: [REDACTED]
 5 February 2025

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PM10 High Volume Sampler Calibration

Verification Report No.
 SO2500028-E001-PM 02

L PM **E** Onsite
 Site: BTS ศาลาแดง
 UTM: 47P 1517300 664905
 Sampler: EPM10#44
 Recorder: ECRDS01618125

Date: 5 Feb 25
 Technical: [REDACTED]
 Approval: [REDACTED]

CONDITIONS

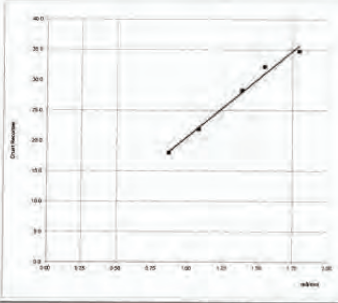
Barometric Press. (hPa): 989.0	Corrected Pressure (mm Hg): 741.8
Temperature (deg C): 34.0	Temperature (deg K): 307.0
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc	Qstd Slope: 1.26504
Model: TE-5025A	Qstd Intercept: -0.01667
Serial#: 5411	Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.10	1.782	54.0	34.74
2	9.75	1.601	50.0	32.17
3	7.54	1.410	44.0	28.31
4	4.93	1.142	34.0	21.87
5	2.74	0.855	28.0	18.01

LINEAR REGRESSION
 Slope = 18.9064
 Intercept = 1.3443
 Corr. coeff = 0.9952
 SFR = 1.173
 SSP = 36.55
 # of Observations: 5
 Range of Chart at SFR ±10%: 34 / 39



Calibrated by: [REDACTED]
 5 February 2025
 Approved by: [REDACTED]
 5 February 2025

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Verification Test Report

Report No.:
SO2500028-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 1518201 665872

Calibrated Date: 5 February 2025
Site : BTS ศาลาแดง
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 2122

Environment: Temperature 34 °C Humidity 66 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230,Brue&Kjaer
 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: [Signature]

Date: 5 February 2025

Approve By: [Signature]

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Verification Test Report

Report No.:
SO2500028-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P 1517749 665369

Calibrated Date: 5 February 2025
Site : BTS ช่องนนทรี
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 2198

Environment: Temperature 34 °C Humidity 66 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230,Brue&Kjaer
 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: [Signature]

Date: 5 February 2025

Approve By: [Signature]

Date: 5 February 2025

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Certificate of Calibration

Calibration Certification Information			
Cal. Date: February 9, 2024	Rootsmeier S/N: 438320	Ta: 295 °K	
Operator: [REDACTED]		Pa: 749.0 mm Hg	
Calibration Model #: TE-5025A	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	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 (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9914	0.7106	1.4111	0.9957	0.7138	0.8875
0.9871	1.0032	1.9956	0.9915	1.0076	1.2551
0.9851	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= 1.26504
		b= -0.02667			b= -0.01677
		r= 0.99993			r= 0.99993

Calculations			
Vstd= ΔVol((Pa-ΔP)/Pstd)(Tstd/Ta)	Va= ΔVol((Pa-ΔP)/Pa)		
Qstd= Vstd/ΔTime	Qa= Va/ΔTime		
For subsequent flow rate calculations:			
Qstd= $1/m \left(\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)} - b \right)$	Qa= $1/m \left(\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)} - b \right)$		

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

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

Tsch Environmental, Inc.
45 South Miami Avenue
Village of Cleves, OH 45002

www.tsch-env.com
TOLL FREE: (877)263-7610

Certificate of Calibration

Certificate No. : 68-200034-1

Page : 1 of 2

Submitted by : [REDACTED]

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 : (20.4 to 21.0) °C

Relative Humidity : (41.9 to 42.9) %

Air Pressure : 1014.0 mbar

Date of Received : 28 January 2025

Date of Calibration : 28 January 2025

Date of Issue : 30 January 2025

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.

Cert. No.

Due Date

Traceability

E261-E2624

C02242009

07 Nov 2025

National Institute of Metrology (Thailand), (NIMT)

Approved by : [REDACTED]

The Uncertainties are for a confidence probability of approximately 95%

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CAL-P0031-03



Certificate of Calibration

Certificate No. : 68-200034-1

Page : 2 of 2

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	0.0000	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
0.0004 0.0004 0.0005 0.0004 0.0000 g



Repeatability

Load test : 200 g
Stdv. : 0.00005 g

-o0o-

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:

Part Number: E04NI99E15A00V3
Cylinder Number: EB0160267
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12023
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 160-402685487-1
Cylinder Volume: 144.0 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Mar 31, 2023

Expiration Date: Mar 31, 2026

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800R-12/231, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items listed. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
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	45.59 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
NTRM	210607-22	CC708067	48.41 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%	Sep 21, 2025
PRM	12385	D887660	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 22, 2022
GMIS	124206889104	CC322509	4.326 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 21, 2025
NTRM	160610-01	CC473196	48.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Mar 22, 2028
GMIS	072120228109	EB0141209	50.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Dec 21, 2026
CO	220608	CC744768	2501.6 PPM CARBON MONOXIDE/NITROGEN	+/-0.5%	Sep 30, 2028

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD578	NDIR	Mar 07, 2023
Nicolet IS50 FTIR AUP2010245 NO	FTIR	Mar 09, 2023
Nicolet IS50 FTIR AUP2010245 NO2	FTIR	Mar 23, 2023
Nicolet IS50 FTIR AUP2010245 SO2	FTIR	Mar 16, 2023

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg
Net Weight: 4.8 Kg
PO# 5223001123





SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6801001

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: AF22e	Manufacturer: Environnement SA, France S/N: ESOESAF22E2482
---	---

Calibration System

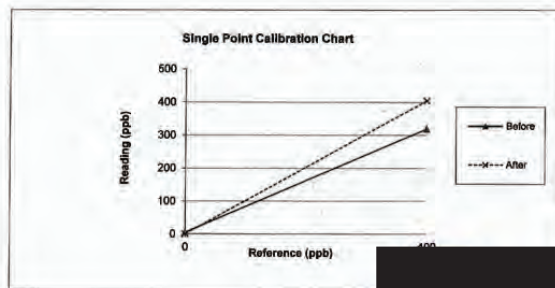
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 25.3 °C

Humidity: 60 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	5.1	5.1	400.0	319.3	-11.2
After	0.0	0.3	0.3	400.0	405.1	0.6



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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6801001

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Feb-25	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	I UV lamp	44.3	mA
+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		Meas.ratio	0.34	
Mean sig.	0.7		Raw trend	11	
Raw sig.	24.4	ppb	Inst.meas.	22.8	ppb
I UV Lamp	44.7	mA	HV 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:

Date: 1-Feb-25

Approve By:

Date: 1-Feb-25

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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6802002

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: AF22e	Manufacturer Environnement SA, France S/N: ESOESAF22E2485
---	--

Calibration System

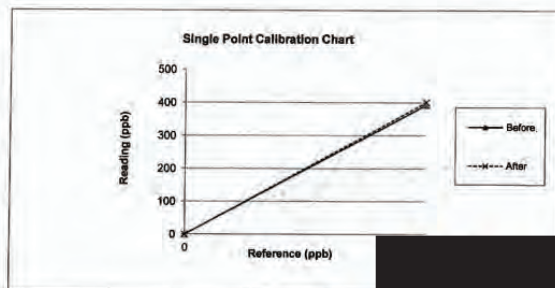
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.30 PPM
	SO2 Conc 45.05 PPM
	CO Conc 4528 PPM
	Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 25.2 °C

Humidity: 61 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.0	0.0	400.0	393.5	-0.8
After	0.0	0.0	0.0	400.0	401.0	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6802002

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Feb-25	Time	13:11:00		
Power Supplies					
Option	0.00	mV	+5 V Sensor	5	V
+4 V	4088	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
+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		Meas ratio	0.34	
Mean sig.	0.7		Raw trend	11	
Raw sig.	24.4	ppb	Inst.meas.	22.8	ppb
UV Lamp	44.7	mA	HV 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 :

Date: 1-Feb-25

Approve By :

Date: 1-Feb-25

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6802004

Page:1/1

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20002469
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 24.7 °C

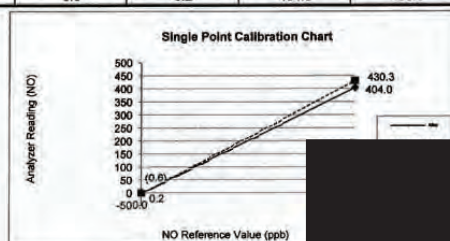
Humidity: 65 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-0.3	0.0	-0.3	429.4	400.0	3.5
NO ₂	-0.4	0.0	-0.4	0.9	0.0	0.1
NOx	-0.6	0.0	-0.6	430.3	400.0	3.6

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.0	0.0	0.0	398.4	400.0	-0.5
NO ₂	0.2	0.0	0.2	7.6	0.0	1.0
NOx	0.2	0.0	0.2	404.0	400.0	0.5



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6802004

Page:1/1

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-25				
Time	13:30:00 AM				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	505	480	
Ozone Flow	60-90	cc/min	78	72	
PMT Detector	0-5000	mV	28.2	28.3	
AZERO	-20-150	mV	56.0	55.0	
HVPS	400-800 constant	V	755	755	
DCPS	2500 +/- 200	mV	-	-	
RCCELL TEMP	50 +/- 1	Degree C	50	50	
BOX TEMP	20-35	Degree C	30.2	32.0	
PMT TEMP	7 +/- 1	Degree C	7.2	7.2	
IRS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	315.0	315.0	
RCCL PRES	4-10 constant	IN-Hg-A	4	5	
SAMP PRES	20-30 constant	IN-Hg-A	29	29	
NO Slope	1 +/- 0.3		0.890	1.118	
NOx Slope	1 +/- 0.3		0.911	1.046	
NO Offset	-10 to + 150	mV	12.9	2.2	
NOx Offset	-10 to + 150	mV	-2.4	9.1	
Span and Cal Values					
Zero Value	NO	0	ppb	-0.3	0.0
	NOx	0	ppb	-0.6	0.2
Span Value	NO	400	ppb	429.4	398.4
	NOx	400	ppb	430.3	404.0

Calibrate By :

Approve By :

Date: 1-Feb-25

Date: 1-Feb-25

This report shall not be reproduced



NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6802010

Page:1/1

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: AC32e	Manufacturer: Environnement SA., France S/N: ENOESAC32E2399
--	--

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature 25.8 °C

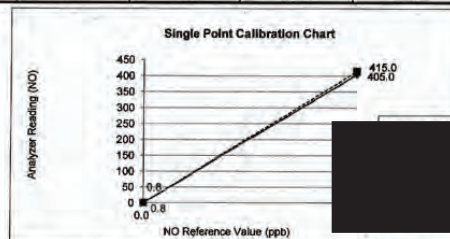
Humidity: 61 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.567	0.0	0.6	411.0	400.0	1.4
NO ₂	0.226	0.0	0.2	4.0	0.0	0.5
NOx	0.793	0.0	0.8	415.0	400.0	1.8

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.540	0.0	0.5	403.0	400.0	0.4
NO ₂	0.242	0.0	0.2	2.0	0.0	0.2
NOx	0.782	0.0	0.8	405.0	400.0	0.6



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NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6802010

Page:1/1

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Feb-25	Time	14:14		
Power Supplies					
Option	-13.52	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
I O3	82.74	mA			
Optical Bench					
Dark PM sig.	0.0	mV	PM NO sig.	84.28	mV
PM Nox sig.	107.0	mV	PM Ny sig.	86.71	mV
Sample					
Chamber T	60	deg.C	Internal Temp.	33.33	deg.C
Chamber P	1720.8	hPa	PM T.	1.46	deg.C
Flow	47.21	NI/h	Sample Pr.	993.2	hPa

Calibrate By: [Redacted]

Date: 1-Feb-25

Date: 1-Feb-25

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6802001

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: ECOESAC012E202
--	---

Calibration System

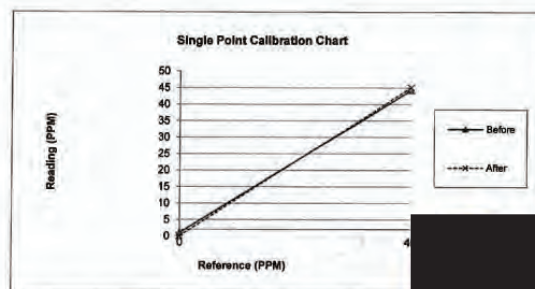
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature: 27.1 °C

Humidity: 66 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.042	1.0	45.0	44.23	-0.9
After	0.0	0.081	0.1	45.0	45.10	0.1



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6802001

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Feb-25	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 ratio	884.7	mA	Pbse current	618.2	mV
Optical T.	48.0	deg.C	Pbse T.	-24.2	deg.C
Measure sig.	506.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
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-25

Date: 1-Feb-25

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6802005

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA., France S/N: ECOESACO12E204
--	--

Calibration System

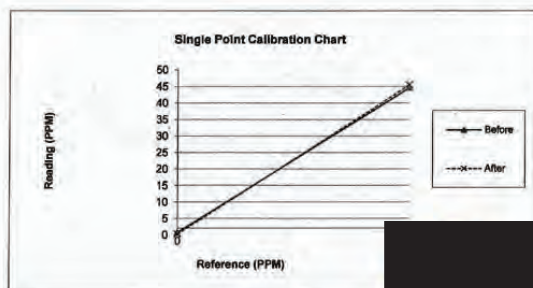
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792	NOx Conc: 45.30 PPM
ZERO AIR Generator: ZAG7001 S/N: 644	NO Conc: 45.30 PPM
	SO2 Conc: 45.05 PPM
	CO Conc: 45.28 PPM
	Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature 25.2 °C

Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.765	0.8	45.0	44.67	-0.4
After	0.0	0.214	0.2	45.0	45.54	0.6



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6802005

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Feb-25	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 ratio	884.7	mA	Pbse current	618.2	mV
Optical T.	46.0	deg.C	Pbse T.	-24.2	deg.C
Measure sig.	506.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
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 :

Date: 1-Feb-25

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Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 24 October, 2024

Certification No. 359/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : Novalynx

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

Serial No. : EWSNV110WS2511

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1009.2 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629588)

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

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

: Thermocouple holder No.918802

The Result of Calibration

Sensor model EWSNV110WS2511

Certification No. 359/24

24 October, 2024

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.0	0.02
11.01	-	-	-	11.0	0.01
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 Aloft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	

Calibrated by :

Mechanical Engineer

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

๗7-54

Sensor model	EWSNV110WS2511
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Certification No. 359/24

24 October, 2024

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.12	1009.36	0.76
1010.35	1009.53	0.82
1010.56	1009.72	0.84
1010.85	1010.12	0.73
1011.05	1010.24	0.81
1011.46	1010.69	0.77
1011.82	1010.95	0.87
1011.95	1011.15	0.80
1012.15	1011.32	0.83
1012.54	1011.68	0.86
1012.81	1012.01	0.80
1010.25	1009.37	0.88
1010.14	1009.35	0.79
1009.95	1009.16	0.79
1009.84	1008.91	0.93
1009.45	1008.68	0.77
1009.32	1008.54	0.78
1009.11	1008.28	0.83
1009.56	1008.64	0.92
1009.86	1008.95	0.91

Average

Calibre

Mechanical Engineer

Sensor model EWSNV110WS2511 Certification No. 359/24

24 October, 2024

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	45.8	-0.2
30.2	30.3	-0.1
15.1	15.2	-0.1

Calib

Mechanical Engineer



The Result of Calibration

Sensor model EWSNV110WS2511 Certification No. 359/24
24 October, 2024 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
92.5	88.7	3.8
65.4	63.2	2.2
45.2	44.2	1.0

Calibrate
Mechanical Engineer



Date of Issue 24 October, 2024 Certification No. 359/24
Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ Davis Instruments แบบ TIPPING
BUCKET Product No. [Redacted] ทำการสอบเทียบกับแก้ววัด
ฝนแบบแก้วดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm./TIP)

ลงชื่อ



วิศวกรชำนาญการ





Issued by : Calibration & Test Section : Meteorological Instruments Bureau
Date of Issue : 6 April, 2024 Certification No. 170/24
Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิตัว
Manufacturer : DYACON
Type : Data Logger MS-100
Serial No. : 130150 ID No. : EWSDCMS1200150
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 731/241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec
STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94
: Thermoschneider No.9188 : testo, testo 645 Serial No. 02848057



The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 170/24
6 April, 2024 Serial No. 1224 Page : 2 of 6

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/Sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	2.9	0.12
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	-	-	-	12.9	0.11
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

Wind Aloft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	91
180	180
270	

Calibrated by : Mechanical Engineer



The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6275

Certification No. 170/24

6 April, 2024

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1009.59	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	1011.8	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

Average

Calib

Mechanical Engineer

The Result of Calibration

Sensor Temperature Model TPH-1 C

Certification No. 170/24

6 April, 2024

Serial No. 6275

Page : 4 of 6

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

Calit

Mechanical Engineer



The Result of Calibration

6 April, 2024 Sensor Humidity Model TPH-1 C Certification No. 170/24
Serial No. 6275 Page : 5 of 6

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

Calibr

Mechanical Engineer



Date of Issue 6 April, 2024

Certification No. 170/24

Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีฟส์ 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)

ลงช

วิศวกรชำนาญการ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No.** EEL. BP. 65/0168

CALIBRATION CERTIFICATE

Submitted by [REDACTED]
Address [REDACTED]
Calibrated at [REDACTED]

Instrument Calibrated : Description : Acoustic Calibrator Manufacturer : Pulsar Model : 103 Serial No. : 98971	Ambient Environment Temperature : (23 ± 3) °C Relative Humidity : (50 ± 15) % Ambient Pressure : (101.325 ± 1.500) kPa
---	--

Standards used :

- Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
- Measuring Amplifier Brüel&Kjaer 2636 S/N 1537484.
- Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
- Digital Multimeter Agilent 34401A S/N MY44005560.
- Pressure Transmitter Vaisala PTB202AD S/N T0650001.
- Audio Analyzer Panasonic VP-7722A S/N 041477D122.
- Condenser Microphone B&K 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 : 10 Jan. 2025
Date of Calibration : 17 Jan. 2025

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

FM.BLMTC.002 Rev.5

Head Office 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand Tel. (66) 0 2577 9036 Fax. (66) 0 2577 9009	Office/Laboratory 668 Mu 2 Tambon Bangpoomai, Amphoe Muang Samutprakan, Changwat Samutprakan 10280, Thailand Tel. (66) 0 2323 1672-80 ext. 115, 116 (66) 08 3219 9440 E-mail : mtc@tistr.or.th Website : www.tistr.or.th	Office 196 Phahonyothin Road, Ladyao, Chatuchak, Bangkok 10900, Thailand Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217 (66) 08 1889 6827
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No.** EEL. BP. 65/0168

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	93.93	-0.07	± 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	1000.4	0.4	± 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	1.40	± 0.50	±3.0%

Note :

- No adjustment.
- The calibrator pressure correction was not included.
- The microphone volume correction was not included.

Date of Calibration : 17 Jan. 2025

2 / 3

The results relate only to the items tested/calibrated or value assigned.
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FM.BLMTC.002 Rev.5

Head Office 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang, Changwat Pathumthani 12120, Thailand Tel. (66) 0 2577 9036 Fax. (66) 0 2577 9009	Office/Laboratory 668 Mu 2 Tambon Bangpoomai, Amphoe Muang Samutprakan, Changwat Samutprakan 10280, Thailand Tel. (66) 0 2323 1672-80 ext. 115, 116 (66) 08 3219 9440 E-mail : mtc@tistr.or.th Website : www.tistr.or.th	Office 196 Phahonyothin Road, Ladyao, Chatuchak, Bangkok 10900, Thailand Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217 (66) 08 1889 6827
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[REDACTED]

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152
MTC No. EEL. BP. 65/0168

Nominal Output of Unit Under Test = 114 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 Bruel&Kjaer 4180	114.01	0.01	± 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 Bruel&Kjaer 4180	1000.3	0.3	± 1.5	±3.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	2.05	± 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 : [REDACTED]

Approved by : [REDACTED]

Electrical Engineering Laboratory

Date of Calibration : 17 Jan. 2025

Date of Issue : 20 Jan. 2025

Industrial Metrology and Testing Service Centre

Ref : 2011268011000116001

End of Certificate

3 / 3

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

รับรองว่าถูกต้อง
 รับรองโดยควบคุมคุณภาพ

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
สถานีรถไฟฟ้าชองนนทบุรี (อาคารโดมอันทาวเวอร์)
สถานีรถไฟฟ้าศาลาแดง (สถานีอาคารหอแว่น)
ครั้งที่ 4/2568
วันที่ตรวจวัด วันที่ 3-8 พฤษภาคม 2568

TSP High Volume Sampler Calibration

Verification Report No.
SO2500126-E001 -TSP_01

☐ PM ☒ Onsite
 Site: BTS ศาลาแดง
 UTM : 47P 665860 m E 1518197 m N
 Sampler: ETSP#29#15127
 Recorder: NCRCIS00903157

Date: 3 May 25
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1008.0	Corrected Pressure (mm Hg): 756.1
Temperature (deg C): 33.2	Temperature (deg K): 306.2
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc	Qstd Slope: 2.06933
Model: TE-5025A	Qstd Intercept: -0.02815
Serial#: 2067	Date Certified: 4 Mar 25
	Due Date: 03-Mar-26

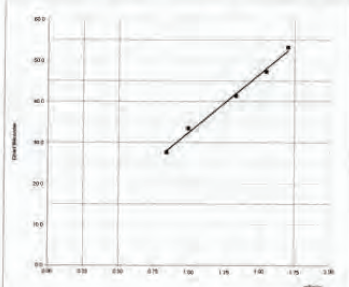
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.62	1.703	54.0	53.13
2	10.40	1.547	48.0	47.23
3	7.69	1.332	42.0	41.33
4	4.27	0.996	34.0	33.45
5	3.03	0.841	28.0	27.55

LINEAR REGRESSION

Slope = 28.2684
Intercept = 4.2454
Corr. coeff = 0.9967

of Observations: 5

Range of Chart: 36
at 1.1 - 1.7 m3/min: 53



Calibrated by: XXXXXXXXXX

3 May 2025

Approved by: XXXXXXXXXX

3 May 2025

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ประเภทที่ 01/02/2566

TSP High Volume Sampler Calibration

Verification Report No.
SO2500126-E001 -TSP_02

☐ PM ☒ Onsite
 Site: BTS ศาลาแดง
 UTM : 47P 665860 m E 1518197 m N
 Sampler: ETSP#35#14938
 Recorder: NCRTI500904867

Date: 3 May 25
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1008.4	Corrected Pressure (mm Hg): 756.4
Temperature (deg C): 33.4	Temperature (deg K): 306.4
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc	Qstd Slope: 2.06933
Model: TE-5025A	Qstd Intercept: -0.02815
Serial#: 2067	Date Certified: 4 Mar 25
	Due Date: 03-Mar-26

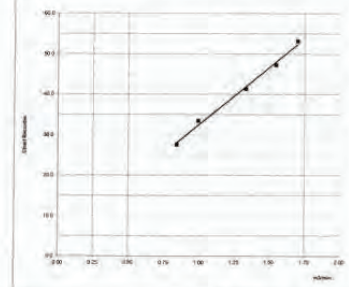
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.25	1.678	54.0	53.13
2	10.71	1.570	50.0	49.19
3	8.37	1.389	44.0	43.29
4	5.28	1.106	36.0	35.42
5	3.12	0.853	30.0	29.52

LINEAR REGRESSION

Slope = 28.5700
Intercept = 4.4203
Corr. coeff = 0.9971

of Observations: 5

Range of Chart: 37
at 1.1 - 1.7 m3/min: 53



Calibrated by: XXXXXXXXXX

3 May 2025

Approved by: XXXXXXXXXX

3 May 2025

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ประเภทที่ 01/02/2566

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

พ7-63

PM10 High Volume Sampler Calibration

Verification Report No.
SQ2500126-E001-PM 01

L: PM L: Onsite
Site: BTS สถานะ
UTM : 47P 665860 m E 1516197 m N
Sampler: EPMK31#14938
Recorder: NCRTIC5143068
Date: 3 May 25
Technical:
Approval:

CONDITIONS

Barometric Press. (hPa): 1008.0 Corrected Pressure (mm Hg): 756.1
Temperature (deg C): 33.2 Temperature (deg K): 306.2
Average Press. (hPa): 1013.0 Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc. Slope: 1.29578
Model: TE-5025A Intercept: -0.01772
Serial#: 2067 Date Certified: 4 Mar 25
Due Date: 3 Mar 26

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.54	1.753	54.0	34.37
2	9.75	1.547	50.0	31.82
3	7.54	1.362	44.0	28.00
4	4.93	1.104	34.0	21.64
5	2.74	0.827	28.0	17.82

Slope = 16.8610
Intercept = 1.6579
Corr. coeff = 0.9938
SFR = 1.148
SSP = 36.93
of Observations: 5
Range of Chart at SFR ±10%: 34/39

LINEAR REGRESSION

Calibrated by:
3 May 2025
Approved by:
3 May 2025

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วันที่ 03/05/2566

PM10 High Volume Sampler Calibration

Verification Report No.
SQ2500126-E001-PM 02

L: PM L: Onsite
Site: BTS สถานะ
UTM : 47P 665860 m E 1516197 m N
Sampler: EPMK30#16333
Recorder: NCRAN000004601
Date: 3 May 25
Technical:
Approval:

CONDITIONS

Barometric Press. (hPa): 1008.4 Corrected Pressure (mm Hg): 756.4
Temperature (deg C): 33.4 Temperature (deg K): 306.4
Average Press. (hPa): 1013.0 Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc. Slope: 1.29578
Model: TE-5025A Intercept: -0.01772
Serial#: 2067 Date Certified: 4 Mar 25
Due Date: 3 Mar 26

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.31	1.737	54.0	34.37
2	9.15	1.499	50.0	31.82
3	7.35	1.345	44.0	28.00
4	4.43	1.048	34.0	21.64
5	2.84	0.841	28.0	17.82

Slope = 19.3071
Intercept = 1.7454
Corr. coeff = 0.9939
SFR = 1.148
SSP = 37.56
of Observations: 5
Range of Chart at SFR ±10%: 35/40

LINEAR REGRESSION

Calibrated by:
3 May 2025
Approved by:
3 May 2025

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วันที่ 03/05/2566

Verification Test Report

Report No.:
Test Data -SLM 01

☐ PM ☒ Onsite UTM : 47P 665872 m E 1518201 m N

Calibrated Date: 17 April 2025
Site : BTS ศาสนาสง
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : ESMPUMD44N1862

Environment: Temperature 25 °C Humidity 69 %RH
Reference Standard: Acoustic Calibrator Class 1 Model 103 ,Pulsar
 Serial No.98971
 Date of Calibration : 17 Jan 2025
 Uncertainty : 0.10 dB

Result of Test			
Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.93	94.20	0.27	93.93
Error After Adjust (dB)	Total Error (dB)	Acceptant value	Pass/Fail Judgment
0.00	0.10	±1.0 dB	Pass

Calibrated By:
 Date: 17 April 2025
 Approve By:
 Date: 17 April 2025

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Verification Test Report

Report No.:
Test Data -SLM 02

☐ PM ☒ Onsite UTM : 47P 665368 m E 1517249 m N

Calibrated Date: 17 April 2025
Site : BTS ปทุมธานี
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : NSMPUMD44N1974

Environment: Temperature 25 °C Humidity 69 %RH
Reference Standard: Acoustic Calibrator Class 1 Model 103 ,Pulsar
 Serial No.98971
 Date of Calibration : 17 Jan 2025
 Uncertainty : 0.10 dB

Result of Test			
Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.93	94.10	0.17	93.93
Error After Adjust (dB)	Total Error (dB)	Acceptant value	Pass/Fail Judgment
0.00	0.10	±1.0 dB	Pass

Calibrated By:
 Date: 17 April 2025
 Approve By:

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www.evtesting.com

Certificate of Calibration

Certificate No. : 68-200034-1 **Page : 1 of 2**

Submitted by : [Redacted]

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 : (20.4 to 21.0) °C
Relative Humidity : (41.9 to 42.9) %
Air Pressure : 1014.0 mbar

Date of Received : 28 January 2025
Date of Calibration : 28 January 2025
Date of Issue : 30 January 2025
Calibrated by : Akaradath 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

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02242009	07 Nov 2025	National Institute of Metrology (Thailand), (NIMT)

The Uncertainties are for a confidence probability of approximately 95%
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CAL-P0031-03

Certificate of Calibration

Certificate No. : 68-200034-1 **Page : 2 of 2**

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	0.0000	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	0.0004
B	0.0004
C	0.0005
D	0.0004
E	0.0000

Repeatability

Load test	200 g
Sidev.	0.00005 g

- 000 -

Certificate of Calibration

Calibration Certification Information

Cal. Date: March 4, 2025 Roots-meter S/N: 438320 Ta: 294 °K
 Operator: Jim Tisch Pa: 746.0 mm Hg
 Calibration Model #: TE-5025A Calibrator S/N: 2067

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4220	3.2	2.00
2	3	4	1	1.0090	6.4	4.00
3	5	6	1	0.9030	8.0	5.00
4	7	8	1	0.8610	8.8	5.50
5	9	10	1	0.7090	12.8	8.00

Data Tabulation

Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va (x-axis)	Qa (y-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9907	0.6967	1.4106	0.9957	0.7002	0.8878
0.9864	0.9776	1.9949	0.9914	0.9826	1.2556
0.9843	1.0900	2.2304	0.9893	1.0955	1.4038
0.9832	1.1419	2.3393	0.9842	1.1477	1.4723
0.9775	1.3792	2.8212	0.9826	1.3862	1.7756

QSTD m= 2.06933 QA m= 1.29578
 b= -0.02815 b= -0.01772
 r= 0.99997 r= 0.99997

Calculations

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

For subsequent flow rate calculations:

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

Standard Conditions

Tstd: 298.15 °K
 Pstd: 760 mm Hg
 Key

ΔH: calibrator manometer reading (in H2O)
 ΔP: roots-meter manometer reading (mm Hg)
 Ta: actual absolute temperature (°K)
 Pa: actual barometric pressure (mm Hg)
 b: intercept
 m: slope

RECALIBRATION

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

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: [REDACTED]

Part Number: E04N199E15A00V3 Reference Number: 160-402685487-1
 Cylinder Number: EB0160267 Cylinder Volume: 144.0 CF
 Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
 PGVP Number: A12023 Valve Outlet: 660
 Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Mar 31, 2023

Expiration Date: Mar 31, 2026

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gas-phase Calibration Standards (May 2012) documents EPA, 810/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items tested. The report shall not be reproduced except in full without approval of this laboratory. Do not Use This Cylinder below 100 psig, i.e. 6.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
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	45.98 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
NTRM	210807-22	CC708067	48.41 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%	Sep 21, 2024
PRM	12385	DB87660	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 22, 2022
GMIS	124208889104	CC322509	4.326 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 21, 2025
NTRM	160610-01	CC473196	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Mar 22, 2028
GMIS	072120228109	EB0141209	50.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Dec 21, 2026
CG	220608	CC744768	2501.8 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Sep 30, 2028

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 NTK0579	NDIR	Mar 07, 2023
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Mar 09, 2023
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Mar 23, 2023
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Mar 16, 2023

Triad Data Available Upon Request
 NOTES: Gross Weight: 27.8 Kg
 Net Weight: 4.8 Kg
 POF 5223001123



CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805006

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

Calibration System

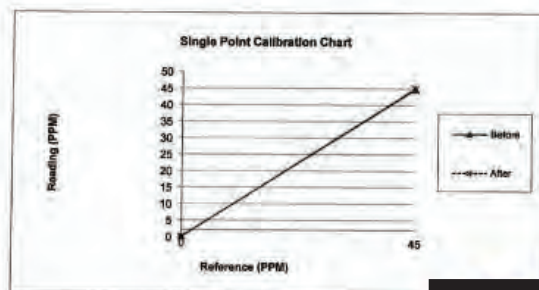
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.30 PPM
	SO2 Conc 45.05 PPM
	CO Conc 4528 PPM
	Expire Date: OCT 23 2027 EB0170003

Environment: Temperature 26.1 °C

Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.066	0.1	45.0	44.81	-0.2
After	0.0	0.032	0.0	45.0	45.09	0.1



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805006

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	2-May-25	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 ratio	884.7	mA	Pbse current	618.2	mV
Optical T.	46.0	deg.C	Pbse T.	-24.2	deg.C
Measure sig.	506.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
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 :

Date:

2-May-25

Approve By :

Date:

2-May-25

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805002

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer Environnement SA, France S/N: NCOESACO12E356
--	--

Calibration System

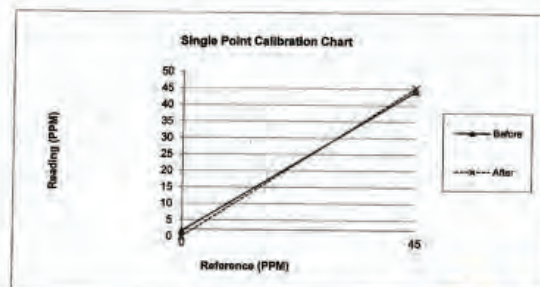
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.30 PPM
	SO2 Conc 45.05 PPM
	CO Conc 4528 PPM
	Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 24.7 °C

Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.712	1.7	45.0	44.23	-0.9
After	0.0	0.044	0.0	45.0	45.19	0.2



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805002

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	2-May-25	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 ratio	884.7	mA	Pbse current	618.2	mV
Optical T.	46.0	deg.C	Pbse T.	-24.2	deg.C
Measure sig.	508.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
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 :

Date: 2-May-25

Approve By :

Date: 2-May-25

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6805002

Calibrated Date: 2-May-25

Page:1/1

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200E	Manufacturer: API S/N: ENQAI200E00579
---	--

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 25.2 °C

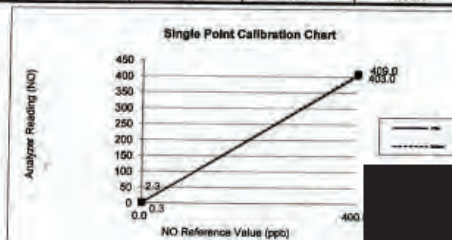
Humidity: 55 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.5	0.0	1.5	407.0	400.0	0.9
NO ₂	0.8	0.0	0.8	2.0	0.0	0.2
NOx	2.3	0.0	2.3	409.0	400.0	1.1

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.5	0.0	0.5	401.0	400.0	0.1
NO ₂	-0.2	0.0	-0.2	2.0	0.0	0.2
NOx	0.3	0.0	0.3	403.0	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6805002

Calibrated Date: 2-May-25

Page:1/1

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	2-May-25				
Time	13:25				
Range	0.00 - 500.00 PPB	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	474.0	441.0	
Ozone Flow	80-80	cc/min	76.0	76.0	
PMT Detector	0-5000	mV	24.5	62.2	
AZERO	20-150	mV	8.6	67.5	
HVPS	400-800 constant	V	838.0	836.0	
DCPS	2500 +/- 200	mV	-	-	
CELL TEMP	50 +/- 1	Dewegge C	50.0	50.0	
BOX TEMP	20-35	Dewegge C	34.5	30.5	
PMT TEMP	7 +/- 1	Dewegge C	7.0	7.1	
ZS TEMP	50 +/- 4	Dewegge C	-	-	
MOLY Temp	315 +/- 5	Dewegge C	315.0	314.4	
CELL PRES	4-10 constant	IN-Hg-A	4.20	7.90	
SAMP PRES	20-30 constant	IN-Hg-A	29.9	28.6	
NO Slope	1 +/- 0.3		1.256	1.032	
NOx Slope	1 +/- 0.3		1.232	1.048	
NO Offset	-10 to + 150	mV	4.50	6.90	
NOx Offset	-10 to + 150	mV	-5.00	-1.50	
Span and Cal Values					
Zero Value	NO	0	ppb	1.5	0.5
	NOx	0	ppb	2.3	0.3
Span Value	NO	400	ppb	407.0	401.0
	NOx	400	ppb	409.0	403.0

Calibrate By: [Redacted]

Date: 2-May-25

Approve By: [Redacted]

Date: 2-May-25

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6805010

Page:1/1

Calibrated Date: 1-May-25

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200E	Manufacturer API S/N: ENQAI200E00305
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 23.5 °C

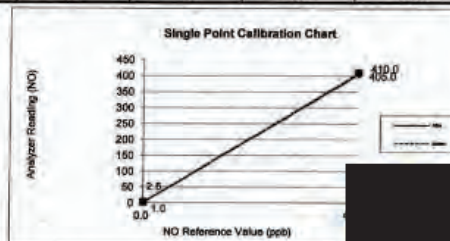
Humidity: 55 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.3	0.0	1.3	409.0	400.0	1.1
NO ₂	1.2	0.0	1.2	1.0	0.0	0.1
NOx	2.5	0.0	2.5	410.0	400.0	1.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.8	0.0	0.8	403.0	400.0	0.4
NO ₂	0.2	0.0	0.2	2.0	0.0	0.2
NOx	1.0	0.0	1.0	405.0	400.0	0.6



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6805010

Page:1/1

Calibrated Date: 1-May-25

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Norm/Cal range	Unit	Before	After	Note
Date	1-May-25				
Time	13:25				
Range	0.00 - 500.00 PPB	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500±1.50	cc/min	474.0	441.0	
Ozone Flow	60-90	cc/min	78.0	78.0	
PMT Detector	0-5000	mV	24.5	62.2	
AZERO	20-150	mV	8.6	67.5	
HVPS	400-900 constant	V	839.0	838.0	
DCPS	2500 ±1.200	mV	-	-	
CELL TEMP	50±1	Dreages C	50.0	50.0	
BOX TEMP	20-35	Dreages C	34.5	35.5	
PMT TEMP	7 ±1	Dreages C	7.0	7.1	
IZS TEMP	50±1.4	Dreages C	-	-	
MOLY Temp	315 ±1.5	Dreages C	315.0	314.4	
CELL PRES	4-10 constant	IN-Hg-A	4.20	7.90	
SAMP PRES	20-30 constant	IN-Hg-A	28.9	28.6	
NO Slope	1 ±1.0.3		1.256	1.032	
NOx Slope	1 ±1.0.3		1.232	1.048	
NO Offset	-10 to +150	mV	4.80	8.90	
NOx Offset	-10 to +150	mV	-5.00	-1.50	
Span and Cal Values					
Zero Value	NO	0	ppb	1.3	0.6
	NOx	0	ppb	2.5	1.0
Span Value	NO	400	ppb	409.0	403.0
	NOx	400	ppb	410.0	405.0

Calibrate By: [Redacted]

Approve By: [Redacted]

Date: 1-May-25

Date: 1-May-25

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6805002

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: T100	Manufacturer API S/N: ESOAIT10002034
--	---

Calibration System

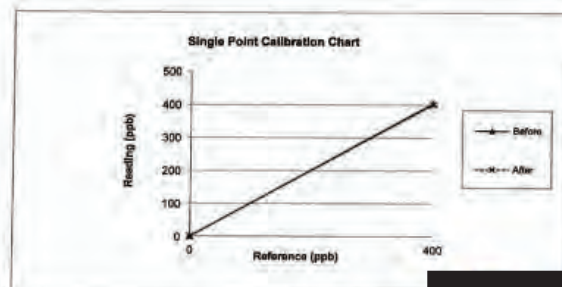
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 25.4 °C

Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.1	1.1	400.0	405.0	0.6
After	0.0	0.1	0.1	400.0	401.1	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6805002

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	2-May-25				
Time	11:50				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	850 (+/- 50)	cc/min	650	610	
PMT Detector	0 - 5000	mV	34.7	26.4	
Norm PMT Detector	0 - 5000	mV	44.0	25.9	
HVPS	400-900 constant	V	723	723	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL TEMP	50 (+/- 1)	Degree C	50	50	
BOX TEMP	23-40	Degree C	35.5	33.9	
PMT TEMP	7 (+/- 1)	Degree C	8.0	8.0	
UV Lamp	1000-4800	mV	2132.0	2132.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR Light (Zero Gas)	<100	PPB	19	19	
Dark PMT	(-50) - (+200)	mV	84.5	84.5	
Dark Lamp	(-50) - (+200)	mV	-15.1	-15.1	
SAMP PHES	20-30 constant	IN-Hg-A	27.4	27.8	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2012	2005	
SO2 Conc	1000 (+/- 250)	PPB	1008	1004	
SO2 Slope	1 (+/- 0.3)	-	0.859	0.859	
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	
Gas Test Response					
Zero Gas (0.0 PPB)	0	ppb	1.1	0.1	
Span Gas (400 PPB)	400	ppb	405.0	401.1	± 5% of Range

Calibrate By: [Signature]

Approve By: [Signature]

Date: 2-May-25

Date: 2-May-25

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6805006

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

Analyzer Type: SO2 Analyzer Model: 100E	Manufacturer API S/N: ESOAH100E01225
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Calibration System

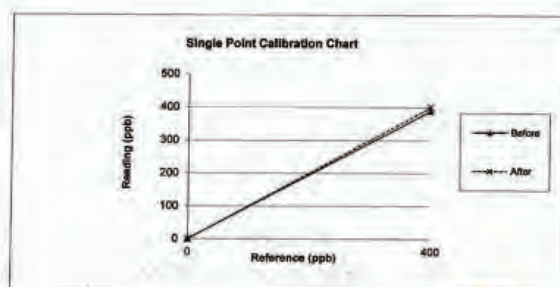
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature 25.3 °C

Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	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



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6805006

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page: 2/2

Test Function Values	Nominal range	Unit	Before	After	Note
Date	2-May-25				
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	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
HVPS	400-900 constant	V	719	648	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL TEMP	30 (+/- 1)	Dreages C	50	50	
BOX TEMP	20-40	Dreages C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Dreages C	8.0	8.0	
UV lamp	1000-4900	mV	4034.0	4034.0	
Lamp Ratio	99-120	%	114.0	114.0	
STR. Light (Zero Gas)	<100	PPB	29	29	
Dark PMT	(-50) - (+200)	mV	44.7	44.7	
Dark lamp	(-50) - (+200)	mV	5.1	5.1	
SAMP PRES	20-30 constant	IN-Hg-A	26.1	27.8	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.888	
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	0.9	0.3	
Span Gas (400 PPB)	400	ppb	390.0	400.9	± 5% of Range

Calibrate By: [Signature]

Date: 2-May-25

Approve By: [Signature]

Date: 2-May-25

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No. EEL- BP** 65/0168

CALIBRATION CERTIFICATE

Submitted by
Address
Calibrated at

Instrument Calibrated :

Description : Acoustic Calibrator

Manufacturer : Pulsar

Model : 103

Serial No. : 98971

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 Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tansagawa 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 Panasonic VP-7722A S/N 041477D122.
7. Condenser Microphone B&K 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 : 10 Jan. 2025

Date of Calibration : 17 Jan. 2025

The results relate only to the items tested/calibrated or value assigned.
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No. EEL- BP** 65/0168

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 I
1/2 inch Bruel&Kjaer 4180	93.93	-0.07	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	1000.4	0.4	± 1.5	±1.0%

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	1.40	± 0.50	±3.0%

Note :

1. No adjustment.
2. The calibrator pressure correction was not included.
3. The microphone volume correction was not included.

Date of Calibration : 17 Jan. 2025

2

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152MTC No. EEL, BP, 65/0168

Nominal Output of Unit Under Test = 114 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 I
1/2 inch Bruel&Kjaer 4180	114.01	0.01	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	1000.3	0.3	± 1.5	±3.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	2.05	± 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 : 17 Jan. 2025Industrial Metrology and Testing Service Centre

Date of Issue : 20 Jan. 2025Ref : 2011268011000116001

End of Certificate3 / 3

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

THAI METEOROLOGICAL DEPARTMENT

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 24 October, 2024Certification No. 360/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger CM-1

Serial No. : 130129ID No. : NWSDCMS1200129

Customer :

Calibration Condition : Temperature 25.1 °CBarometric Pressure 1009.5 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563
: HOOK GAGE NO 1425 : Wind Aloft Plotting Board
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)

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

STANDARD THERMOMETER : Theodor Friedrich : Dry No.8380/94 Wet No. 8389/94
: Thermoschneider No.918802

The Result of Calibration

Sensor model NWSDCMS1200129 Certification No. 360/24
24 October, 2024 Serial No. 1198 Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H ₂ O	inches H ₂ O	mi/sec	m/sec	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 Aloft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	92
180	181
270	

Calibrated by

The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6235 Certification No. 360/24

24 October, 2024 Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.12	1009.81	0.31
1010.35	1010.08	0.27
1010.56	1010.26	0.30
1010.85	1010.48	0.37
1011.05	1010.72	0.33
1011.46	1011.12	0.34
1011.62	1011.56	0.26
1011.95	1011.64	0.31
1012.15	1011.83	0.32
1012.54	1012.26	0.28
1012.81	1012.52	0.29
1010.25	1009.88	0.37
1010.14	1009.81	0.33
1009.95	1009.83	0.32
1009.84	1009.45	0.39
1009.45	1008.12	0.33
1009.32	1008.12	0.20
1009.11	1008.92	0.19
1009.56	1009.23	0.33
1009.86	1009.56	0.30

Average

Calibrated by

Mechanical Engineer

The Result of Calibration

Sensor Temperature Model TPH-1 C Certification No. 360/24
24 October, 2024 Serial No. 6235 Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	45.6	0.0
30.2	30.3	-0.1
15.1	15.1	0.0

Calibrated by

Mechanical Engineer





The Result of Calibration



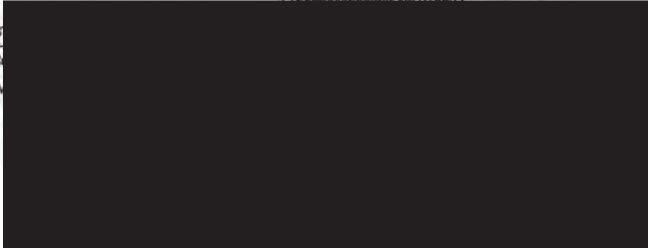
Sensor Humidity Model TPH-1 C Certification No. 360/24
24 October, 2024 Serial No. 6235 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
92.5	91.2	1.3
65.4	64.6	0.8
45.2	44.8	0.4

Calibrated by

Mechanical Engineer

	
Date of Issue 24 October, 2024	Certification No. 360/24
Page: 6 of 6	
ใบรับรอง	
หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ Davis Instruments แบบ TIPPING BUCKET Product No.  ทำการสอบเทียบกับแก้ววัดฝนแบบแก้ววง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm./TIP)	
	
วิศวกรชำนาญการ	
	

	
Calibration Certificate	
Issued by : Calibration & Test Section : Meteorological Instruments Bureau	
Date of Issue 24 October, 2024	Certification No. 361/24
Page : 1 of 6	
Object :	เครื่องมือตรวจวัดอุตุนิยมวิทยา
Manufacturer :	DIACON
Type :	Data Logger MS-100
Serial No. :	130152 ID No. : NWSDCMS1200152
Customer :	
Calibration Condition : Temperature 25.1 °C Barometric Pressure 1009.9 hPa	
NATIONAL STANDARD WIND TUNNEL : Micromanometer Theodor Friedrichs FC014 Serial.9310119	
: HOOK GAGE NO 1425 : Wind Aloft Plotting Board	
N.I.S.T. Test Reference Number 731/241460	
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)	
Serial Number 110730029 (sensor 120629586)	
JAPAN QUALITY ASSURANCE ORGANIZATION	
STANDARD THERMOMETER : Theodor Friedrichs : Dry No.8390/94 Wet No. 8389/94	
: Thermocouple Model No. R18802	
	



The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 361/24
24 October, 2024 Serial No. 1226 Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer					
m/sec	inches H2O	inches H2O	ft/100	m/sec	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	-	-	-	9.0	0.02
11.01	-	-	-	11.0	0.01
13.01	-	-	-	13.0	0.01
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.1	-0.08
20.02	-	+	-	20.0	0.02

Wind Aloft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	91
180	182
270	

Calibrated
Mechanical Engineer



The Result of Calibration

Sensor Pressure Model TPH-1 C
Serial No. 6277 Certification No. 361/24
24 October, 2024 Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.12	1009.95	0.17
1010.35	1010.12	0.23
1010.56	1010.35	0.21
1010.85	1010.64	0.21
1011.05	1010.86	0.19
1011.46	1011.22	0.24
1011.82	1011.54	0.28
1011.95	1011.68	0.27
1012.15	1011.98	0.17
1012.54	1012.31	0.23
1012.81	1012.56	0.25
1010.25	1010.02	0.23
1010.14	1009.86	0.28
1009.95	1009.73	0.22
1009.84	1009.65	0.19
1009.45	1009.15	0.30
1009.32	1009.10	0.22
1009.11	1008.86	0.25
1009.56	1009.12	0.44
1009.86	1009.65	0.21

Average

Calibrated
Mechanical Engineer





The Result of Calibration

Sensor Temperature Model TPH-1 C Certification No. 361/24
24 October, 2024 Serial No. 6277 Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	45.7	-0.1
30.2	30.2	0.0
15.1	15.1	0.0

Calibrated by



Mechanical Engineer



The Result of Calibration

Sensor Humidity Model TPH-1 C Certification No. 361/24
24 October, 2024 Serial No. 6277 Page : 5 of 6


Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
92.5	89.5	3.0
65.4	64.3	1.1
45.2	44.8	0.4

Calibrated by



Mechanical Engineer







Date of Issue 24 October, 2024


Certification No. 361/24

Page: 6 of 6


ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชื่อ Davis Instruments แบบ TIPPING
BUCKET Product No.  ทำการสอบเทียบกับแก้ววัด
ฝนแบบแก้วทรง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/TIP)



ลงชื่อ 

วิศวกรชำนาญการ



ภาคผนวกที่ 7-3
เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
ครั้งที่ 3/2567
สถานีโรงเรียนกรุงเทพคริสเตียนวิทยาลัย
สถานีโรงพยาบาลเซนต์หลุยส์
วันที่ตรวจวัดวันที่ 5-10 กุมภาพันธ์ 2568

TSP High Volume Sampler Calibration

Verification Report No.
SO2500026-E001-TSP_01

☐ PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM: 47P 1517388 664628
 Sampler: NTSP#21
 Recorder: ECRDCPR4169240

Date: 5 Feb 25
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 989.0	Corrected Pressure (mm Hg): 741.8
Temperature (deg C): 34.0	Temperature (deg K): 307.0
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 32.0	Average Temp. (deg K): 305.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc	Qstd Slope: 2.02024
Model: TE-5025A	Qstd Intercept: -0.02667
Serial#: 5411	Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.46	1.714	54.0	52.56
2	10.57	1.580	48.0	46.72
3	8.87	1.448	44.0	42.83
4	5.58	1.151	36.0	35.04
5	3.32	0.891	30.0	29.20

LINEAR REGRESSION
 Slope = 27.6410
 Intercept = 3.7668
 Corr. coeff = 0.9936
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min
 36
52

Calibrated by: XXXXXXXXXX
 5 February 2025
 Approved by: XXXXXXXXXX
 5 February 2025

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www.envilabtesting.com Environmental responsibility with accuracy measurement

15-ENV17-23 Rev. 02-01/01/07

TSP High Volume Sampler Calibration

Verification Report No.
SO2500026-E001-TSP_02

☐ PM ☒ Onsite
 Site: กรุงเทพมหานครเขตหลักสี่
 UTM: 47P 1517300 664905
 Sampler: ETSP#44
 Recorder: 0

Date: 5 Feb 25
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 989.0	Corrected Pressure (mm Hg): 741.8
Temperature (deg C): 34.0	Temperature (deg K): 307.0
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc	Qstd Slope: 2.02024
Model: TE-5025A	Qstd Intercept: -0.02667
Serial#: 5411	Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.92	1.745	54.0	52.56
2	10.44	1.570	48.0	46.72
3	7.49	1.332	42.0	40.88
4	4.37	1.020	34.0	33.09
5	3.00	0.848	28.0	27.25

LINEAR REGRESSION
 Slope = 27.2736
 Intercept = 4.5657
 Corr. coeff = 0.9985
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min
 36
52

Calibrated by: XXXXXXXXXX
 5 February 2025
 Approved by: XXXXXXXXXX
 5 February 2025

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PM10 High Volume Sampler Calibration

Verification Report No.
SO2500026-E001-PM 01

L ☐ PM ☒ Onsite
 Site: โรงพยาบาลเทพรัตนราชธานี
 UTM: 47P 1517388 664628
 Sampler: NPM10#18
 Recorder: ECRDS01618124
 Date: 5 Feb 25
 Technical:
 Approval:

CONDITIONS

Barometric Press. (hPa): 999.0 Corrected Pressure (mm Hg): 741.8
 Temperature (deg C): 34.0 Temperature (deg K): 307.0
 Average Press. (hPa): 1013.0 Corrected Avg Press. (mm Hg): 759.8
 Average Temp. (deg C): 32.0 Average Temp. (deg K): 305.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc. Qstd Slope: 1.26504
 Model: TE-5025A Qstd Intercept: -0.01667
 Serial#: 5411 Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.53	1.813	54.0	34.74
2	9.65	1.593	50.0	32.17
3	7.15	1.373	42.0	27.02
4	4.53	1.096	34.0	21.87
5	2.79	0.863	28.0	18.01

LINEAR REGRESSION
 Slope = 18.2545
 Intercept = 2.1647
 Corr. coeff = 0.9967
 SFR = 1.165
 SSP = 36.42
 # of Observations: 5
 Range of Chart: 34
 at SFR ±10%: 39

Calibrated by:
 5 February 2025
 Approved by:
 5 February 2025

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www.evtesting.com Environmental responsibility with accuracy measurement

PM10 High Volume Sampler Calibration

Verification Report No.
SO2500026-E001-PM 02

L ☐ PM ☒ Onsite
 Site: โรงพยาบาลเทพรัตนราชธานี
 UTM: 47P 1517300 664905
 Sampler: EPM10#45
 Recorder: ECRDS01618125
 Date: 5 Feb 25
 Technical:
 Approval:

CONDITIONS

Barometric Press. (hPa): 999.0 Corrected Pressure (mm Hg): 741.8
 Temperature (deg C): 34.0 Temperature (deg K): 307.0
 Average Press. (hPa): 1013.0 Corrected Avg Press. (mm Hg): 759.8
 Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc. Qstd Slope: 1.26504
 Model: TE-5025A Qstd Intercept: -0.01667
 Serial#: 5411 Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.30	1.797	54.0	34.74
2	9.45	1.576	50.0	32.17
3	7.94	1.446	44.0	28.31
4	4.23	1.059	34.0	21.87
5	2.94	0.885	28.0	18.01

LINEAR REGRESSION
 Slope = 18.5850
 Intercept = 1.8794
 Corr. coeff = 0.9957
 SFR = 1.173
 SSP = 36.80
 # of Observations: 5
 Range of Chart: 34
 at SFR ±10%: 39

Calibrated by:
 5 February 2025
 Approved by:
 5 February 2025

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Verification Test Report

Report No.:
SO2500026-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 1517701 664657

Calibrated Date: 5 February 2025
Site : โรงเรียนกรุงเทพคริสเตียน
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 2199

Environment: Temperature 34 °C Humidity 66 %RH

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

Date: 5 February 2025

Approve By:

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Verification Test Report

Report No.:
SO2500026-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P 1517271 664905

Calibrated Date: 5 February 2025
Site : โรงพยาบาลเซนต์หลุยส์
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 2205

Environment: Temperature 34 °C Humidity 66 %RH

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

Date: 5 February 2025

Approve By:

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**RECALIBRATION
DUE DATE:
February 9, 2025**

Certificate of Calibration

Calibration Certification Information					
Cal. Date: February 9, 2024	Rootsmeier S/N: 438320	Ta: 295 °K			
Operator: Jim Tisch		Pa: 749.0 mm Hg			
Calibration Model #: TE-5025A	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	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 (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9914	0.7106	1.4111	0.9957	0.7138	0.8875
0.9871	1.0032	1.9956	0.9915	1.0076	1.2551
0.9851	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= 1.26504
		b= -0.02667			b= -0.01677
		r= 0.99993			r= 0.99993

Calculations	
Vstd= ΔVol((Pa-ΔP)/Pstd)(Tstd/Ta)	Va= ΔVol((Pa-ΔP)/Pa)
Qstd= Vstd/ΔTime	Qa= Va/ΔTime

For subsequent flow rate calculations:

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

Standard Conditions

Tstd: 298.15 °K

Pstd: 760 mm Hg

Key

ΔH: calibrator manometer reading (in H2O)

ΔP: rootsmeier manometer reading (mm Hg)

Ta: actual absolute temperature (°K)

Pa: actual barometric pressure (mm Hg)

b: intercept

m: slope

RECALIBRATION

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

Tisch Environmental, Inc.
45 South Miami Avenue
Willage of Cleves, OH 45002

www.tisch-env.com
TOLL FREE: (877) 363-7610

Certificate of Calibration

Page : 1 of 2

Certificate No. : 68-200034-1

Submitted by : [REDACTED]

Equipment : Electronic Balance

Manufacturer : Sartorius Model : SECURA224-1S

Serial No. : 0034803270 ID No. : ELABBALANCE04

Capacity : 220 g Resolution : 0.0001 g

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

Ambient Temperature : (20.4 to 21.0) °C

Relative Humidity : (41.9 to 42.9) %

Air Pressure : 1014.0 mbar

Date of Received : 28 January 2025

Date of Calibration : 28 January 2025

Date of Issue : 30 January 2025

Calibrated by : Akaradath 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-E264	C02242009	07 Nov 2025	National Institute of Metrology (Thailand), (NIMT)

The Uncertainties are for a confidence probability of approximately 95%

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CAL-F0031-03

Certificate of Calibration

Certificate No. : 68-200034-1

Page : 2 of 2

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	0.0000	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
0.0004 0.0004 0.0005 0.0004 0.0000 g



Repeatability
Load test : 200 g
Sidev. : 0.00005 g

-o0o-

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:

Part Number: E04N199E15A00V3
Cylinder Number: EB0160267
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12023
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 160-402685487-1
Cylinder Volume: 144.0 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Mar 31, 2023

Expiration Date: Mar 31, 2026

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 600/R-12/531, using the assay procedures issued. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted. The results relate only to the items listed. The report shall not be reproduced except in full without approval of the laboratory. Do not use this cylinder below 100 psig, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
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	45.59 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
NTRM	210607-22	CC708067	48.41 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%	Sep 21, 2025
PRM	12395	D887660	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 22, 2022
GMIS	124206889104	CC322509	4.328 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 21, 2025
NTRM	160610-01	CC473196	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Mar 22, 2028
GMIS	07212022B109	EB0141209	50.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Dec 21, 2026
CO	220608	CC744768	2501.8 PPM CARBON MONOXIDE/NITROGEN	+/-0.5%	Sep 30, 2028

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Mar 07, 2023
Nicolet IS50 FTIR AUP2010245 NO	FTIR	Mar 09, 2023
Nicolet IS50 FTIR AUP2010245 NO2	FTIR	Mar 23, 2023
Nicolet IS50 FTIR AUP2010245 SO2	FTIR	Mar 16, 2023

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg
Net Weight: 4.8 Kg
PO# 5223001123

Approved for Release

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6801002

Calibrated Date: 15/1/2025

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API S/N: ESOA100E01002
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Calibration System

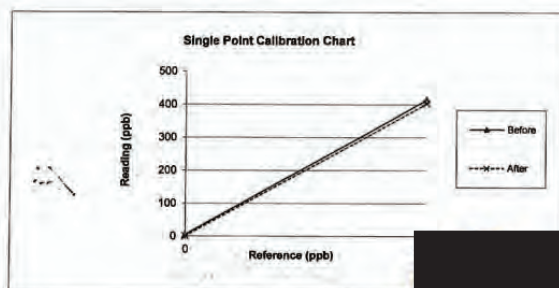
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 24.6 °C

Humidity: 54 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	5.3	5.3	400.0	414.4	1.8
After	0.0	0.6	0.6	400.0	403.1	0.4



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6801002

Calibrated Date: 15/1/2025

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	15/1/2025				
Time	13:45				
Range	50 - 20000	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.2	0.1	
Sample Flow	650 (+/- 50)	cc/min	582.0	581.0	
PMT Detector	0 - 5000	mV	255.6	61.0	
Norm PMT Detector	0 - 5000	mV	59.7	65.2	
HVPS	400-900 constant	V	607.0	607.0	
DCPS	2500 (+/- 200)	mV	-	-	
RCELL TEMP	50 (+/- 1)	Degree C	50.0	50.0	
BOX TEMP	20-40	Degree C	34.0	34.1	
PMT TEMP	7 (+/-1)	Degree C	8.0	8.0	
UV lamp	1000-4900	mV	1981.0	1981.0	
Lamp Ratio	30-120	%	82.6	82.6	
STR Light (Zero Gas)	<100	PPB	61.5	61.7	
Dark PMT	(-50) - (+200)	mV	3.8	3.6	
Dark Lamp	(-50) - (+200)	mV	56.5	57.0	
SAMP PRES	20-30 constant	IN-Hg-A	29.3	29.3	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	1682.0	2044.0	
SO2 Conc	1000 (+/- 250)	PPB	841.0	1022.0	
SO2 Slope	1 (+/- 0.3)	-	1.224	1.104	
SO2 Offset	< 250	mV	24.6	8.0	
Stability at Zero	< 0.2	PPB	0.2	0.2	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.2	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	5.3	0.6	
Span Gas (400 PPB)	400	ppb	414.4	403.1	± 5% of Range

Calibrate By: _____

Approve By: _____

Date: 15/1/2025

Date: 15/1/2025

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6801003

Calibrated Date: 21/1/2025

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: 100E	Manufacturer API S/N: ESOAI100E01108
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Calibration System

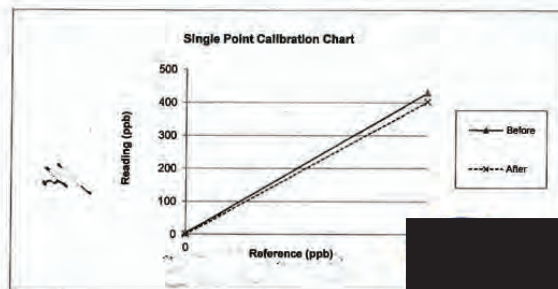
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 24.0 °C

Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	4.9	4.9	400.0	429.5	3.6
After	0.0	0.3	0.3	400.0	402.4	0.3



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6801003

Calibrated Date: 21/1/2025

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	21/1/2025				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	850 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
HVPS	400-900 constant	V	719	648	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL TEMP	50 (+/- 1)	Dreagee C	50	50	
BOX TEMP	20-40	Dreagee C	34.1	32.7	
PMT TEMP	7 (+/-1)	Dreagee C	8.0	8.0	
UV lamp	1000-4900	mV	4034.0	4034.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR. Light (Zero Gas)	<100	PPB	29	29	
Dark PMT	(-50) - (+200)	mV	44.7	44.7	
Dark lamp	(-50) - (+200)	mV	5.1	5.1	
SAMP PRES	20-30 contant	IN-Hg-A	28.1	27.8	
Electric Test/Optic Test					
PMT Volta	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	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	4.9	0.3	
Span Gas (400 PPB)	400	ppb	429.5	402.4	± 5% of Range

Calibrate By :

Approve By :

Date: 21/1/2025

Date: 21/1/2025

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6802003

Page:1/1

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20002470
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 24.7 °C

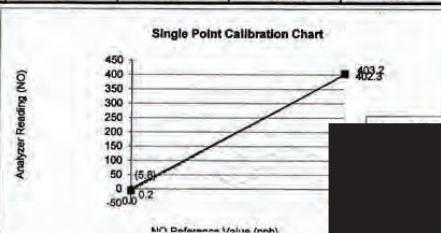
Humidity: 56 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-0.9	0.0	-0.9	401.0	400.0	0.1
NO ₂	-4.9	0.0	-4.9	2.2	0.0	0.3
NOx	-5.8	0.0	-5.8	403.2	400.0	0.4

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.1	0.0	0.1	399.1	400.0	-0.1
NO ₂	0.1	0.0	0.1	3.2	0.0	0.4
NOx	0.2	0.0	0.2	402.3	400.0	0.3



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6802003

Page:1/1

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-25				
Time	10:10				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	511	532	
Ozone Flow	60-80	cc/min	80	80	
PMT Detector	0-5000	mV	27.4	16.4	
AZERO	-20-150	mV	54.2	54.2	
HVPS	400-900 constant	V	819	819	
DCPS	2500 +/- 200	mV	-	-	
RCCELL TEMP	50 +/- 1	Dreogee C	50	50	
BOX TEMP	20-35	Dreogee C	33.7	32.9	
PMT TEMP	7 +/- 1	Dreogee C	7.1	7.1	
IZS TEMP	50 +/- 4	Dreogee C	-	-	
MOLY Temp	315 +/- 5	Dreogee C	314.4	315.0	
RCCL PRES	4-10 constant	IN-Hg-A	10	10	
SAMP PRES	20-30 constant	IN-Hg-A	29.0	29.4	
NO Slope	1 +/- 0.3		0.820	0.801	
NOx Slope	1 +/- 0.3		0.848	0.813	
NO Offset	-10 to + 150	mV	10.2	15.3	
NOx Offset	-10 to + 150	mV	-2.0	-3.4	
Span and Cal Values					
Zero Value	NO	0	ppb	-0.9	0.1
	NOx	0	ppb	-5.8	0.2
Span Value	NO	400	ppb	401.0	399.1
	NOx	400	ppb	403.2	402.3

Calibrate By: [Signature]

Approve By: [Signature]

Date: 1-Feb-25

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6802001

Page:1/1

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENQAI200A02600
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.30 PPM
	SO2 Conc 45.05 PPM
	CO Conc 4528 PPM
	Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 26.5 °C

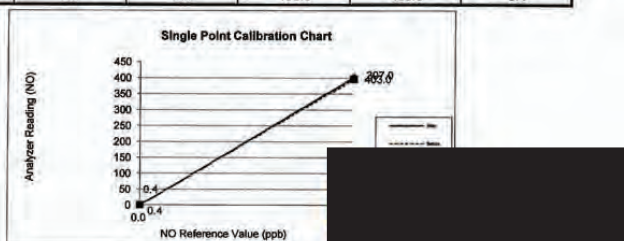
Humidity: 64 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.6	0.0	0.6	405.8	400.0	0.7
NO ₂	-0.2	0.0	-0.2	-8.8	0.0	0.0
NOx	0.4	0.0	0.4	397.0	400.0	-0.4

Calibration Check (After adjust)

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



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6802001

Page:1/1

Calibrated Date: 1-Feb-25

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Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-25				
Time	11:20				
Range	0.00 - 500.00 PPB	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.8	0.2	
Sample Flow	500 +/- 50	cc/min	470.0	476.0	
Orson Flow	80-80	cc/min	90.0	76.0	
PMT Detector	0-5000	mV	24.8	19.6	
AZERO	-20-150	mV	11.7	7.3	
HVPS	400-900 constant	V	768.0	714.0	
DCPS	2500 +/- 200	mV	-	-	
RCCELL TEMP	50 +/- 1	Dreagee C	50.3	50.3	
BOX TEMP	20-35	Dreagee C	28.0	27.5	
PMT TEMP	7 +/- 1	Dreagee C	7.7	7.8	
ISZ TEMP	50 +/- 4	Dreagee C	-	-	
MOLY Temp	315 +/- 5	Dreagee C	313.1	315.0	
RCCEL 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		0.647	0.963	
Nox Slope	1 +/- 0.3		0.652	0.940	
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	0	ppb	0.6	0.2
	NOx	0	ppb	0.4	0.4
Span Value	NO	400	ppb	405.8	400.0
	NOx	400	ppb	397.0	403.0

Calibrate By :

Approve By :

Date: 1-Feb-25

Date: 1-Feb-25

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6802006

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer Environnement SA.,France S/N: ECOESACO12E205
--	--

Calibration System

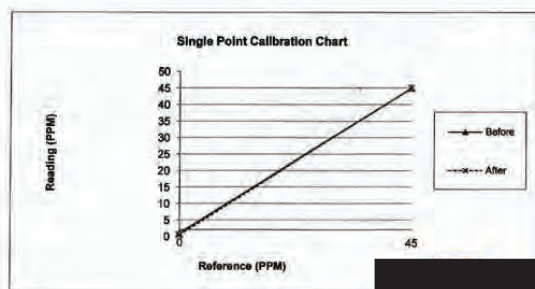
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.30 PPM
	SO2 Conc 45.05 PPM
	CO Conc 4528 PPM
	Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 27.2 °C

Humidity: 67 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.988	1.0	45.0	44.96	0.0
After	0.0	0.397	0.4	45.0	45.02	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6802006

Calibrated Date: 1-Feb-25

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Page:2/2

Analyzer Signal Values					
Date	1-Feb-25	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 ratio	884.7	mA	Pbse current	618.2	mV
Optical T.	46.0	deg.C	Pbse T.	-24.2	deg.C
Measure sig.	508.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
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 :

Date: 1-Feb-25

Date: 1-Feb-25

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6802002

Calibrated Date: 1-Feb-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: NCOESACO12E355
--	---

Calibration System

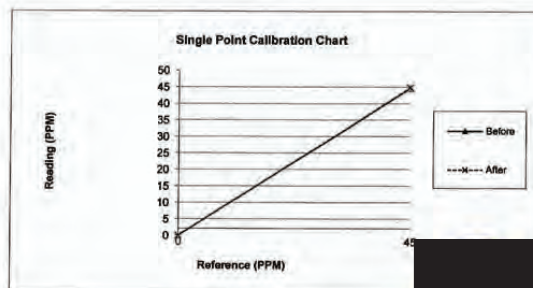
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792	NOx Conc: 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc: 45.30 PPM
	SO2 Conc: 45.05 PPM
	CO Conc: 4528 PPM
	Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature 27.2 °C

Humidity: 68 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	-0.072	-0.1	45.0	44.60	-0.4
After	0.0	0.005	0.0	45.0	44.84	-0.2



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6802002

Calibrated Date: 1-Feb-25

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Page:2/2

Analyzer Signal Values					
Date	1-Feb-25	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 ratio	884.7	mA	Pbse current	618.2	mV
Optical T.	46.0	deg.C	Pbse T.	-24.2	deg.C
Measure sig.	506.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
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-25

Date: 1-Feb-25

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Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 24 October, 2024

Certification No. : 360/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger CM-1

Serial No. : 130129 ID No. : NWSDCMS1200129

Customer : Envilab Co.,Ltd.(Head Office)
540.540/1 Soi Bangkhae 7, Bangkhae, Bangkhae
Bangkok 10160,Thailand.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1009.5 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563
: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)

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

STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94
: Thermoschneider No.918802

The Result of Calibration

Sensor model : NWSDCMS1200129

Certification No. : 360/24

24 October, 2024

Serial No. : 1198

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	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 Aloft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	92
180	181

The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6235

Certification No. 360/24

24 October, 2024

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.12	1009.81	0.31
1010.35	1010.08	0.27
1010.56	1010.26	0.30
1010.85	1010.48	0.37
1011.05	1010.72	0.33
1011.46	1011.12	0.34
1011.82	1011.56	0.26
1011.95	1011.64	0.31
1012.15	1011.83	0.32
1012.54	1012.26	0.28
1012.81	1012.52	0.29
1010.25	1009.88	0.37
1010.14	1009.81	0.33
1009.95	1009.63	0.32
1009.84	1009.45	0.39
1009.45	1009.12	0.33
1009.32	1009.12	0.20
1009.11	1008.92	0.19
1009.56	1009.23	0.33
1009.86	1009.56	0.30

Calibra

Mechanical Engineer

The Result of Calibration

Sensor Temperature Model TPH-1 C

Certification No. 360/24

24 October, 2024

Serial No. 6235

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	45.6	0.0
30.2	30.3	-0.1
15.1	15.1	0.0

Calibre

Mechanical Engineer

The Result of Calibration

Sensor Humidity Model TPH-1 C Certification No. 360/24
24 October, 2024 Serial No. 6235 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
92.5	91.2	1.3
65.4	64.8	0.6
45.2	44.8	0.4

Calibrated by

Mechanical Engineer

Date of Issue 24 October, 2024

Certification No. 360/24

Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีฟือ Davis Instruments แบบ TIPPING
BUCKET Product No. 7342.026 Code No. NWSDCMS1200129 ทำการสอบเทียบกับแก้ววัด
ฝนแบบแก้วดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm./TIP)

ลงชื่อ

วิศวกรชำนาญการ



Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 24 October, 2024

Certification No. 358/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิตามอากาศ

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2509

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1009.5 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

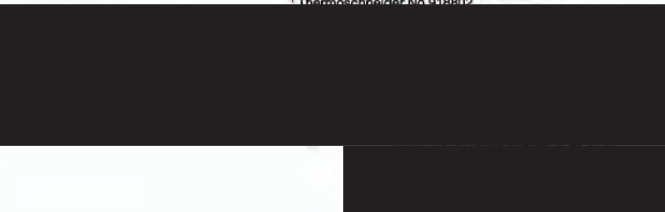
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)

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

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

: Thermoschneider No.518802



The Result of Calibration

Sensor model EWSNV110WS2509

Certification No. 358/24

24 October, 2024

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	Inches H2O	Inches H2O	m/sec	m/sec	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	-	-	-	9.1	-0.08
11.01	-	-	-	11.0	0.01
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.1	-0.08
20.02	-	-	-	20.1	-0.08

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

Calibrated

Mechanical Engineer



[Redacted]			[Redacted]		
The Result of Calibration			The Result of Calibration		
Sensor model		EWSNV110WS2509	Sensor model		EWSNV110WS2509
24 October, 2024		Certification No. 358/24	24 October, 2024		Certification No. 358/24
		Page : 3 of 6			Page : 4 of 6
Standard Barometer	Tested Barometer	Correction	Standard	Temperature Sensor Reading	
Pressure	Pressure		Temp.	Reading	Correction
			°C	°C	°C
1010.12	1009.52	0.60	45.6	45.8	-0.2
1010.35	1009.78	0.57	30.2	30.3	-0.1
1010.58	1009.98	0.58	15.1	14.9	0.2
1010.85	1010.35	0.50			
1011.05	1010.48	0.57			
1011.48	1010.82	0.64			
1011.82	1011.23	0.59			
1011.95	1011.42	0.53			
1012.15	1011.68	0.57			
1012.54	1011.95	0.59			
1012.81	1012.29	0.52			
1010.25	1009.68	0.57			
1010.14	1009.64	0.50			
1009.95	1009.38	0.57			
1009.84	1009.18	0.66			
1009.45	1008.85	0.60			
1009.32	1008.73	0.59			
1009.11	1008.58	0.53			
1009.56	1008.93	0.63			
1009.86	1009.21	0.65			
[Redacted]			[Redacted]		
Mechanical Engineer			[Redacted]		
[Redacted]			[Redacted]		



The Result of Calibration

Sensor model EWSNV110WS2509 Certification No. 358/24
24 October, 2024 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
92.5	96.5	-4.0
65.4	68.1	-2.7
45.2	46.1	-0.9

Calibrate

Mechanical Engineer



Date of Issue 24 October, 2024

Certification No. 358/24

Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้รับรองว่า เครื่องวัดฝน ยี่ห้อ Davis Instruments แบบ TIPPING
BUCKET Product No. 7342.026 Code No. EWSNV110WS2509 ทำการสอบเทียบกับแก้ววัด
ฝนแบบแก้วดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.01.inches/TIP)



ลงชื่อ

วิศวกรชำนาญการ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No.** EEL, BP. 65/0168

CALIBRATION CERTIFICATE

Submitted by : [REDACTED]
Address : [REDACTED]
Calibrated at : [REDACTED]

Instrument Calibrated :
 Description : Acoustic Calibrator
 Manufacturer : Pulsar
 Model : 103
 Serial No. : 98971

Ambient Environment
 Temperature : (23 ± 3) °C
 Relative Humidity : (50 ± 15) %
 Ambient Pressure : (101.325 ± 1.500) kPa

Standards used :

- Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
- Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
- Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
- Digital Multimeter Agilent 34401A S/N MY44005560.
- Pressure Transmitter Vaisala PTB202AD S/N T0650001.
- Audio Analyzer Panasonic VP-7722A S/N 041477D122.
- Condenser Microphone B&K 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 : 10 Jan. 2025
Date of Calibration : 17 Jan. 2025

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

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FM.BLMTC.002 Rev.5

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No.** EEL, BP. 65/0168

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 Bruel&Kjaer 4180	93.93	-0.07	± 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 Bruel&Kjaer 4180	1000.4	0.4	± 1.5	±1.0%

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.40	± 0.50	±3.0%

Note :

- No adjustment.
- The calibrator pressure correction was not included.
- The microphone volume correction was not included.

Date of Calibration : 17 Jan. 2025

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

Head Office
 35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
 Changwat Pathumthani 12120, Thailand
 Tel. (66) 0 2577 9036
 Fax. (66) 0 2577 9009

Office/Laboratory
 668 Mu 2 Tambon Bangpoornai, Amphoe Muang Samutprakan,
 Changwat Samutprakan 10280, Thailand
 Tel. (66) 0 2323 1672-80 ext. 115, 116
 (66) 08 3219 9440
 E-mail : mtc@tistr.or.th Website : www.tistr.or.th

Office
 196 Phahonyothin Road, Ladyao, Chatuchak,
 Bangkok 10900, Thailand
 Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
 (66) 08 1889 6827

FM.BLMTC.002 Rev.5

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 **MTC No.** EEL. BP. 65/0168

Nominal Output of Unit Under Test = 114 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 Bruel&Kjaer 4180	114.01	0.01	± 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 Bruel&Kjaer 4180	1000.3	0.3	± 1.5	±3.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	2.05	± 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 : [Redacted]

Approved by : [Redacted]

Electronics Engineering Laboratory
Industrial Engineering Laboratory

Date of Calibration : 17 Jan. 2025

Date of Issue : 20 Jan. 2025

End of Certificate

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

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

สถานีโรงพยาบาลเซนต์หลุยส์

สถานีโรงเรียนกรุงเทพคริสเตียนวิทยาลัย

ครั้งที่ 4/2567

วันที่ตรวจวัด วันที่ 3 – 8 พฤษภาคม 2568

TSP High Volume Sampler Calibration

Verification Report No.
SQ2500125-E001 -TSP_01

☐ PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM: 47P 664628 m E 1517388 m N
 Sampler: ETSP#34#21685
 Recorder: NCRC1500903157
 Date: 3 May 25
 Technical:
 Approval:

CONDITIONS

Barometric Press. (hPa): 1008.0 Corrected Pressure (mm Hg): 756.1
 Temperature (deg C): 33.2 Temperature (deg K): 306.2
 Average Press. (hPa): 1013.0 Corrected Avg Press. (mm Hg): 759.8
 Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

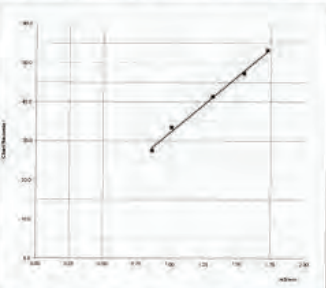
CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc Qstd Slope: 2.06933
 Model: TE-5025A Qstd Intercept: -0.02815
 Serial#: 2067 Date Certified: 4 Mar 25
 Due Date: 03-Mar-26

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.82	1.723	54.0	53.13
2	10.44	1.550	48.0	47.23
3	7.49	1.315	42.0	41.33
4	4.37	1.008	34.0	33.45
5	3.20	0.864	28.0	27.55

LINEAR REGRESSION
 Slope = 28.5383
 Intercept = 3.6707
 Corr. coeff = 0.9974
 # of Observations: 5
 Range of Chart: 36
 at 1.1 - 1.7 m3/min: 53



Calibrated by:
 3 May 2025
 Approved by:
 3 May 2025

www.evltesting.com Environmental responsibility with accuracy measurements

บันทึกใช้ 01/02/2566

TSP High Volume Sampler Calibration

Verification Report No.
SQ2500125-E001 -TSP_02

☐ PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM: 47P 664905 m E 1517300 m N
 Sampler: ETSP#33#5090
 Recorder: NCRC1500904867
 Date: 3 May 25
 Technical:
 Approval:

CONDITIONS

Barometric Press. (hPa): 1008.4 Corrected Pressure (mm Hg): 756.4
 Temperature (deg C): 33.4 Temperature (deg K): 306.4
 Average Press. (hPa): 1013.0 Corrected Avg Press. (mm Hg): 759.8
 Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

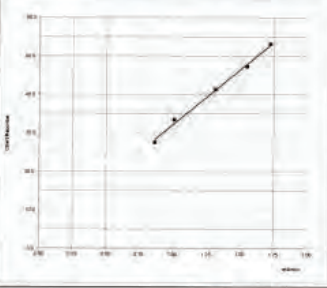
CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc Qstd Slope: 2.06933
 Model: TE-5025A Qstd Intercept: -0.02815
 Serial#: 2067 Date Certified: 4 Mar 25
 Due Date: 03-Mar-26

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.46	1.692	54.0	53.13
2	10.57	1.559	48.0	47.22
3	8.87	1.430	44.0	43.29
4	5.58	1.137	36.0	35.42
5	3.32	0.880	30.0	29.52

LINEAR REGRESSION
 Slope = 28.3127
 Intercept = 3.7909
 Corr. coeff = 0.9936
 # of Observations: 5
 Range of Chart: 36
 at 1.1 - 1.7 m3/min: 52



Calibrated by:
 3 May 2025
 Approved by:
 3 May 2025

www.evltesting.com Environmental responsibility with accuracy measurements

บันทึกใช้ 01/02/2566

PM10 High Volume Sampler Calibration

Verification Report No.
SO2500125-ED01 -PM 01

L PM ☐ Onsite

Site: กรุงเทพมหานคร

UTM: 47P 664628 m E 1517388 m N

Sampler: EPM4483185

Recorder: NCR1105143068

Date: 3 May 25

Technical: [Redacted]

Approval: [Redacted]

CONDITIONS

Barometric Press. (hPa): 1008.0 Corrected Pressure (mm Hg): 756.1
 Temperature (deg C): 33.2 Temperature (deg K): 306.2
 Average Press. (hPa): 1013.0 Corrected Avg. Press. (mm Hg): 759.8
 Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc Slope: 1.29578
 Model: TE-5025A Intercept: -0.01772
 Serial#: 2067 Date Certified: 4 Mar 25
 Due Date: 3 Mar 26

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.31	1.737	52.0	33.09
2	9.45	1.523	48.0	30.55
3	7.94	1.398	44.0	28.00
4	4.23	1.024	34.0	21.64
5	2.94	0.856	28.0	17.82

Slope = 17.4564
 Intercept = 3.3955
 Corr. coeff = 0.9964
 SFR = 1.148
 SSP = 36.61
 # of Observations: 5
 Range of Chart at SFR ±10%: 35

Calibrated by: [Redacted]
3 May 2025

Approved by: [Redacted]
3 May 2025

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Environmental responsibility with accuracy measurement

วันที่ 01/02/2566

PM10 High Volume Sampler Calibration

Verification Report No.
SO2500125-ED01 -PM 02

L PM ☐ Onsite

Site: กรุงเทพมหานคร

UTM: 47P 664905 m E 1517300 m N

Sampler: EPM47W3981

Recorder: NCRAND00004601

Date: 3 May 25

Technical: [Redacted]

Approval: [Redacted]

CONDITIONS

Barometric Press. (hPa): 1008.4 Corrected Pressure (mm Hg): 756.4
 Temperature (deg C): 33.4 Temperature (deg K): 306.4
 Average Press. (hPa): 1013.0 Corrected Avg. Press. (mm Hg): 759.8
 Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc Slope: 1.29578
 Model: TE-5025A Intercept: -0.01772
 Serial#: 2067 Date Certified: 4 Mar 25
 Due Date: 3 Mar 26

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.53	1.752	54.0	34.37
2	9.65	1.540	50.0	31.82
3	7.15	1.327	42.0	26.73
4	4.53	1.089	34.0	21.64
5	2.79	0.834	28.0	17.82

Slope = 18.6981
 Intercept = 2.1240
 Corr. coeff = 0.9967
 SFR = 1.148
 SSP = 37.06
 # of Observations: 5
 Range of Chart at SFR ±10%: 35

Calibrated by: [Redacted]
3 May 2025

Approved by: [Redacted]
3 May 2025

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วันที่ 01/02/2566

Verification Test Report

Report No.:

Test Data -SLM 01

☐ PM ☒ Onsite UTM : 47P 664657 m E 1517401 m N

Calibrated Date: 3 May 2025

Site : โรงเรียนกรุงเทพคริสเตียน

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : ESMPUMD44N1860

Environment: Temperature 25 °C Humidity 69 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 103 ,Pulsar

Serial No.98971

Date of Calibration : 17 Jan 2025

Uncertainty : 0.10 dB

Result of Test			
Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.93	94.00	0.07	93.93
Error After Adjust (dB)	Total Error (dB)	Acceptant value	Pass/Fail Judgment
0.00	0.10	±1.0 dB	Pass

Calibrated By:

Date: 3 May 2025

Approve By:

Date: 3 May 2025

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ประกาศใช้ 01/02/2566

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FE-MNT-01-22-Rev.01

Verification Test Report

Report No.:

Test Data -SLM 02

☐ PM ☒ Onsite UTM : 47P 664905 m E 1517271 m N

Calibrated Date: 3 May 2025

Site : โรงพยาบาลเซนต์หลุยส์

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : NSMPUMD44N1968

Environment: Temperature 25 °C Humidity 69 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 103 ,Pulsar

Serial No.98971

Date of Calibration : 17 Jan 2025

Uncertainty : 0.10 dB

Result of Test			
Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.93	94.10	0.17	93.93
Error After Adjust (dB)	Total Error (dB)	Acceptant value	Pass/Fail Judgment
0.00	0.10	±1.0 dB	Pass

Calibrated By:

Date: 3 May 2025

Approve By:

(Wisan Ritthikamon)

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ประกาศใช้ 01/02/2566

www.evitestesting.com

FE-MNT-01-22-Rev.01

Certificate of Calibration

Certificate No. : 68-200034-1 **Page : 1 of 2**

Submitted by : [REDACTED]

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 : (20.4 to 21.0) °C
 Relative Humidity : (41.9 to 42.9) %
 Air Pressure : 1014.0 mbar

Date of Received : 28 January 2025
Date of Calibration : 28 January 2025
Date of Issue : 30 January 2025
Calibrated by : Akaradath 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	C02242009	07 Nov 2025	National Institute of Metrology (Thailand), (NIMT)

The Uncertainties are for a confidence probability of approximately 95%
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CAL-P0031-03

Certificate of Calibration

Certificate No. : 68-200034-1 **Page : 2 of 2**

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	0.0000	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	0.0004 0.0004 0.0005 0.0004 0.0000 g

Repeatability

Load test	200 g
Sidev.	0.00005 g

-o0o-



RECALIBRATION DUE DATE: March 4, 2026

Certificate of Calibration

Calibration Certification Information				
Cal. Date: March 4, 2025	Rootmeter S/N: 438320	Tac: 294	*K	
Operator: Jim Tisch		Pa: 746.0	mm Hg	
Calibration Model #: TE-5025A	Calibrator S/N: 2067			

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4220	3.2	2.00
2	3	4	1	1.0090	6.4	4.00
3	5	6	1	0.9030	8.0	5.00
4	7	8	1	0.8610	8.8	5.50
5	9	10	1	0.7090	12.8	8.00

Data Tabulation					
Vstd (m3)	Qstd (y-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9907	0.6967	1.4106	0.9957	0.7002	0.8878
0.9864	0.9776	1.9949	0.9914	0.9826	1.2556
0.9843	1.0900	2.2304	0.9893	1.0955	1.4038
0.9832	1.1419	2.3393	0.9882	1.1477	1.4723
0.9779	1.3792	2.8212	0.9828	1.3862	1.7756
QSTD		m= 2.06933	QA		m= 1.29578
		b= -0.02815			b= -0.01772
		r= 0.99997			r= 0.99997

Calculations			
Vstd= ΔVol((Pa-ΔP)/Pstd)/(Tstd/Ta)	Va= ΔVol((Pa-ΔP)/Pa)		
Qstd= Vstd/ΔTime	Qa= Va/ΔTime		
For subsequent flow rate calculations:			
Qstd= 1/m $\left(\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)} - b \right)$	Qa= 1/m $\left(\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)} - b \right)$		

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

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

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

Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
3441 Easton Road
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:	BANGKOK INDUSTRIAL	Reference Number:	160-402685487-1
Part Number:	GAS CO LTD	Cylinder Volume:	144.0 CF
Cylinder Number:	E04N199E15A00V3	Cylinder Pressure:	2015 PSIG
Laboratory:	124 - Plumsteadville - PA	Valve Outlet:	660
PGVP Number:	A12023	Certification Date:	Mar 31, 2023
Gas Code:	CO, NO, NOX, SO2, BALN		

Expiration Date: Mar 31, 2026

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012), document EPA-820-R-12-031, using the assay procedures listed. Analytical Methodology does not require correction for analyte interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a molar/mole basis unless otherwise noted. The results relate only to the items listed. The report shall not be reproduced except in full without approval of the laboratory. Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
NOX	45.00 PPM	46.50 PPM	G1	+/- 1.4% NIST Traceable
NITRIC OXIDE	45.00 PPM	46.50 PPM	G1	+/- 1.4% NIST Traceable
SULFUR DIOXIDE	45.00 PPM	45.88 PPM	G1	+/- 1.0% NIST Traceable
CARBON MONOXIDE	4500 PPM	4507 PPM	G1	+/- 1.4% NIST Traceable
NITROGEN	Balance			03/24/2023

CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	219807-22	CC708067	48.41 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%
PRM	12393	D897860	9.91 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%
GMIS	124206889104	CC22509	4.326 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%
NTRM	160610-01	CC473196	48.03 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%
GMIS	072120225109	EB0141209	50.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%
CO	220608	CC744788	2501.6 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	After 07, 2023
Nicolat IS50 FTIR AUP2010245 NO	FTIR	Mar 08, 2023
Nicolat IS50 FTIR AUP2010245 NO2	FTIR	Mar 23, 2023
Nicolat IS50 FTIR AUP2010245 SO2	FTIR	Mar 16, 2023

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg
Net Weight: 4.8 Kg
PD# 5223001123

Approved for Release

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805003

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: ECOESACO12E203
--	---

Calibration System

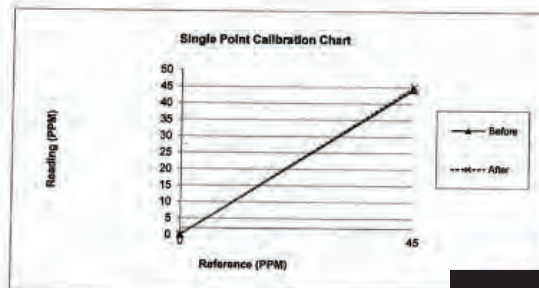
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792	NOx Conc: 45.30 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc: 45.30 PPM
	SO2 Conc: 45.05 PPM
	CO Conc: 4528 PPM
	Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 24.7 °C

Humidity: 67 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.009	0.0	45.0	44.32	-0.8
After	0.0	0.008	0.0	45.0	45.01	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805003

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	2-May-25	Time	10:08:00		
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 ratio	884.7	mA	Ptse current	618.2	mV
Optical T.	46.0	deg.C	Ptse T.	-24.2	deg.C
Measure sig.	506.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
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:

Date: 2-May-25

Approve By:

Date: 2-May-25

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805004

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: ECOESACO12E204
--	---

Calibration System

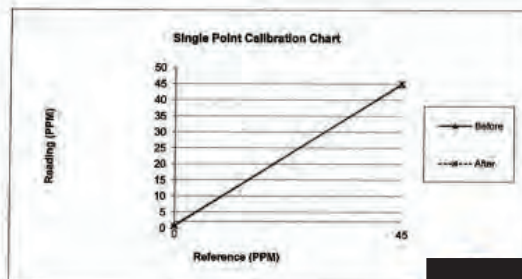
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792	NOx Conc: 45.30 PPM
ZERO AIR Generator: ZAG7001 S/N: 644	NO Conc: 45.30 PPM
	SO2 Conc: 45.05 PPM
	CO Conc: 4528 PPM
	Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature: 24.8 °C

Humidity: 66 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.900	0.9	45.0	44.87	-0.1
After	0.0	0.543	0.5	45.0	45.09	0.1



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6805004

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page: 2/2

Analyzer Signal Values					
Date	2-May-25	Time	10:08:00		
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 ratio	884.7	mA	Pbse current	618.2	mV
Optical T.	46.0	deg.C	Pbse T.	-24.2	deg.C
Measure sig.	506.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
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: 2-May-25

Date: 2-May-25

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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6805004

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: AF22e	Manufacturer: Environnement SA, France S/N: ESOESAF22E2485
---	---

Calibration System

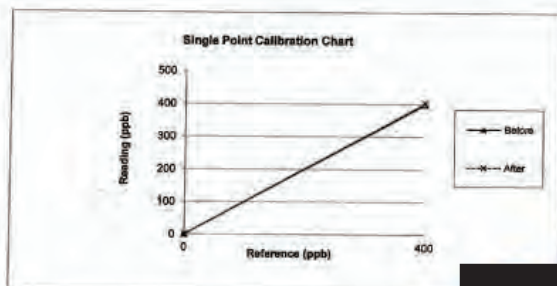
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 782 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature 27.3 °C

Humidity: 63 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.5	0.5	400.0	399.0	-0.1
After	0.0	0.3	0.3	400.0	403.0	0.4



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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6805004

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	2-May-25	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	I UV lamp	44.3	mA
+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	Inst. mass.	22.8	ppb
I UV Lamp	44.7	mA	HV 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:

Date: 2-May-25

Approve By:

Date: 2-May-25

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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6805003

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: AF22e	Manufacturer: Environnement SA, France S/N: ESOESAF22E2482
---	---

Calibration System

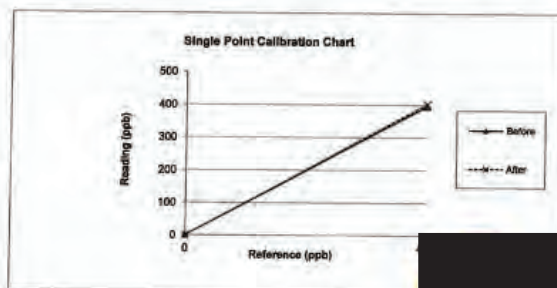
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792	NOx Conc: 45.30 PPM
ZERO AIR Generator: ZAG7001 S/N: 644	NO Conc: 45.30 PPM
	SO2 Conc: 45.05 PPM
	CO Conc: 4528 PPM
	Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature: 26.9 °C

Humidity: 61 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.9	0.9	400.0	396.3	-0.6
After	0.0	0.5	0.5	400.0	403.0	0.4



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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6805003

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page: 2/2

Analyzer Signal Values					
Date	2-May-25	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	I UV lamp	44.3	mA
+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		Meas ratio	0.34	
Mean sig.	0.7		Raw trend	11	
Raw sig.	24.4	ppb	Inst. meas.	22.8	ppb
I UV Lamp	44.7	mA	HV 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: 2-May-25

Approve By: [Redacted]

Date: 2-May-25

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6805003

Page:1/1

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20000108
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23,2027 EB0170003

Environment: Temperature 25.2 °C

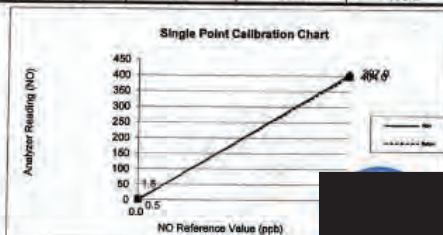
Humidity: 65 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.5	0.0	1.5	394.0	400.0	-0.8
NO ₂	0.3	0.0	0.3	3.0	0.0	0.4
NOx	1.8	0.0	1.8	397.0	400.0	-0.4

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.2	0.0	0.2	401.0	400.0	0.1
NO ₂	0.3	0.0	0.3	3.0	0.0	0.4
NOx	0.5	0.0	0.5	404.0	400.0	0.5



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6805003

Page:1/1

Calibrated Date: 2-May-25

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	2-May-25				
Time	10:10				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	511	532	
Ozone Flow	60-80	cc/min	60	60	
PMT Detector	0-5000	mV	27.4	16.4	
AZERO	-20-150	mV	54.2	54.2	
IN/PS	400-900 constant	V	819	819	
DCPS	2500 +/- 200	mV	-	-	
CELL TEMP	50 +/- 1	Degree C	50	50	
BOX TEMP	20-35	Degree C	33.7	32.9	
PMT TEMP	7 +/- 1	Degree C	7.1	7.1	
IS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	314.4	315.0	
RCCL PRES	4-10 constant	IN-Hg-A	10	10	
SAMP PRES	20-30 constant	IN-Hg-A	29.0	29.4	
NO Slope	1 +/- 0.3		0.820	0.801	
NOx Slope	1 +/- 0.3		0.848	0.813	
NO Offset	-10 to + 150	mV	10.2	15.3	
NOx Offset	-10 to + 150	mV	-2.0	-3.4	
Span and Cal Values					
Zero Value	NO	0	ppb	1.5	0.2
	NOx	0	ppb	1.8	0.5
Span Value	NO	400	ppb	394.0	401.0
	NOx	400	ppb	397.0	404.0

Calibrate By: [Signature]

Approve By: [Signature]

Date: 2-May-25

Date: 2-May-25

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6805004

Page:1/1

Calibrated Date: 2-May-25

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Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200E	Manufacturer API S/N: ENQAI200E02788
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.30 PPM NO Conc 45.30 PPM SO2 Conc 45.05 PPM CO Conc 4528 PPM Expire Date: OCT 23, 2027 EB0170003

Environment: Temperature 25.2 °C

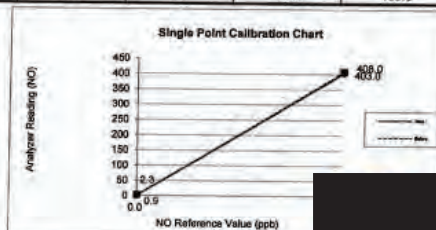
Humidity 54 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.8	0.0	1.8	405.0	400.0	0.6
NO ₂	0.5	0.0	0.5	3.0	0.0	0.4
NOx	2.3	0.0	2.3	408.0	400.0	1.0

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.4	0.0	0.4	400.1	400.0	0.0
NO ₂	0.5	0.0	0.5	2.9	0.0	0.4
NOx	0.9	0.0	0.9	403.0	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6805004

Page:1/1

Calibrated Date: 2-May-25

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Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	2 May-25				
Time	10:10				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	511	532	
Ozone Flow	60-80	cc/min	80	80	
PMT Detector	0-5000	mV	27.4	16.4	
AZERO	-20-150	mV	54.2	54.2	
HVPS	400-800 constant	V	818	818	
DCPS	2500 +/- 200	mV	-	-	
RECELL TEMP	50 +/- 1	Draeger C	50	50	
BOX TEMP	20-35	Draeger C	33.7	32.9	
PMT TEMP	7 +/- 1	Draeger C	7.1	7.1	
IZS TEMP	50 +/- 4	Draeger C	-	-	
MOLY Temp	315 +/- 5	Draeger C	314.4	315.0	
RECEL PRES	4-10 constant	IN-Hg-A	10	10	
SAMP PRES	20-30 constant	IN-Hg-A	29.0	29.4	
NO Slope	1 +/- 0.3		0.820	0.801	
NOx Slope	1 +/- 0.3		0.848	0.813	
NO Offset	-10 to + 150	mV	10.2	15.3	
NOx Offset	-10 to + 150	mV	-2.0	-3.4	
Span and Cal Values					
Zero Value	NO	0	ppb	1.8	0.4
	NOx	0	ppb	2.3	0.9
Span Value	NO	400	ppb	405.0	400.1
	NOx	400	ppb	408.0	403.0


Calibrate By: [Signature]

Approve By: [Signature]

Date: 2-May-25

Date: 2-May-25




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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)
CALIBRATION UNIT

Request No. 21-68/0152 **MTC No.** EEL. BP. 65/0168

CALIBRATION CERTIFICATE

Submitted by 
Address 
Calibrated at 

Instrument Calibrated :		Ambient Environment	
Description	: Acoustic Calibrator	Temperature	: (23 ± 3) °C
Manufacturer	: Pulsar	Relative Humidity	: (50 ± 15) %
Model	: 103	Ambient Pressure	: (101.325 ± 1.500) kPa
Serial No.	: 98971		

Standards used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-303A S/N QF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Panasonic VP-7722A S/N 041477D122.
7. Condenser Microphone B&K 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 : 10 Jan. 2025
Date of Calibration : 17 Jan. 2025

1 / 3

The results relate only to the items tested/calibrated or value assigned.
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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)
CALIBRATION UNIT

Request No. 21-68/0152 **MTC No.** EEL. BP. 65/0168

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
1/2 inch Bruel&Kjaer 4180	93.93	-0.07	± 0.10	IEC60942:2003 Class I ±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit
1/2 inch Bruel&Kjaer 4180	1000.4	0.4	± 1.5	IEC60942:2003 Class I ±1.0%

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit
1/2 inch Bruel&Kjaer 4180	1.40	± 0.50	IEC60942:2003 Class I ±3.0%

Note :

1. No adjustment.
2. The calibrator pressure correction was not included.
3. The microphone volume correction was not included.

Date of Calibration : 17 Jan. 2025

2 / 3

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-68/0152 MTC No. EEL. BP. 65/0168

Nominal Output of Unit Under Test = 114 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 Bruel&Kjaer 4180	114.01	0.01	± 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 Bruel&Kjaer 4180	1000.3	0.3	± 1.5	±3.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	2.05	± 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: [Redacted] Approve: [Redacted]

Date of Calibration : 17 Jan. 2025
Date of Issue : 20 Jan. 2025

Ref : 2011268011000116001
3 / 3

End of Certificate

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Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 24 October, 2024

Certification No. 357/24

Page : 1 of 6

Object : เครื่องวัดความเร็วลม/ทิศทาง

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2508

Customer : EnviLab Co.,Ltd.(Head Office)
540.540/1 Soi Bangkhuae 7, Bangkhuae, Bangkhuae
Bangkok 10160,Thailand.

Calibration Condition : Temperature : 25.1 °C Barometric Pressure : 1009.8 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

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

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



The Result of Calibration

Sensor model EWSNV110WS2508 Certification No. 357/24

24 October, 2024 Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.6	0.40
7.04	-	-	-	6.7	0.34
9.02	-	-	-	9.1	-0.08
11.01	-	-	-	10.7	0.31
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	14.8	0.21
17.02	-	-	-	17.1	-0.08
20.02	-	-	-	20.3	-0.28

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

Calibration



The Result of Calibration

Sensor model EWSNV110WS2508

Certification No. 357/24

24 October, 2024

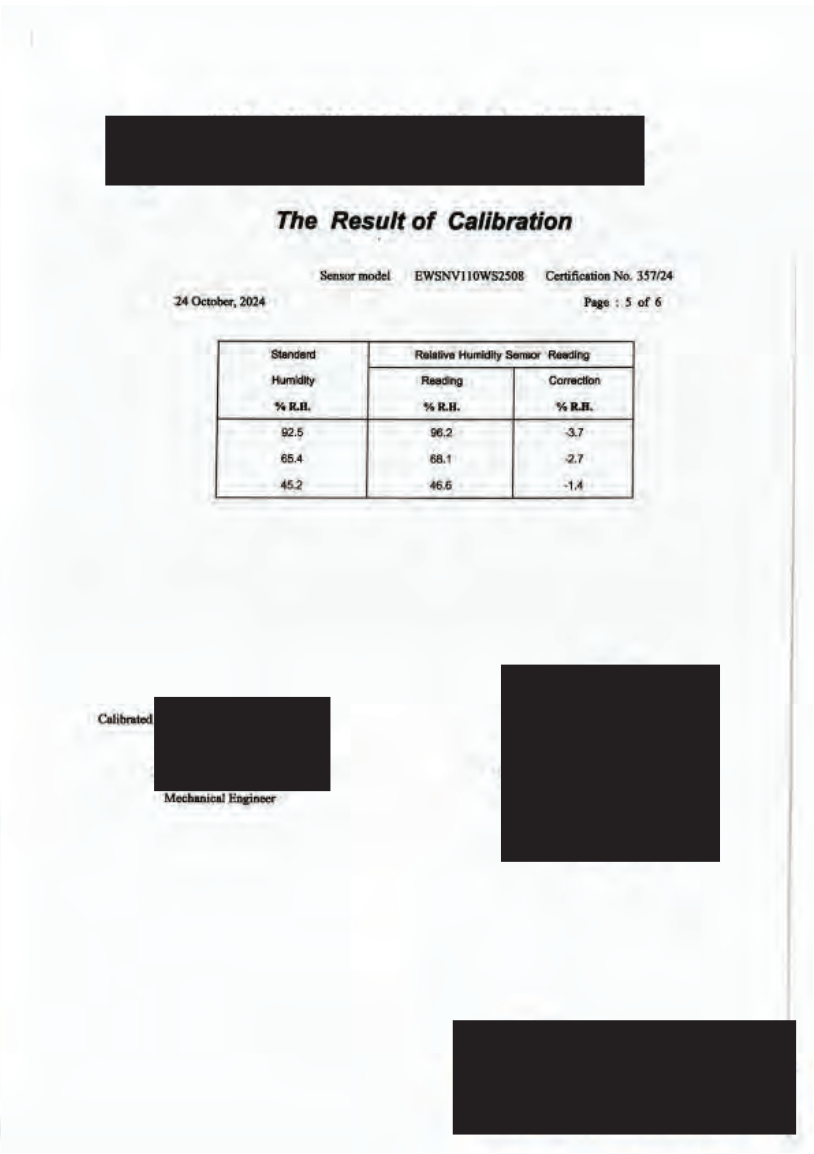
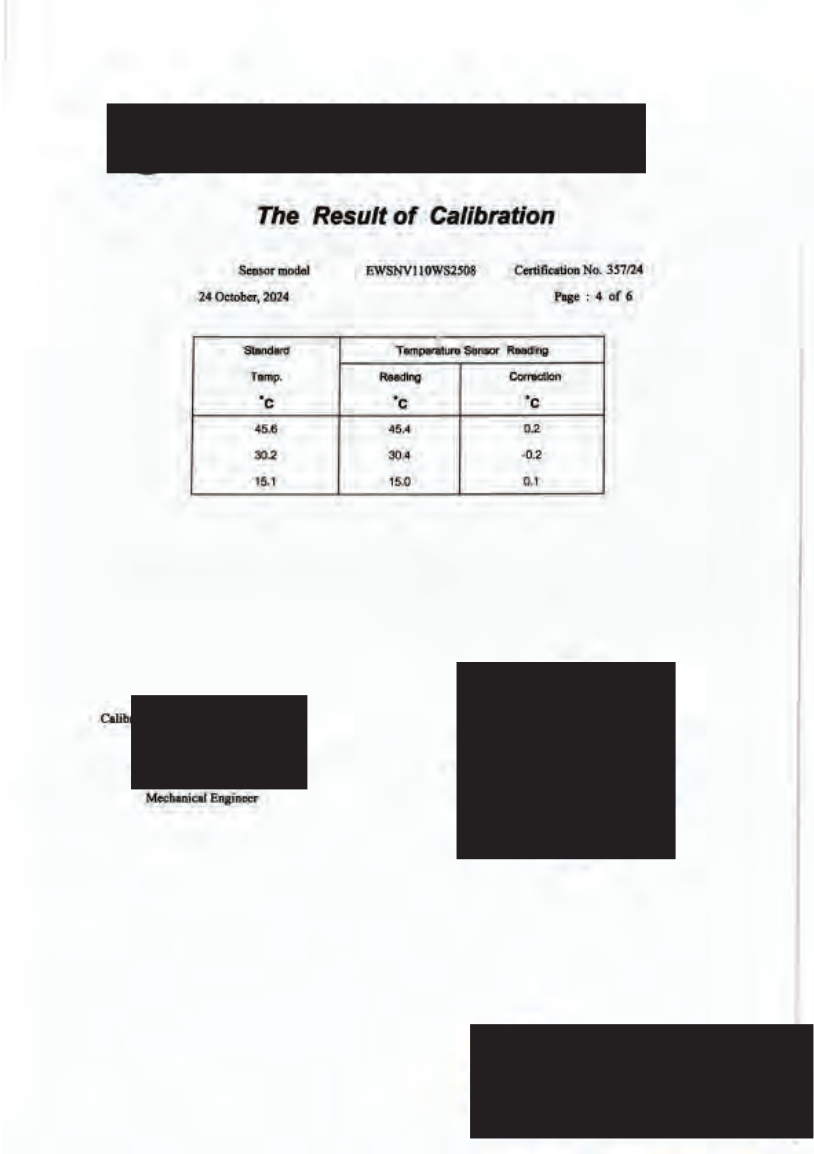
Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.12	1009.65	0.47
1010.35	1009.95	0.40
1010.56	1010.12	0.44
1010.85	1010.41	0.44
1011.05	1010.54	0.51
1011.46	1010.95	0.51
1011.82	1011.26	0.56
1011.95	1011.55	0.40
1012.15	1011.67	0.48
1012.54	1012.09	0.45
1012.91	1012.32	0.49
1010.25	1009.79	0.46
1010.14	1009.72	0.42
1009.95	1009.46	0.49
1009.84	1009.28	0.56
1009.45	1008.86	0.59
1009.32	1008.77	0.55
1009.11	1008.64	0.47
1009.56	1009.08	0.48
1009.86	1009.18	0.68

Average

Calibration

Mechanical Engineer



Date of Issue 24 October, 2024

Certification No. 357/24

Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ Davis Instruments แบบ TIPPING
BUCKET Product No. 7342.026 Code No. EWSNV110WS2508 ทำการสอบเทียบกับแก้ววัด
ฝนแบบแก้วทรง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2mm/TIP)

ลงชื่อ...

วิศวกรชำนาญการ

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 24 October, 2024

Certification No. 358/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2508

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1009.5 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

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

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

: Thermoschneider No.918802

The Result of Calibration

Sensor model EWSNV110WS2509 Certification No. 358/24

24 October, 2024

Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H ₂ O	inches H ₂ O	m/sec	m/sec	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	-	-	-	9.1	-0.08
11.01	-	-	-	11.0	0.01
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.1	-0.08
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 EWSNV110WS2509

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Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.12	1009.52	0.60
1010.35	1009.78	0.57
1010.58	1009.98	0.58
1010.85	1010.35	0.50
1011.05	1010.48	0.57
1011.46	1010.82	0.64
1011.82	1011.23	0.59
1011.95	1011.42	0.53
1012.15	1011.58	0.57
1012.54	1011.95	0.59
1012.81	1012.29	0.52
1010.25	1009.68	0.57
1010.14	1009.64	0.50
1009.95	1009.38	0.57
1009.84	1009.18	0.66
1009.45	1008.85	0.60
1009.32	1008.73	0.59
1009.11	1008.58	0.53
1009.55	1008.93	0.63
1009.86	1009.21	0.65



The Result of Calibration

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Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	45.6	-0.2
30.2	30.3	-0.1
15.1	14.9	0.2

Calibration



Mechanical Engineer



The Result of Calibration

Sensor model EWSNV110WS2509 Certification No. 358/24
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Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
92.5	96.5	-4.0
65.4	68.1	-2.7
45.2	46.1	-0.9

Calibration



Mechanical Engineer



