

ภาคผนวกที่ 5

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

ภาคผนวกที่ 5-1
เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
ครั้งที่ 1/2567
โรงเรียนแสงหิรัญ
และสถาบันการบินพลเรือน
วันที่ตรวจวัดวันที่ 1-6 สิงหาคม 2567

TSP High Volume Sampler Calibration

Verification Report No.
SO2400222-E001 -TSP 01

☐ PM ☒ Onsite
 Site: โรงเรียนแสงหิรัญ
 UTM : 47P 672861 m E 1516324 m N
 Sampler: ETS#28
 Recorder: ECRDGP4169240

Date: 1 Aug 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1001.0
Temperature (deg C): 32.0
Average Press. (hPa): 1001.0
Average Temp. (deg C): 31.0

Corrected Pressure (mm Hg): 750.8
Temperature (deg K): 305.0
Corrected Avg.Press. (mm Hg): 750.8
Average Temp. (deg K): 304.0

CALIBRATION ORIFICE

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

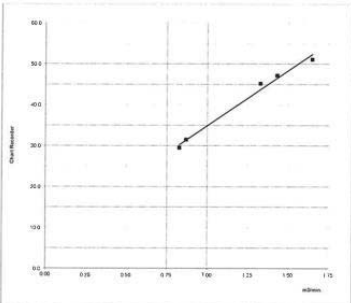
Qstd Slope: 2.02024
Qstd Intercept: -0.02667
Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.30	1.648	52.0	51.09
2	8.50	1.431	48.0	47.16
3	7.30	1.327	46.0	45.19
4	3.10	0.869	32.0	31.44
5	2.80	0.827	30.0	29.47

LINEAR REGRESSION
 Slope = 27.0039
 Intercept = 7.9121
 Corr. coeff = 0.9937
 # of Observations: 5

Range of Chart
 at 1.1 - 1.7 m3/min.



Calibrated by: XXXXXXXXXX
 1 August 2024
 Approved by: XXXXXXXXXX
 1 August 2024

EE-5001-20 Rev A (2-05-2018)

TSP High Volume Sampler Calibration

Verification Report No.
SO2400222-E001 -TSP 02

☐ PM ☒ Onsite
 Site: สถาบันการอาชีวศึกษา
 UTM : 47P 667883 m E 1526242 m N
 Sampler: ETS#43
 Recorder: ECRANG15315224

Date: 1 Aug 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1004.0
Temperature (deg C): 32.0
Average Press. (hPa): 1004.0
Average Temp. (deg C): 32.0

Corrected Pressure (mm Hg): 753.1
Temperature (deg K): 305.0
Corrected Avg.Press. (mm Hg): 753.1
Average Temp. (deg K): 305.0

CALIBRATION ORIFICE

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

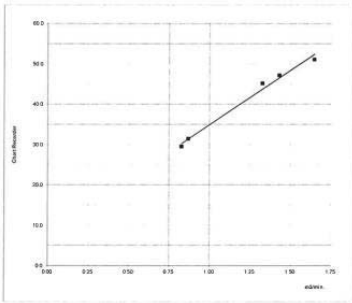
Qstd Slope: 2.02024
Qstd Intercept: -0.02667
Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.00	1.629	54.0	53.13
2	8.50	1.433	50.0	49.20
3	7.10	1.311	44.0	43.29
4	3.30	0.898	32.0	31.49
5	2.60	0.799	28.0	27.55

LINEAR REGRESSION
 Slope = 31.1756
 Intercept = 3.0901
 Corr. coeff = 0.9966
 # of Observations: 5

Range of Chart
 at 1.1 - 1.7 m3/min.



Calibrated by: XXXXXXXXXX
 1 August 2024
 Approved by: XXXXXXXXXX
 1 August 2024

EE-5001-20 Rev A (2-05-2018)

PM10 High Volume Sampler Calibration

Verification Report No.
SO2400222-E001 -PM 01

☒ PM ☐ Onsite
 Site: กรุงเทพมหานคร
 UTM : 47P 672861 m E 1516324 m N
 Sampler: EPM10#27
 Recorder: ECRDS01618124

Date: 1 Aug 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1001.0

Corrected Pressure (mm Hg): 750.8

Temperature (deg C): 32.0

Temperature (deg K): 305.0

Average Press. (hPa): 1001.0

Corrected Avg Press. (mm Hg): 750.8

Average Temp. (deg C): 31.0

Average Temp. (deg K): 304.0

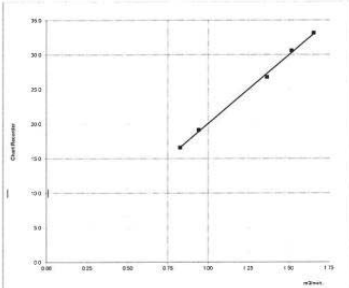
CALIBRATION ORIFICE

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

Qstd Slope: 1.26504
Qstd Intercept: -0.01667
Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	10.60	1.654	52.0	33.14	
2	8.90	1.516	48.0	30.59	
3	7.20	1.365	42.0	26.77	
4	3.40	0.942	30.0	19.12	
5	2.60	0.826	26.0	16.57	



Calibrated by : XXXXXXXXXX
 1 August 2024

 Approved by : XXXXXXXXXX
 1 August 2024

TE-M017-08 Rev 6/25/07/01

PM10 High Volume Sampler Calibration

Verification Report No.
SO2400222-E001 -PM 02

☒ PM ☐ Onsite
 Site: สถานีการันตผลเรือน
 UTM : 47P 667883 m E 1526242 m N
 Sampler: EPM10#45
 Recorder: ECRDS016431075

Date: 1 Aug 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1004.0

Corrected Pressure (mm Hg): 753.1

Temperature (deg C): 32.0

Temperature (deg K): 305.0

Average Press. (hPa): 1004.0

Corrected Avg Press. (mm Hg): 753.1

Average Temp. (deg C): 32.0

Average Temp. (deg K): 305.0

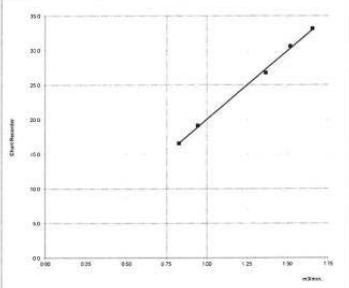
CALIBRATION ORIFICE

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

Qstd Slope: 1.26504
Qstd Intercept: -0.01667
Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	10.40	1.636	52.0	33.09	
2	8.20	1.454	46.0	29.27	
3	7.70	1.409	44.0	28.00	
4	3.40	0.941	30.0	19.09	
5	2.50	0.809	28.0	17.82	



Calibrated by : XXXXXXXXXX
 1 August 2024

 Approved by : XXXXXXXXXX
 1 August 2024

TE-M017-08 Rev 6/25/07/01

Verification Test Report

Report No.:
SO2400222-E001 -SLM 01

☐ PM

☒ Onsite UTM : 47P 672869 m E 1516344 m N

Calibrated Date: 1 August 2024
Site : โรงเรียนแสงหิรัญ
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1968

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	94.00	0.28	93.72

Calibrated By:

Date: 1 August 2024

Approve By:

Date: 1 August 2024

Verification Test Report

Report No.:
SO2400222-E001 -SLM 02

☒ PM

☐ Onsite UTM : 47P 667893 m E 1526258 m N

Calibrated Date: 1 August 2024
Site : สถาบันการนิคมพลเรือน
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1865

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	93.80	0.08	93.72

Calibrated By:

Date: 1 August 2024

Approve By:

Date: 1 August 2024

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

ผ5-5



Certificate of Calibration

Calibration Certification Information			
Cal. Date:	February 9, 2024	Rootsmeter S/N:	438320
Operator:	Jim Tisch	Ta:	295 °K
Calibration Model #:	TE-5025A	Pa:	749.0 mm Hg
		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	
$V_{std} = \Delta Vol((Pa - \Delta P) / P_{std})(T_{std} / T_a)$	$V_a = \Delta Vol((Pa - \Delta P) / P_a)$
$Q_{std} = V_{std} / \Delta time$	$Q_a = V_a / \Delta time$
For subsequent flow rate calculations:	
$Q_{std} = 1/m \left(\sqrt{\Delta H \left(\frac{Pa}{P_{std}} \right) \left(\frac{T_{std}}{T_a} \right)} - b \right)$	$Q_a = 1/m \left(\sqrt{\Delta H \left(T_a / Pa \right)} - b \right)$

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

isch Environmental, Inc.
45 South Miami Avenue
Millage of Cleves, OH 45002

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



Certificate of Calibration

Certificate No. : 67-200034-1

Page : 1 of 2

Submitted by :

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

Ambient Temperature : (22.8 to 23.6) °C

Relative Humidity : (44.6 to 45.3) %

Air Pressure : 1014.0 mbar

Date of Received : 01 February 2024

Date of Calibration : 01 February 2024

Date of Issue : 06 February 2024

Calibrated by :

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

Edition 7 - November 2022

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02232088	08 Nov 2024	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 pr

01A15F0031-03

Certificate of Calibration

Certificate No. : 67-200034-1

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	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00038

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

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

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



Repeatability Load test : 200 g
Sidev. : 0.00005 g

- o o o -

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:

Part Number:
Cylinder Number:
Laboratory:
PGVP Number:
Gas Code:

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 820-R-12-031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. The 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	124206889104	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 21, 2028
GMIS	072120228109	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 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

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708001

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20003573
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MCC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 25.5 °C

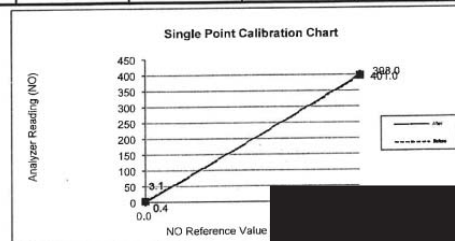
Humidity: 62 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.0	0.0	2.0	395.3	400.0	-0.6
NO ₂	1.1	0.0	1.1	2.7	0.0	0.3
NOx	3.1	0.0	3.1	398.0	400.0	-0.3

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.2	0.0	0.2	400.0	400.0	0.0
NO ₂	0.2	0.0	0.2	1.0	0.0	0.1
NOx	0.4	0.0	0.4	401.0	400.0	0.1



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708001

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Normal range	Unit	Before	After	Note
Date	1-Aug-24				
Time	0:26				
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	491	485	
Ozone Flow	60-80	cc/min	80	80	
PMT Detector	0-5000	mV	85.0	25.0	
AZERO	-20-150	mV	94.1	14.5	
WVPS	400-800 constant	V	734	734	
DCPS	2500 +/- 200	mV	-	-	
RCCL TEMP	50 +/- 1	Degree C	50	50	
BOX TEMP	20-35	Degree C	34.7	33.6	
PMT TEMP	7 +/- 1	Degree C	7.0	7.0	
ZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	314.0	314.0	
RCCL PRES	4-10 constant	IN-Hg-A	5.0	5.0	
SAMP PRES	20-30 constant	IN-Hg-A	28.8	27.9	
NO Slope	1 +/- 0.3		1.135	1.197	
Nox Slope	1 +/- 0.3		1.260	1.114	
NO Offset	-10 to + 150	mV	0.8	-3.6	
NOx Offset	-10 to + 150	mV	-2.6	6.1	
Span and Cal Values					
Zero Value	NO	0	ppb	2.0	0.2
	NOx	0	ppb	3.1	0.4
Span Value	NO	400	ppb	395.3	400.0
	NOx	400	ppb	398.0	401.0

Calibrate By:

Approve By:

Date:

Date:

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708003

Page:1/1

Calibrated Date: 1-Aug-24

☒ 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	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19,2024 EB0140762

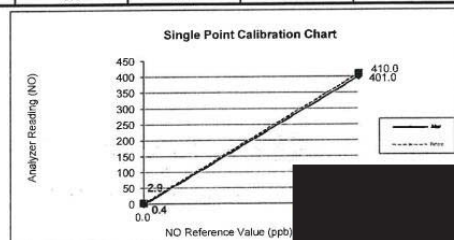
Environment: Temperature 25.5 °C Humidity: 64 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.1	0.0	2.1	408.0	400.0	1.0
NO ₂	0.8	0.0	0.8	2.0	0.0	0.2
NOx	2.9	0.0	2.9	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	0.2	0.0	0.2	398.0	400.0	-0.3
NO ₂	0.2	0.0	0.2	3.0	0.0	0.4
NOx	0.4	0.0	0.4	401.0	400.0	0.1



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708003

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Aug-24				
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	60-90	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	-	-	
RECELL 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	
IZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree 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	2.1	0.2
	NOx	0	ppb	2.9	0.4
Span Value	NO	400	ppb	408.0	398.0
	NOx	400	ppb	410.0	401.0

Calibrate By :

Approve By :

Date: 1-Aug-24

Date: 1-Aug-24

This report shall not be reproduced

SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6708005

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

Calibration System

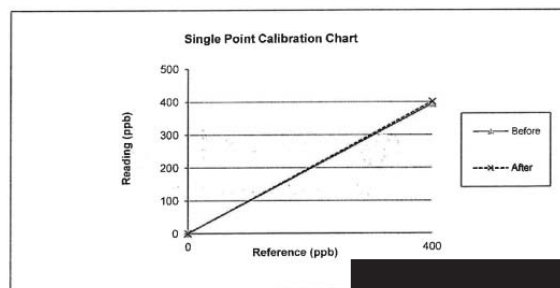
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc: 46.50 PPM NO Conc: 46.50 PPM SO2 Conc: 45.59 PPM CO Conc: 4507 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 25.9 °C

Humidity: 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.8	0.8	400.0	394.9	-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-S6708005

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Aug-24	Time	13:11:00		
Power Supplies					
Option	0.00	mV	+5 V Sensor	5	V
+4 V	4068	mV	+3.3 V	3.3	V
+24 V	24.1	V	+12 V	11.9	V
+5 V	5	V	UV lamp	44.3	mA
+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 :

Approve By :

Date: 1-Aug-24

Date: 1-Aug-24

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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6708003

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

Calibration System

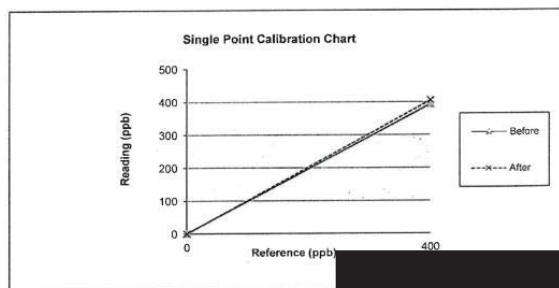
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM SO2 Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 25.9 °C

Humidity: 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.3	1.3	400.0	393.4	-0.8
After	0.0	0.2	0.2	400.0	405.0	0.6



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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6708003

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Aug-24	Time	13:11:00		
Power Supplies					
Option	0.00	mV	+5 V Sensor	5	V
+4 V	4068	mV	+3.3 V	3.3	V
+24 V	24.1	V	+12 V	11.9	V
+5 V	5	V	UV lamp	44.3	mA
+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 :

Approve By :

Date: 1-Aug-24

Date: 1-Aug-24

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6708005

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

Calibration System

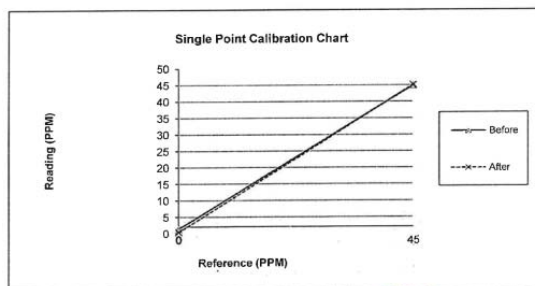
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792 ZERO AIR Generator: ZAG7001 S/N: 644	NOx Conc: 46.50 PPM NO Conc: 46.50 PPM So2 Conc: 45.59 PPM Co Conc: 4507 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature: 26.1 °C

Humidity: 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.341	1.3	45.0	44.93	-0.1
After	0.0	0.340	0.3	45.0	45.09	0.1



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6708005

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Aug-24	Time	10:09:00		
Power Supplies					
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
Optical Bench					
IR current 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-Aug-24

Approve By :

Date: 1-Aug-24

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6708004

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

Calibration System

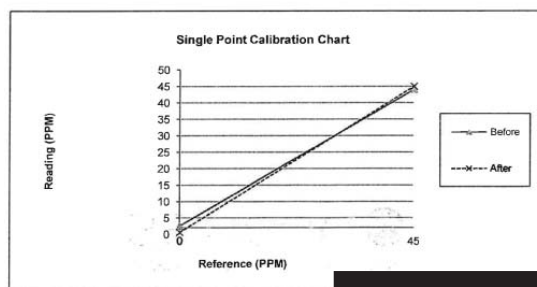
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 26.1 °C

Humidity: 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	2.541	2.5	45.0	44.11	-1.0
After	0.0	0.571	0.6	45.0	45.02	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6708004

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Aug-24	Time	10:09:00		
Power Supplies					
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
Optical Bench					
IR current 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-Aug-24

Approve By :

Date: 1-Aug-24

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0391 MTC No. EEL. BP. 30/0467

CALIBRATION CERTIFICATE

Submitted by
Address
Calibrated at

Instrument Calibrated :

Description : Sound Level Calibrator
Manufacturer : Bruel & Kjaer
Model : 4230
Serial No. : 1351075

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 Keithley 2015-P S/N4106495.
- Condenser Microphone B&K 4180 S/N 2889871.

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

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

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

Date of Receipt : 9 Apr. 2024
Date of Calibration : 10 Apr. 2024

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

FM-BL-MTC-002 Rev.5

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0391 MTC No. EEL. BP. 30/0467

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

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

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total Distortion

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

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

Calibrated by :

Date of Calibration : 10 Apr. 2024
Date of Issue : 11 Apr. 2024

End of Certificate

The results relate only to the items 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.

FM-BL-MTC-002 Rev.5

THAI METEOROLOGICAL DEPARTMENT
4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469
Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau
Date of Issue : 2 October, 2023 Certification No. 340/23
Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger CM-1

Serial No. : 130129 ID No. : NWSDCMS1200129

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.7 hPa

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

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

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

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

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

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



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Sensor model NWSDCMS1200129 Certification No. 340/23
2 October, 2023 Serial No. 1198 Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Precature	Vacumm	Velocity	Velocity	Correction
m/sec	inch H2O	inch 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	91
180	180

The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6235

Certification No. 340/23

2 October, 2023

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1005.63	1005.30	0.33
1006.25	1005.90	0.35
1006.22	1005.90	0.32
1006.54	1006.20	0.34
1006.88	1006.50	0.38
1007.36	1007.00	0.36
1007.58	1007.20	0.38
1007.52	1007.20	0.32
1005.60	1005.30	0.30
1005.84	1005.50	0.34
1006.28	1005.90	0.38
1006.60	1006.30	0.30
1007.07	1006.70	0.37
1007.26	1006.90	0.36
1007.38	1007.00	0.38
1005.50	1005.20	0.30
1005.83	1005.50	0.33
1006.55	1006.20	0.35
1007.31	1007.00	0.31
1007.01	1006.70	0.31

Average

The Result of Calibration

Sensor Temperature Model TPH-1 C

Certification No. 340/23

2 October, 2023

Serial No. 6235

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.2	45.2	0.0
31.1	31.1	0.0
15.8	15.9	-0.1



The Result of Calibration

Sensor Humidity Model TPH-1 C Certification No. 340/23
2 October, 2023 Serial No. 6235 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.2	85.6	0.6
62.4	62.1	0.3
45.6	45.4	0.2

Calibrate



Date of Issue 2 October, 2023

Certification No. [REDACTED]

Page: 6 of 6

ใบรับรอง

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



ลงชื่อ...

วิศวกรชำนาญการ

THAI METEOROLOGICAL DEPARTMENT
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 : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130148 ID No. : EWSDCMS1200148

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

: Thermoschneider No.9188 : testo, testo 645 Serial No. 02848057

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. 1220645



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

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

6 April, 2024

Serial No. 1222

Page : 2 of 6

Standard	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	90
180	182
270	

Calibrated





THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6273

Certification No. 168/24

6 April, 2024

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1009.59	1009.1	0.49
1009.45	1009.0	0.45
1010.10	1009.5	0.60
1010.94	1010.5	0.44
1011.46	1010.9	0.56
1011.84	1011.3	0.54
1012.06	1011.6	0.46
1013.04	1012.6	0.44
1013.18	1012.6	0.58
1012.89	1012.3	0.59
1013.20	1012.8	0.40
1013.44	1012.9	0.54
1013.81	1013.3	0.51
1014.19	1013.6	0.59
1015.96	1015.4	0.56
1016.23	1015.6	0.43
1015.64	1015.1	0.54
1015.23	1014.8	0.43
1012.87	1012.3	0.57
1013.63	1013.1	0.53

Average

Calit

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor Temperature Model TPH-1 C

Certification No. 168/24

6 April, 2024

Serial No. 6273

Page : 4 of 6

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

Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

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 % R.H.	Correction % 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

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

Calibrat

Mechanical Engineer



ลงชื่อ

วิศวกรชำนาญการ

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
โรงเรียนแสงหิรัญและสถาบันการบินพลเรือน
ครั้งที่ 2/2567
ตรวจวัดวันที่ 31 ตุลาคม - 5 พฤศจิกายน 2567

TSP High Volume Sampler Calibration

Verification Report No.
SO2400279-E001 -TSP 01

☐ PM ☒ Onsite
 Site: โรงโม่หินบางใหญ่
 UTM : 47P 1516348 672841
 Sampler: ETSP#117
 Recorder: ECRANG15314157
 Date: 31 Oct 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 989.0	Corrected Pressure (mm Hg): 741.8
Temperature (deg C): 38.0	Temperature (deg K): 311.0
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

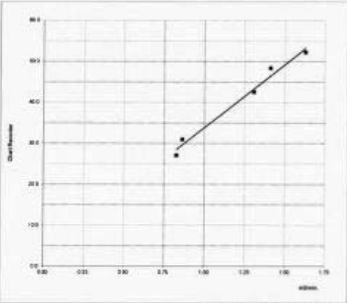
CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.39	1.629	54.0	52.22
2	8.52	1.410	50.0	48.35
3	7.31	1.307	44.0	42.55
4	3.16	0.864	32.0	30.95
5	2.89	0.827	28.0	27.08

LINEAR REGRESSION
 Slope = 30.7836
 Intercept = 3.0575
 Corr. coeff = 0.9907
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min: 39 / 57



Calibrated by: XXXXXXXXXX
 31 October 2024
 Approved by: XXXXXXXXXX
 31 October 2024

TSP High Volume Sampler Calibration

Verification Report No.
SO2400279-E001 -TSP 02

☐ PM ☒ Onsite
 Site: สถานีการเดินรถไฟ
 UTM : 47P 1526239 667881
 Sampler: ETSP#111
 Recorder: ECRANG15314154
 Date: 31 Oct 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 989.0	Corrected Pressure (mm Hg): 741.8
Temperature (deg C): 38.0	Temperature (deg K): 311.0
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

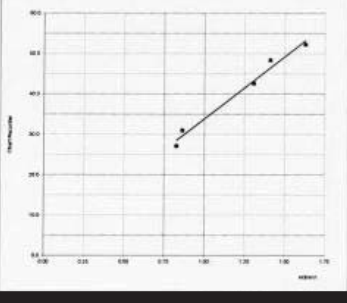
CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.35	1.626	54.0	52.22
2	8.58	1.415	50.0	48.35
3	7.24	1.301	44.0	42.55
4	3.64	0.927	34.0	32.88
5	2.87	0.824	28.0	27.08

LINEAR REGRESSION
 Slope = 30.9693
 Intercept = 2.8770
 Corr. coeff = 0.9914
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min: 39 / 57



Calibrated by: XXXXXXXXXX
 31 October 2024
 Approved by: XXXXXXXXXX
 31 October 2024

PM10 High Volume Sampler Calibration

Verification Report No.
SO2400279-E001 -PM 01

L PM **E** Onsite
 Site: โรงเรียนแสงหิรัญ
 UTM : 47P 1516348 672841
 Sampler: EPM10621
 Recorder: ECRDS01618124

Date: 31 Oct 24
 Technical: [Redacted]
 Approval: [Redacted]

CONDITIONS

Barometric Press. (hPa): 989.0
 Temperature (deg C): 35.0
 Average Press. (hPa): 1013.0
 Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 741.8
 Temperature (deg K): 311.0
 Corrected Avg Press. (mm Hg): 759.8
 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

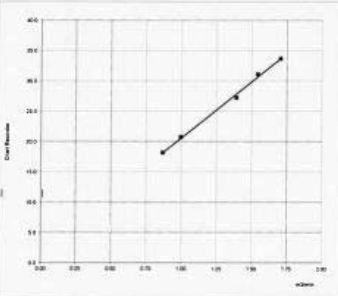
Brand: Tisch Environmental, Inc
 Model: TE-5025A
 Serial#: 5411

Qstd Slope: 1.26504
 Qstd Intercept: -0.01667
 Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.92	1.705	52.0	33.67
2	8.93	1.543	48.0	31.06
3	7.25	1.391	42.0	27.19
4	3.68	0.995	32.0	20.72
5	2.79	0.868	28.0	18.13

LINEAR REGRESSION
 Slope = 18.5209
 Intercept = 2.0750
 Corr. coeff = 0.9981
 SFR = 1.188
 SSP = 37.19
 # of Observations: 5
 Range of Chart at SFR ±10%: 35 / 40



Calibrated by : [Redacted]
 31 October 2024
 Approved by : [Redacted]
 31 October 2024

PM10 High Volume Sampler Calibration

Verification Report No.
SO2400279-E001 -PM 02

L PM **E** Onsite
 Site: สถานีการันดุมพาลี
 UTM : 47P 1526239 667881
 Sampler: EPM10615
 Recorder: ECRDS016431075

Date: 31 Oct 24
 Technical: [Redacted]
 Approval: [Redacted]

CONDITIONS

Barometric Press. (hPa): 989.0
 Temperature (deg C): 35.0
 Average Press. (hPa): 1013.0
 Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 741.8
 Temperature (deg K): 311.0
 Corrected Avg Press. (mm Hg): 759.8
 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

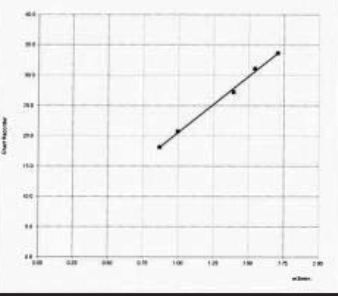
Brand: Tisch Environmental, Inc
 Model: TE-5025A
 Serial#: 5411

Qstd Slope: 1.26504
 Qstd Intercept: -0.01667
 Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.87	1.701	50.0	32.37
2	9.02	1.550	46.0	29.78
3	7.12	1.379	42.0	27.19
4	3.32	0.946	30.0	18.42
5	2.85	0.877	24.0	15.54

LINEAR REGRESSION
 Slope = 19.3053
 Intercept = -0.0519
 Corr. coeff = 0.9904
 SFR = 1.188
 SSP = 35.34
 # of Observations: 5
 Range of Chart at SFR ±10%: 33 / 38



Calibrated by : [Redacted]
 31 October 2024
 Approved by : [Redacted]
 31 October 2024



Verification Test Report

Report No.:

SO2400279-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 672864 m E 1516342 m N

Calibrated Date: 31 October 2024

Site : โรงเรียนแสงหิรัญ

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1968

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	93.70	-0.02	93.72

Calibrated By:

Date: 31 October 2024

Approve By:

Date: 31 October 2024



Verification Test Report

Report No.:

SO2400279-E001 -SLM 02

☒ PM ☐ Onsite UTM : 47P 667889 m E 1526229 m N

Calibrated Date: 31 October 2024

Site : สถาบันการป๋นพลเรือน

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1974

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: 31 October 2024

Approve By:

Date: 31 October 2024



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

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

CAL

Certificate of Calibration

Certificate No. : 67-200034-1 Page : 1 of 2

Submitted by : [Redacted]

Equipment : Electronic Balance

Manufacturer : Sartorius Model : SECURA224-IS

Serial No. : 0034803270 ID No. : ELABBALANCEN04

Capacity : 220 g Resolution : 0.0001 g

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

Ambient Temperature : (22.8 to 23.6) °C

Relative Humidity : (44.6 to 45.3) %

Air Pressure : 1014.0 mbar

Date of Received : 01 February 2024

Date of Calibration : 01 February 2024

Date of Issue : 06 February 2024

Calibrated by : Akaradeth Thippichai

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 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-E264	C02232088	08 Nov 2024	National Institute of Metrology (Thailand), (NIMT)

Approved by [Redacted]

CAL

Certificate of Calibration

Certificate No. : 67-200034-1 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	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00038

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

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

Eccentric error

Load test : 50 g

A B C D E

-0.0001 -0.0001 -0.0001 0.0001 0.0000 g

Repeatability

Load test : 200 g

Sidev. : 0.00005 g

-o0o-

CAL-0031-03

Airgas
an Air Liquide company

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: BANGKOK INDUSTRIAL
GAS CO LTD

Part Number: E04N99E15A00V3
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-12/531, 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 maximum 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 before 100 psi, 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	45.50 PPM	G1	+/- 1.0% NIST Traceable	03/24/2023, 03/31/2023
CARBON MONOXIDE	4500 PPM	4507 PPM	G1	+/- 1.4% NIST Traceable	03/24/2023
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	210607-22	CC708067	48.41 PPM NITRIC OXIDE/NITROGEN	+/- 1.2%	Sep 21, 2025
PRM	12395	D887860	9.81 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 22, 2022
GMS	124206889104	CC322509	4.326 PPM NITROGEN DIOXIDE/AIR	+/- 2.0%	Feb 21, 2025
NTRM	160810-01	CC473196	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Mar 22, 2028
GMS	072123228109	EB0141209	50.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Dec 21, 2028
CO	220608	CC744768	2501.8 PPM CARBON MONOXIDE/NITROGEN	+/-0.5%	Sep 30, 2028

The SRM, NTRM, PRM, or ROM noted above is only in reference to the GMS 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

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6710003

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: ECOESACO12E203
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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 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

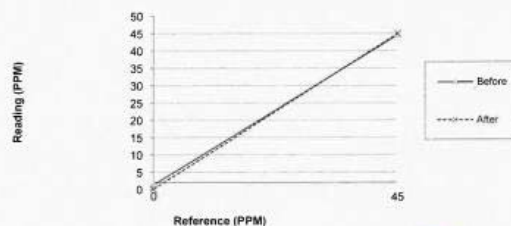
Environment: Temperature 23.2 °C

Humidity: 52 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.354	1.4	45.0	44.54	-0.5
After	0.0	0.145	0.1	45.0	44.98	0.0

Single Point Calibration Chart



CO Analyzer Verification Test Report

Calibration Report No.: ES-C6710003

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Oct-24	Time	10:09:00		
Power Supplies					
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
Optical Bench					
IR current 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-Oct-24

Approve By :

Date: 1-Oct-24

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6710004

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

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

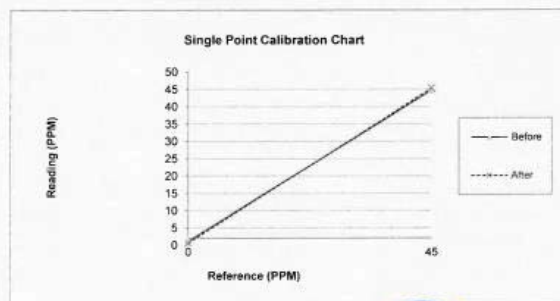
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792	NOx Conc: 46.50 PPM
ZERO AIR Generator: ZAG7001 S/N: 644	NO Conc: 46.50 PPM
	So2 Conc: 45.59 PPM
	Co Conc: 4507 PPM
	Expire Date: Mar 31 2026 EB0160267

Environment: Temperature: 23.3 °C

Humidity: 52 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.093	1.1	45.0	44.75	-0.3
After	0.0	0.541	0.5	45.0	45.34	0.4



CO Analyzer Verification Test Report

Calibration Report No.: ES-C6710004

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 2/2

Analyzer Signal Values					
Date	1-Oct-24	Time	10:09:00		
Power Supplies					
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
Optical Bench					
IR current ratio	884.7	mA	Ptse current	618.2	mV
Optical T.	46.0	deg.C	Pose 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-Oct-24

Approve By :

Date: 1-Oct-24

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710002

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

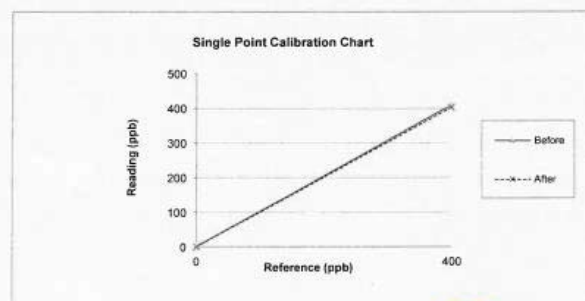
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.3 °C

Humidity: 56 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.3	1.3	400.0	410.0	1.2
After	0.0	0.8	0.8	400.0	403.0	0.4



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710002

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-24				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	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)	Dreegee C	50	50	
BOX TEMP	20-40	Dreegee C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Dreegee 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 constant	IN-Hg-A	28.1	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	0.866	
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	1.3	0.8	
Span Gas (400 PPB)	400	ppb	410.0	403.0	± 5% of Range

Calibrate By:

Date: 1-Oct-24

Approve By:

Date: 1-Oct-24

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710005

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: 100E	Manufacturer API S/N: ESOAI100E01225
--	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM SO2 Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31 2026 EB0160267

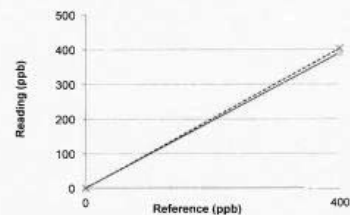
Environment: Temperature 24.3 °C

Humidity: 56 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.7	0.7	400.0	391.0	-1.1
After	0.0	0.3	0.3	400.0	403.0	0.4

Single Point Calibration Chart



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710005

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-24				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	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)	Dreogee C	50	50	
BOX TEMP	20-40	Dreogee C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Dreogee 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 constant	IN-Hg-A	28.1	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	0.886	
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	0.7	0.3	
Span Gas (400 PPB)	400	ppb	391.0	403.0	± 5% of Range

Calibrate By:

Date: 1-Oct-24

Approve By:

Date: 1-Oct-24

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710004

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 1/1

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20003572
---	---

Calibration System

Calibrator Unit Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	Standard Gas NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31, 2026 EB0160267
--	---

Environment: Temperature 24.2 °C Humidity 57 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.5	0.0	2.5	412.0	400.0	1.5
NO ₂	0.3	0.0	0.3	2.0	0.0	0.2
NOx	2.8	0.0	2.8	414.0	400.0	1.7

Calibration Check (After 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	400.0	400.0	0.0
NO ₂	0.2	0.0	0.2	3.0	0.0	0.4
NOx	0.8	0.0	0.8	403.0	400.0	0.4

Single Point Calibration Chart

This report shall not be reproduced or copied without the written approval of the calibration department.

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710004

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 1/1

Test Function Value

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-24				
Time	11:25				
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	500	490	
Ozone Flow	60-90	cc/min	89	80	
PMT Detector	0-5000	mV	50.9	20.4	
AZERO	-20-150	mV	46.3	49.1	
HVPS	400-900 constant	V	745	745	
DCPS	2500 +/- 200	mV	-	-	
RCCELL TEMP	50 +/- 1	Dreagee C	50.0	50.0	
BOX TEMP	20-35	Dreagee C	33.2	32.6	
PMT TEMP	7 +/- 1	Dreagee C	7.2	7.2	
IZS TEMP	50 +/- 4	Dreagee C	-	-	
MOLY Temp	315 +/- 5	Dreagee C	313.3	314.5	
RCEL PRES	4-10 constant	IN-Hg-A	3.7	3.7	
SAMP PRES	20-30 constant	IN-Hg-A	28.3	28.7	
NO Slope	1 +/- 0.3		1.025	1.178	
Nox Slope	1 +/- 0.3		1.066	1.153	
NO Offset	-10 to + 150	mV	8.7	-1.6	
NOx Offset	-10 to + 150	mV	2.1	2.6	

Span and Cal Values

Zero Value	NO	0	ppb	2.5	0.6
	NOx	0	ppb	2.8	0.8
Span Value	NO	400	ppb	412.0	400.0
	NOx	400	ppb	414.0	403.0

Calibrate By: _____

Date: 1-Oct-24

Approve By: _____

Date: 1-Oct-24

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710005

Page:1/1

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: EN0AI200A01679
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.3 °C

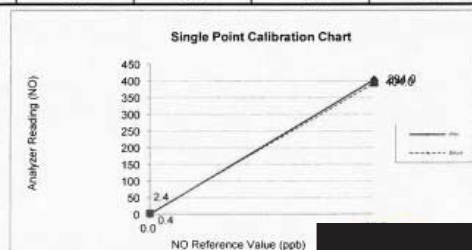
Humidity: 57 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.0	0.0	2.0	390.0	400.0	-1.3
NO ₂	0.4	0.0	0.4	4.0	0.0	0.5
NOx	2.4	0.0	2.4	394.0	400.0	-0.8

Calibration Check (After adjust)

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



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710005

Page:1/1

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-24				
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±1.50	cc/min	482	494	
Ozone Flow	60-90	cc/min	74	77	
PMT Detector	0-5000	mV	51	26	
AZERO	-20-150	mV	53.3	33.3	
HVPS	400-900 constant	V	821	821	
DCPS	2500 ±1.200	mV	2556	2556	
CELL TEMP	50±1	Dreogee C	50	50	
BOX TEMP	20-35	Dreogee C	30.2	32.8	
PMT TEMP	7 ±1.1	Dreogee C	7.5	7.5	
IZS TEMP	50±1.4	Dreogee C	-	-	
MOLY Temp	315 ±1.5	Dreogee C	315.0	314.5	
RECEL 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	2.0	0.2
	NOx	0	ppb	2.4	0.4
Span Value	NO	400	ppb	390.0	401.0
	NOx	400	ppb	394.0	404.0

Calibrate By :

Date:


Approve By :

Date:

Sarawat Keawsrinul
1-Oct-24

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THAI METEOROLOGICAL DEPARTMENT



Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 24 October, 2024 Certification No. 357/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2508

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 1009.8 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
Thermocouples No. 948822

STANDARD BAROMETER



THAI METEOROLOGICAL DEPARTMENT




The Result of Calibration


Sensor model EWSNV110WS2508 Certification No. 357/24

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	-	-	-	13.1	-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
270	

Calibrated 





THAI METEOROLOGICAL DEPARTMENT

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	1011.65	0.40
1012.15	1011.67	0.48
1012.54	1012.09	0.45
1012.81	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

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2508 Certification No. 357/24

24 October, 2024

Page : 4 of 6

Standard Temp.	Temperature Sensor Reading	
	Reading	Correction
°C	°C	°C
45.6	45.4	0.2
30.2	30.4	-0.2
15.1	15.0	0.1

Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Sensor model EWSNV110WS2508 Certification No. 357/24
24 October, 2024 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
92.5	96.2	-3.7
65.4	68.1	-2.7
45.2	46.6	-1.4

Calib

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. [REDACTED] ทำการสอบเทียบกับแก้ววัดฝนแบบแก้วดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2mm./TIP)



ลงชื่อ

วิศวกรชำนาญการ

THAI METEOROLOGICAL DEPARTMENT
Calibration Certificate

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.918902

Water Valsala T : 120015



THAI METEOROLOGICAL DEPARTMENT

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.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	270





THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration


Sensor model EWSNV110WS2510


Certification No. 356/24

24 October, 2024 Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1010.12	1009.88	0.24
1010.35	1010.05	0.30
1010.56	1010.24	0.32
1010.85	1010.65	0.20
1011.05	1010.84	0.21
1011.46	1011.25	0.21
1011.82	1011.54	0.28
1011.95	1011.65	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
1009.56	1009.21	0.35
1009.86	1009.53	0.33
Average		

Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT


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





THAI METEOROLOGICAL DEPARTMENT

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

Calibration

Mechanical Engineer



Date of Issue 24 October, 2024

Certification No. 356/24



Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีฟือ 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)



วิศวกรชำนาญการ

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0391 MTC No. EEL. BP. 30/0467

CALIBRATION CERTIFICATE

Submitted by [Redacted]
Address [Redacted]
Calibrated at [Redacted]

Instrument Calibrated:

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

Standards used :

- Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
- Measuring Amplifier Brüel&Kjær 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 Keithley 2015-P S/N4106495.
- Condenser Microphone B&K 4180 S/N 2889871.

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



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

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

Date of Receipt : 9 Apr. 2024
Date of Calibration : 10 Apr. 2024

1 / 2

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. 21-67/0391 MTC No. EEL. BP. 30/0467

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

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

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total Distortion

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

Note :

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

Calibrated by : [Redacted] [Redacted]

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration : 10 Apr. 2024
Date of Issue : 11 Apr. 2024

Ref : 2011267040901374001
End of Certificate 2 / 2

The results relate only to the items tested/calibrated or value assigned.
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ภาคผนวกที่ 5-2

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
สถานีรถไฟฟ้าชองนนทบุรี (อาคารโดมอันทาวเวอร์)
และสถานีรถไฟฟ้าศาลาแดง (สถานีอาคารหอแว่น)
ครั้งที่ 1/2567
วันที่ตรวจวัด วันที่ 1-6 สิงหาคม 2567

TSP High Volume Sampler Calibration

Verification Report No.
SO2400221-E001 -TSP 01

☐ PM ☒ Onsite
 Site: BTS รางจันทน์
 UTM : 47P 665368 m E 1517742 m N
 Sampler: ETSP#27
 Recorder: ECRDCPR4169240

Date: 1 Aug 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

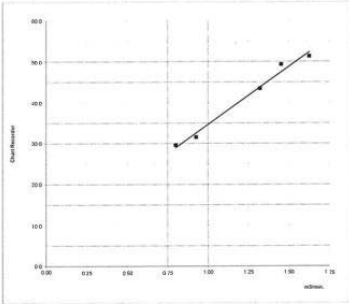
CONDITIONS

Barometric Press. (hPa): 1006.0	Corrected Pressure (mm Hg): 754.6
Temperature (deg C): 31.0	Temperature (deg K): 304.0
Average Press. (hPa): 1006.0	Corrected Avg. Press. (mm Hg): 754.6
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

CALIBRATIONS				
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.90	1.625	52.0	51.30
2	8.70	1.454	50.0	49.33
3	7.20	1.324	44.0	43.41
4	3.50	0.927	32.0	31.57
5	2.60	0.801	30.0	29.60



LINEAR REGRESSION

Slope = 28.3249
Intercept = 6.3143
Corr. coeff = 0.9925

of Observations: 5

Range of Chart	38
at 1.1 - 1.7 m3/min	55

Calibrated by: XXXXXXXXXX

1 August 2024

Approved by: XXXXXXXXXX

1 August 2024

TSP High Volume Sampler Calibration

Verification Report No.
SO2400221-E001 -TSP 02

☐ PM ☒ Onsite
 Site: BTS ศาลาแดง
 UTM : 47P 665854 m E 1518191 m N
 Sampler: ETSP#26
 Recorder: ECRANG15315224

Date: 1 Aug 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

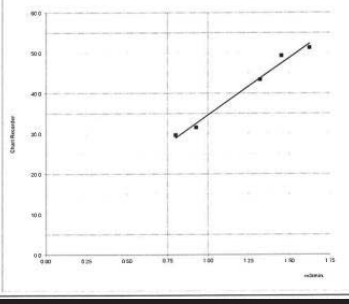
CONDITIONS

Barometric Press. (hPa): 1004.0	Corrected Pressure (mm Hg): 753.1
Temperature (deg C): 32.0	Temperature (deg K): 305.0
Average Press. (hPa): 1004.0	Corrected Avg. Press. (mm Hg): 753.1
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

CALIBRATIONS				
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.80	1.614	50.0	49.20
2	8.60	1.441	48.0	47.23
3	7.10	1.311	42.0	41.33
4	3.40	0.911	34.0	33.45
5	2.50	0.783	30.0	29.52



LINEAR REGRESSION

Slope = 23.9850
Intercept = 11.0712
Corr. coeff = 0.9920

of Observations: 5

Range of Chart	39
at 1.1 - 1.7 m3/min	52

Calibrated by: XXXXXXXXXX

1 August 2024

Approved by: XXXXXXXXXX

1 August 2024

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

ผ5-41

PM10 High Volume Sampler Calibration

Verification Report No.
 SO2400221-E001 -PM 01

L PM ☒ Onsite
 Site: BTS รางจันทน์
 UTM : 47P 665368 m E 1517742 m N
 Sampler: EPM10#47
 Recorder: ECRDS01618124

Date: 1 Aug 24
 Technical: [REDACTED]
 Approval: [REDACTED]

CONDITIONS

Barometric Press. (hPa): 1006.0	Corrected Pressure (mm Hg): 754.6
Temperature (deg C): 31.0	Temperature (deg K): 304.0
Average Press. (hPa): 1006.0	Corrected Avg. Press. (mm Hg): 754.6
Average Temp. (deg C): 32.0	Average Temp. (deg K): 305.0

CALIBRATION ORIFICE

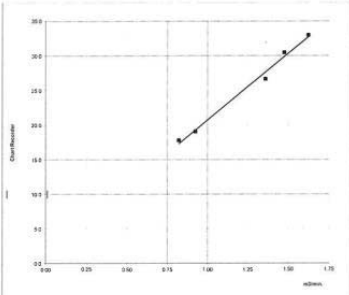
Brand: Tisch Environmental, Inc	Qstd Slope: 1.26504
Model: TE-5025A	Qstd Intercept: -0.01667
Serial#: 5411	Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.30	1.623	52.0	33.01
2	8.50	1.476	48.0	30.47
3	7.20	1.360	42.0	26.66
4	3.30	0.925	30.0	19.04
5	2.60	0.822	28.0	17.77

LINEAR REGRESSION

Slope = 19.2556
Intercept = 1.4898
Corr. coeff = 0.9955
SFR = 1.126
SSP = 36.52
of Observations: 5

Range of Chart	34
at SFR ±10%	39



Calibrated by: [REDACTED]

1 August 2024

Approved by: [REDACTED]

1 August 2024

PM10 High Volume Sampler Calibration

Verification Report No.
 SO2400221-E001 -PM 02

L PM ☒ Onsite
 Site: BTS ศาลาแดง
 UTM : 47P 665854 m E 1518191 m N
 Sampler: EPM10#28
 Recorder: ECRDS016431075

Date: 1 Aug 24
 Technical: [REDACTED]
 Approval: [REDACTED]

CONDITIONS

Barometric Press. (hPa): 1004.0	Corrected Pressure (mm Hg): 753.1
Temperature (deg C): 32.0	Temperature (deg K): 305.0
Average Press. (hPa): 1004.0	Corrected Avg. Press. (mm Hg): 753.1
Average Temp. (deg C): 32.0	Average Temp. (deg K): 305.0

CALIBRATION ORIFICE

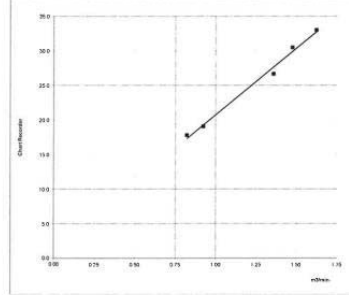
Brand: Tisch Environmental, Inc	Qstd Slope: 1.26504
Model: TE-5025A	Qstd Intercept: -0.01667
Serial#: 5411	Date Certified: 9 Feb 2024

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.80	1.666	52.0	33.09
2	8.90	1.514	46.0	29.27
3	6.90	1.335	40.0	25.46
4	3.50	0.954	30.0	19.09
5	2.70	0.840	28.0	17.82

LINEAR REGRESSION

Slope = 18.2736
Intercept = 1.8887
Corr. coeff = 0.9950
SFR = 1.130
SSP = 35.41
of Observations: 5

Range of Chart	33
at SFR ±10%	38



Calibrated by: [REDACTED]

1 August 2024

Approved by: [REDACTED]

1 August 2024

Verification Test Report

Report No.:
SO2400221-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 665368 m E 1517742 m N

Calibrated Date: 1 August 2024
Site : BTS ปลงนนทรี
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1897

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:

Date: 1 August 2024

Approve By:

Date: 1 August 2024

Verification Test Report

Report No.:
SO2400221-E001 -SLM 02

☒ PM ☐ Onsite UTM : 47P 665854 m E 1518191 m N

Calibrated Date: 1 August 2024
Site : BTS ศาลาแดง
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1900

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	94.00	0.28	93.72

Calibrated By:

Date: 1 August 2024

Approve By:

Date: 1 August 2024

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

ผ5-43



RECALIBRATION
DUE DATE:
February 9, 2025

Certificate of Calibration

Calibration Certification Information			
Cal. Date:	February 9, 2024	Rootsometer S/N:	438320
Operator:	Jim Tisch	Ta:	295 °K
Calibration Model #:	TE-5025A	Pa:	749.0 mm Hg
		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	
$V_{std} = \Delta Vol((Pa - \Delta P) / P_{std})(T_{std} / T_a)$	$V_a = \Delta Vol((Pa - \Delta P) / P_a)$
$Q_{std} = V_{std} / \Delta Time$	$Q_a = V_a / \Delta Time$
For subsequent flow rate calculations:	
$Q_{std} = 1/m \left(\sqrt{\Delta H \left(\frac{Pa}{P_{std}} \right) \left(\frac{T_{std}}{T_a} \right)} \right) - b$	$Q_a = 1/m \left(\sqrt{\Delta H \left(T_a / Pa \right)} \right) - b$

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, 9.2.17, page 30

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

Certificate of Calibration

Certificate No. : 67-200034-1 Page : 1 of 2

Submitted by :

Equipment :

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

Environment :

On site calibration was carried out at the Balance Room, Envilab Co., Ltd.
Ambient Temperature : (22.8 to 23.6) °C
Relative Humidity : (44.6 to 45.3) %
Air Pressure : 1014.0 mbar

Date of Received : 01 February 2024

Date of Calibration : 01 February 2024

Date of Issue : 06 February 2024

Calibrated by : 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	C02232088	08 Nov 2024	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 written consent of the issuing authority.

LAB 14-00031-001

Certificate of Calibration

Certificate No. : 67-200034-1

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	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00038

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

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

Eccentric error Load test : 50 g

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

g



Repeatability Load test : 200 g

Stdev. : 0.00005 g

- 000 -

LOADR0031-03

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-12/531, 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	D887960	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	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Mar 22, 2028
GMIS	072120228109	EB0141209	50.08 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Dec 21, 2028
CO	220608	CC744768	2501.8 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Sep 30, 2026

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.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 NTKD579	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
Net Weight: 4.8 Kg
PO# 5223001123

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708009

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200E	Manufacturer API S/N: ENOAI200E02788
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 46.50 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 46.50 PPM
	SO2 Conc 45.50 PPM
	CO Conc 4507 PPM
	Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 24.4 °C

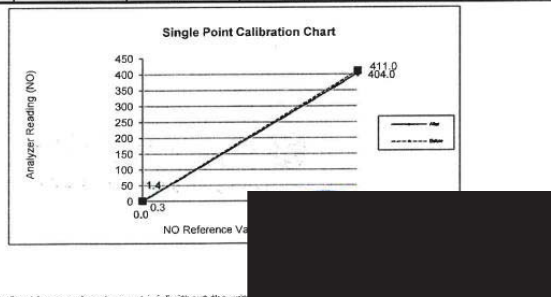
Humidity 61 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.2	0.0	1.2	410.0	400.0	1.2
NO ₂	0.2	0.0	0.2	1.0	0.0	0.1
NOx	1.4	0.0	1.4	411.0	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	0.1	0.0	0.1	402.1	400.0	0.3
NO ₂	0.2	0.0	0.2	1.9	0.0	0.2
NOx	0.3	0.0	0.3	404.0	400.0	0.5



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708009

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Aug-24				
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	60-90	cc/min	80	80	
PMT Detector	0-5000	mV	27.4	16.4	
AZERO	120-150	mV	54.2	54.2	
IN/PS	400-900 constant	V	819	819	
DCPS	2500 +/- 200	mV	-	-	
RCCL TEMP	50 +/- 1	Dreagee C	50	50	
BOX TEMP	20-35	Dreagee C	33.7	32.9	
PMT TEMP	7 +/- 1	Dreagee C	7.1	7.1	
IZS TEMP	50 +/- 4	Dreagee C	-	-	
MOLY Temp	315 +/- 5	Dreagee 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	1.2	0.1
	NOx	0	ppb	1.4	0.3
Span Value	NO	400	ppb	410.0	402.1
	NOx	400	ppb	411.0	404.0

Calibrate By: _____

Approve By: _____

Date: 1-Aug-24

Date: 1-Aug-24

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708004

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200E	Manufacturer API S/N: ENOA1200E00579
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

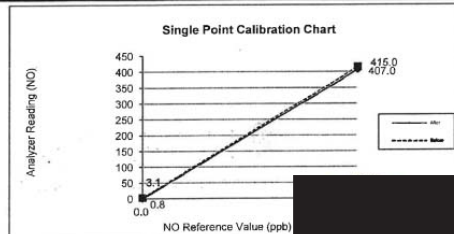
Environment: Temperature 25.3 °C Humidity: 64 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.7	0.0	2.7	412.0	400.0	1.5
NO ₂	0.4	0.0	0.4	3.0	0.0	0.4
NOx	3.1	0.0	3.1	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	0.4	0.0	0.4	405.0	400.0	0.6
NO ₂	0.4	0.0	0.4	2.0	0.0	0.2
NOx	0.8	0.0	0.8	407.0	400.0	0.9



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708004

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Aug-24				
Time	13:25				
Range	0.00 - 500.00 PPR	PPR	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	60-90	cc/min	76.0	76.0	
PMT Detector	0-5000	mV	24.5	62.2	
AZERO	-20-150	mV	8.6	67.5	
HVPS	400-900 constant	V	839.0	836.0	
DCPS	2500 +/- 200	mV	-	-	
RCELL TEMP	50 +/- 1	Degree C	50.0	50.0	
BOX TEMP	20-35	Degree C	34.5	30.5	
PMT TEMP	7 +/- 1	Degree C	7.0	7.1	
IZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	315.0	314.4	
RCEL 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	2.7	0.4
	NOx	0	ppb	3.1	0.8
Span Value	NO	400	ppb	412.0	405.0
	NOx	400	ppb	415.0	407.0

Calibrate By: [Signature]

Approve By: [Signature]

Date: 1-Aug-24

Date: 1-Aug-24

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6708004

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API S/N: ESOAI100EU0091
--	---

Calibration System

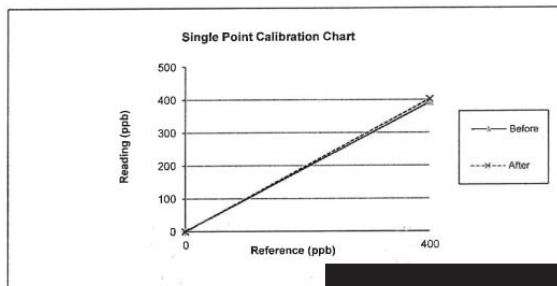
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19,2024 EB0140762

Environment: Temperature 26.0 °C

Humidity: 65 %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	392.4	-1.0
After	0.0	0.7	0.7	400.0	402.0	0.2



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6708004

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Aug-24				
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	592.0	591.0	
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	-	-	
RCCELL 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	1000-4800	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 contant	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	24.8	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	1.1	0.7	
Span Gas (400 PPB)	400	ppb	392.4	402.0	± 5% of Range

Calibrate By :

Approve By :

Date:

1-Aug-24

Date:

1-Aug-24

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6708007

Calibrated Date: 1-Aug-24

☒ 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 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31,2026 EB0160267

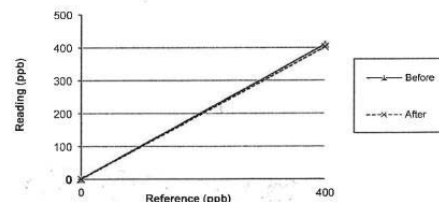
Environment: Temperature 26.0 °C

Humidity: 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.8	0.8	400.0	410.0	1.2
After	0.0	0.4	0.4	400.0	402.0	0.2

Single Point Calibration Chart



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6708007

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Normal range	Unit	Before	After	Note
Date	1-Aug-24				
Time	11:59				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	650 (+/- 50)	cc/min	650	619	
PMT Detector	0 - 5000	mV	34.7	26.4	
Norm PMT Detector	0 - 5000	mV	44.0	25.9	
HVPS	400-900 constant	V	723	723	
DCPS	2500 (+/- 200)	mV	-	-	
PCELL 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	0.8	0.4	
Span Gas (400 PPB)	400	ppb	410.0	402.0	± 5% of Range

Calibrate By:

Date:

This report shall not be reproduced

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6708002

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: NCOESAC012E355
--	---

Calibration System

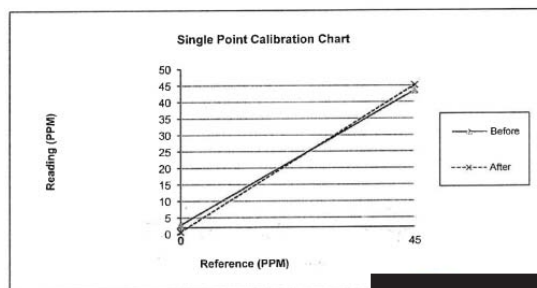
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOX Conc 46.50 PPM NO Conc 46.50 PPM SO2 Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31, 2026 E80160267

Environment: Temperature 26.1 °C

Humidity: 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	2.760	2.8	45.0	43.50	-1.7
After	0.0	0.645	0.6	45.0	45.12	0.1



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6708002

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Analyzer Signal Values					
Date	1-Aug-24	Time	10:09:00		
Power Supplies					
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
Optical Bench					
IR current 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-Aug-24

Approve By :

Date: 1-Aug-24

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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6708007

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

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

Calibration System

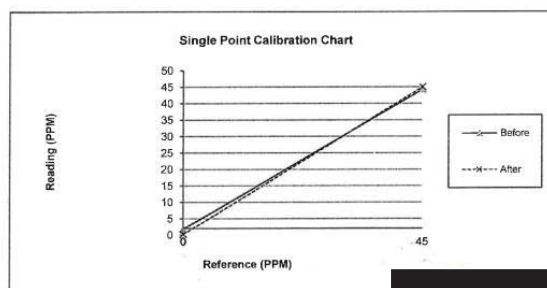
Calibrator Unit	Standard Gas
Dilutor Model ESA MGA101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 26.1 °C

Humidity 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.8	1.8	45.0	44.3	-0.8
After	0.0	0.2	0.2	45.0	45.0	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6708007

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page: 2/2



Detail	Range	Unit	Before	After	Note
Date	1-Aug-24				
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	1.8	0.2	
Span Gas	45	PPM	44.3	45.0	± 5% of Range

Calibrate By :

Approve By :

Date:

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0391 MTC No. EEL. BP. 30/0467

CALIBRATION CERTIFICATE

Submitted by [Redacted]
Address [Redacted]
Calibrated at [Redacted]

Instrument Calibrated :

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

Standards used :

- Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
- Measuring Amplifier Brüel&Kjær 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 Keithley 2015-P S/N4106495.
- Condenser Microphone B&K 4180 S/N 2889871.



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

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

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

Date of Receipt : 9 Apr. 2024
Date of Calibration : 10 Apr. 2024

The results relate only to the items tested/calibrated or 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. 21-67/0391 MTC No. EEL. BP. 30/0467

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

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

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total Distortion

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

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

Calibrated by : [Redacted] **Approved by :** [Redacted]

Date of Calibration : 10 Apr. 2024
Date of Issue : 11 Apr. 2024

Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre
B.F. 20113/20113/20113/20113

End of Certificate

The results relate only to the items tested/calibrated or value assigned.
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THAI METEOROLOGICAL DEPARTMENT
Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 2 October, 2023

Certification No. 341/23

Page : 1 of 5

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130152 ID No. : NWSDCMS1200152

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

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.9 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

: Thermoschneider No.918802

STANDARD BAROMETER

: Digital Barometer Vaisala Type TB220 No. 220015



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

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

2 October, 2023

Serial No. 1226

Page : 2 of 5

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H ₂ O	inches H ₂ O	m/sec	m/sec	m/sec
1.00	-	-	-	0.7	0.30
3.02	-	-	-	2.9	0.12
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.1	-0.08
11.01	-	-	-	11.0	0.01
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

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

Calibr





THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

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

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

Calibrated by :

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

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

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

Calibrated by :

Mechanical Engineer





Date of Issue 2 October, 2023

Certification No. 341/23

Page: 5 of 5

ใบรับรอง

หนังสือฉบับนี้รับรองว่า เครื่องวัดฝน ชื่อ 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



THAI METEOROLOGICAL DEPARTMENT

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 2 October, 2023

Certification No. 338/23

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2509

Customer : [REDACTED]

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1006.8 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

: Thermoschneider No.918802

STANDARD BAROMETER : [REDACTED] 230015

Calibrated by : [REDACTED] Sig [REDACTED]

Mr. Watcharapol [REDACTED] Mr. [REDACTED]

Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2509 Certification No. 338/23

2 October, 2023

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
	m/sec	inches H ₂ O	inches H ₂ O	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	-	-	-	9.0	0.02
11.01	-	-	-	11.0	0.01
13.01	-	-	-	13.0	0.01
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.1	-0.08

Wind Aloft Plotting Board.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	89
180	175
270	286

Calibrated

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2509

Certification No. 338/23

2 October, 2023

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1005.63	1005.12	0.51
1006.25	1005.65	0.60
1008.22	1005.72	0.50
1006.54	1006.00	0.54
1006.88	1006.30	0.58
1007.36	1006.80	0.56
1007.58	1007.04	0.54
1007.52	1007.02	0.50
1005.60	1005.02	0.58
1005.84	1005.35	0.49
1006.28	1005.72	0.56
1006.60	1006.06	0.54
1007.07	1006.54	0.53
1007.26	1006.73	0.53
1007.38	1006.86	0.52
1005.50	1004.98	0.52
1005.83	1005.34	0.49
1006.55	1006.04	0.51
1007.31	1006.86	0.45
1007.01	1006.51	0.50

Average

Calibrated

Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2509 Certification No. 338/23
2 October, 2023 Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.2	45.3	-0.1
31.1	31.1	0.0
15.8	15.9	-0.1

Cal

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2509 Certification No. 338/23
2 October, 2023 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
86.2	82.6	3.6
62.4	59.2	3.2
45.6	42.7	2.9

Calibrated by :





Date of Issue 2 October, 2023

Certification No. 338/23

Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้รับรองว่า เครื่องวัดฝน ชื่อ Davis Instruments แบบ TIPPING
BUCKET Product No. [REDACTED] ทำการสอบเทียบกับแก้ววัด
ฝนแบบแก้วดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.01 in/TIP)



[REDACTED]
วิศวกรชำนาญการ

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
สถานีรถไฟฟ้าชองนนทบุรี (อาคารโดมอันทาวเวอร์)
สถานีรถไฟฟ้าศาลาแดง (สถานีอาคารหอแว่น)
ครั้งที่ 2/2567
วันที่ตรวจวัด วันที่ 31 ตุลาคม – 5 พฤศจิกายน 2567

TSP High Volume Sampler Calibration

Verification Report No.
SO2400278-E001 -TSP 01

☐ PM ☒ Onsite
 Site: BTS สถานะ
 UTM : 47P 1517731 865349
 Sampler: NTSF#21
 Recorder: EVFCDPR02TC002

Date: 31 Oct 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 989.0	Corrected Pressure (mm Hg): 741.8
Temperature (deg C): 38.0	Temperature (deg K): 311.0
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

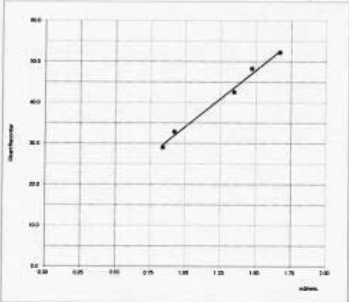
CALIBRATIONS				
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.97	1.699	54.0	52.22
2	9.32	1.475	50.0	48.35
3	7.74	1.345	44.0	42.55
4	3.65	0.928	34.0	32.88
5	2.99	0.841	30.0	29.01

LINEAR REGRESSION

Slope = 27.6906
 Intercept = 6.3485
 Corr. coeff. = 0.9953

of Observations: 5

Range of Chart	39
at 1.1 - 1.7 m3/min	55



Calibrated by : XXXXXXXXXX
 31 October 2024

Approved by : XXXXXXXXXX
 31 October 2024

TSP High Volume Sampler Calibration

Verification Report No.
SO2400278-E001 -TSP 02

☐ PM ☒ Onsite
 Site: BTS ศาลาแดง
 UTM : 47P 1518219 665770
 Sampler: ETSP#26
 Recorder: EVFCDPR02TC016

Date: 31 Oct 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 989.0	Corrected Pressure (mm Hg): 741.8
Temperature (deg C): 38.0	Temperature (deg K): 311.0
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

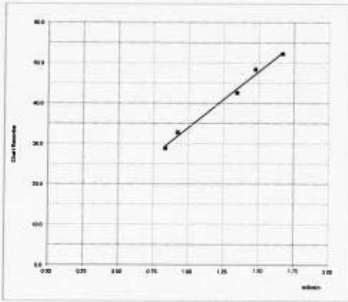
CALIBRATIONS				
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.25	1.619	52.0	50.29
2	9.47	1.485	48.0	46.42
3	7.27	1.304	42.0	40.62
4	3.74	0.939	32.0	30.95
5	2.91	0.830	30.0	29.01

LINEAR REGRESSION

Slope = 27.2750
 Intercept = 5.7572
 Corr. coeff. = 0.9983

of Observations: 5

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



Calibrated by : XXXXXXXXXX

Approved by : XXXXXXXXXX
 31 October 2024

PM10 High Volume Sampler Calibration

Verification Report No.
 SO2400278-E001 -PM 02

L PM <input checked="" type="checkbox"/> Onsite Site: BTS ศาลาแดง UTM : 47P 1518219 665770 Sampler: EPM10#46 Recorder: EVFCPR02TC006	Date: 31 Oct 24 Technical: [REDACTED] Approval: [REDACTED]
--	--

CONDITIONS

Barometric Press. (hPa): 989.0	Corrected Pressure (mm Hg): 741.8
Temperature (deg C): 38.0	Temperature (deg K): 311.0
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

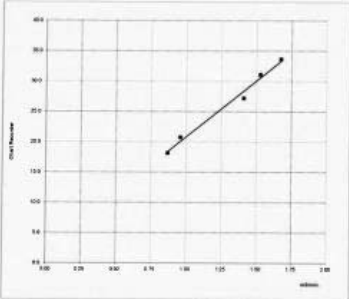
CALIBRATION ORIFICE

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	11.09	1.718	52.0	33.67
2	8.93	1.543	48.0	31.06
3	6.89	1.357	42.0	27.19
4	3.63	0.988	32.0	20.72
5	2.87	0.880	28.0	18.13

LINEAR REGRESSION
 Slope = 18.5461
 Intercept = 2.1018
 Corr. coeff. = 0.9989
 SFR = 1.188
 SSP = 37.27
 # of Observations: 5
 Range of Chart at SFR ±10%: 35 to 40



Calibrated by: [REDACTED]
 31 October 2024
 Approved by: [REDACTED]
 31 October 2024

PM10 High Volume Sampler Calibration

Verification Report No.
 SO2400278-E001 -PM 01

L PM <input checked="" type="checkbox"/> Onsite Site: BTS ศาลาแดง UTM : 47P 1517731 665349 Sampler: NPM10#18 Recorder: ECRDS01618124	Date: 31 Oct 24 Technical: [REDACTED] Approval: [REDACTED]
--	--

CONDITIONS

Barometric Press. (hPa): 989.0	Corrected Pressure (mm Hg): 741.8
Temperature (deg C): 38.0	Temperature (deg K): 311.0
Average Press. (hPa): 1013.0	Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

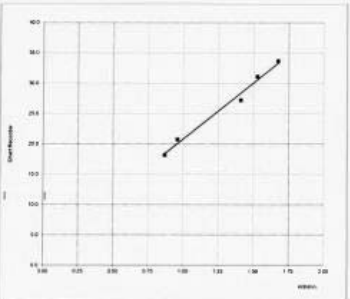
CALIBRATION ORIFICE

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	10.54	1.675	52.0	33.67
2	8.75	1.527	48.0	31.06
3	7.43	1.408	42.0	27.19
4	3.41	0.958	32.0	20.72
5	2.79	0.868	28.0	18.13

LINEAR REGRESSION
 Slope = 18.5085
 Intercept = 2.3313
 Corr. coeff. = 0.9935
 SFR = 1.188
 SSP = 37.56
 # of Observations: 5
 Range of Chart at SFR ±10%: 35 to 40



Calibrated by: [REDACTED]
 31 October 2024
 Approved by: [REDACTED]
 31 October 2024

Verification Test Report

Report No.:
SO2400278-E001 -SLM 02

☒ PM ☐ Onsite UTM : 47P 665868 m E 1518299 m N

Calibrated Date: 31 October 2024
Site : BTS ศาลาแดง
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1914

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	93.90	0.18	93.72

Calibrated By:
Date: 31 October 2024

Verification Test Report

Report No.:
SO2400278-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 665342 m E 1517734 m N

Calibrated Date: 31 October 2024
Site : BTS ปrompt
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:
Date: 31 October 2024

Approve By:
Date: 31 October 2024



RECALIBRATION
DUE DATE:
February 9, 2025

Certificate of Calibration

Calibration Certification Information

Cal. Date: February 9, 2024 Rootsmer 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
m= 2.02024			m= 1.26504		
b= -0.02667			b= -0.01677		
r= 0.99993			r= 0.99993		

Calculations			
Vstd=	$\Delta Vol / (Pa - \Delta P) / Pstd$	Tstd/Ta	Va=
Qstd=	$Vstd / \Delta Time$		Qa=
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:	rootsmer manometer reading (mm Hg)
Ta:	actual absolute temperature (°K)
Pa:	actual barometric pressure (mm Hg)
b:	intercept
m:	slope

Tisch Environmental, Inc.
45 South Miami Avenue
Alliage of Clevs, OH 45002

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

CAL

Calibratech Co., Ltd.

7/106-7 Moo 2, Sukhaphichan 3 Rd., Bangpood, Pakkred, Nonthaburi 11120
Tel: (02) 964-6211 Fax: (02) 964-5153, e-mail: calibratech.cal@yahoo.com, calibratech.cal@hotmail.com



Certificate of Calibration

Certificate No. : 67-200034-1

Page : 1 of 2

Submitted by :

Equipment :

Electronic Balance

Manufacturer : Sartorius

Model : SECURA224-IS

Serial No. : 0034803270

ID No. : ELABBALANCEN04

Capacity : 220 g

Resolution : 0.0001 g

Environment :

Relative Humidity : (44.6 to 45.3) %

Air Pressure : 1014.0 mbar

Date of Received : 01 February 2024

Date of Calibration : 01 February 2024

Date of Issue : 06 February 2024

Calibrated by : 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	C02232088	08 Nov 2024	National Institute of Metrology (Thailand), (NIMT)

Approved by :

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full except with the prior written consent of Calibratech Co., Ltd.

00125F003T-03

Certificate of Calibration

Certificate No. : 67-200034-1 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	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00038

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

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

Eccentric error

Load test : 50 g

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

g

Repeatability

Load test : 200 g

Sidev. : 0.00005 g

- 000 -

CO Analyzer Verification Test Report

Calibration Report No.: TD-C6710007

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Instruments Information Page: 1/2

Analyzer Type: CO Analyzer Model: T300	Manufacturer API S/N: ECOAIT3000098
---	--

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGA101 S/N: 792	NOx Conc 46.50 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 46.50 PPM
	So2 Conc 45.59 PPM
	Co Conc 4507 PPM
	Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 23.4 °C Humidity: 52 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.5	1.5	45.0	44.6	-0.5
After	0.0	0.8	0.8	45.0	45.2	0.2

Single Point Calibration Chart

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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6710007
 Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 2/2

Detail	Range	Unit	Before	After	Note
Date	1-Oct-24				
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	1.5	0.8	
Span Gas	45	PPM	44.6	45.2	± 5% of Range

Calibrate By: [Redacted Signature]
 Date: [Redacted Date]

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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6710006
 Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

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

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 46.50 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 46.50 PPM
	So2 Conc 45.59 PPM
	Co Conc 4507 PPM
	Expire Date: Mar 31,2026 EB0160267

Environment: Temperature_ 23.5 _ °C Humidity_ 52 _ %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.9	0.9	45.0	44.0	-1.1
After	0.0	0.3	0.3	45.0	45.8	0.9

Single Point Calibration Chart

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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6710006

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 2/2

Detail	Range	Unit	Before	After	Note
Date	1-Oct-24				
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	0.9	0.3	
Span Gas	45	PPM	44.0	45.6	± 5% of Range

Calibrate By :

Date:

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710007

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API S/N: ESOAIT10003031
--	---

Calibration System

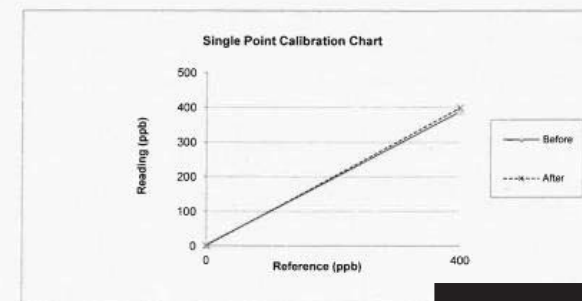
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 46.50 PPM NO Conc 46.50 PPM
ZERO AIR Generator ZAG7001 S/N: 644	SO2 Conc 45.59 PPM CO Conc 4507 PPM
	Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 24.4 °C

Humidity: 57 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	3.1	3.1	400.0	389.0	-1.4
After	0.0	0.9	0.9	400.0	399.0	-0.1



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710007

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Normal range	Unit	Before	After	Note
Date	1-Oct-24				
Time	8:30				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	650 (+/- 50)	cc/min	666	662	
PMT Detector	0 - 5000	mV	24.3	28.2	
Norm PMT Detector	0 - 5000	mV	31.4	34.3	
HVPS	400-900 constant	V	725	725	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL TEMP	50 (+/- 1)	Degree C	50	50	
BOX TEMP	20-40	Degree C	32.6	35.1	
PMT TEMP	7 (+/- 1)	Degree 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	3.1	0.9	
Span Gas (400 PPB)	400	ppb	389.0	399.0	± 5% of Range

Calibrate By:

Date:

This report shall not be reproduced

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710003

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API S/N: ESOAIT10002032
--	---

Calibration System

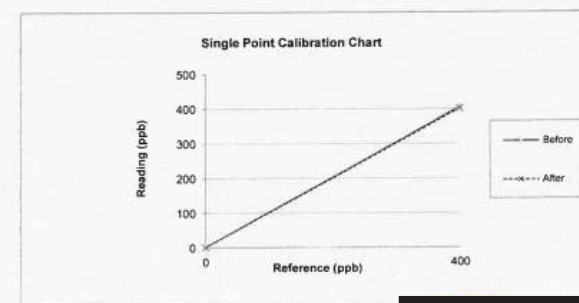
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM SO2 Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 24.3 °C

Humidity: 57 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.4	1.4	400.0	405.2	0.6
After	0.0	0.6	0.6	400.0	401.0	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710003

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-24				
Time	8:30				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	650 (+/- 50)	cc/min	666	662	
PMT Detector	0 - 5000	mV	24.3	28.2	
Norm PMT Detector	0 - 5000	mV	31.4	34.3	
HVPS	400-900 constant	V	725	725	
DCPS	2500 (+/- 200)	mV	-	-	
CELL TEMP	50 (+/- 1)	Dreagee C	50	50	
SOX 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	2019	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	1.4	0.6	
Span Gas (400 PPB)	400	ppb	405.2	401.0	± 5% of Range

Calibrate By :

Date: 1-Oct-24

Date: 1-Oct-24

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710003

Calibrated Date: 1-Oct-24

Page: 1/1

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20002468
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGCT01 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	Nox Conc 46.50 PPM NO Conc 46.50 PPM SO2 Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 24.2 °C

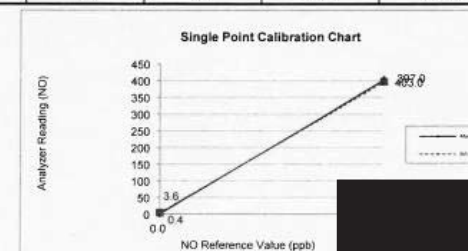
Humidity: 57 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.1	0.0		392.0	400.0	-1.0
NO ₂	0.5	0.0	0.5	5.0	0.0	0.6
NOx	3.6	0.0	3.6	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	3.0	0.0	0.4
NOx	0.4	0.0	0.4	403.0	400.0	0.4



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710003

Page: 1/1

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Normal range	Unit	Before	After	Note
Date	1-Oct-24				
Time	10:13				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	500±1.50	cc/min	482	486	
Ozone Flow	60-80	cc/min	80	80	
PMT Detector	0-5000	mV	33.2	25.1	
AZERO	-20-150	mV	23.4	23.0	
HVPS	400-900 constant	V	733	733	
DCPS	2500 ±1-200	mV	-	-	
CELL TEMP	50±1	Dreogee C	48.9	50.0	
BOX TEMP	20-35	Dreogee C	34.2	33.5	
PMT TEMP	7 ±1	Dreogee C	7.0	7.0	
IS TEMP	50±1-4	Dreogee C	-	-	
MOLY Temp	315 ±1-5	Dreogee C	314.9	314.9	
ICEL PRES	4-10 constant	IN-Hg-A	4.5	4.5	
SAMP PRES	20-30 constant	IN-Hg-A	29.5	23.0	
NO Slope	1 ±1-0.3		0.850	1.095	
NOx Slope	1 ±1-0.3		0.973	0.977	
NO Offset	-10 to + 150	mV	7.1	4.1	
NOx Offset	-10 to + 150	mV	-5.9	15.3	
Span and Cal Values					
Zero Value	NO	0	ppb	3.1	0.2
	NOx	0	ppb	3.6	0.4
Span Value	NO	400	ppb	392.0	400.0
	NOx	400	ppb	397.0	403.0

Calibrate By:

Date: 1-Oct-24

Date: 1-Oct-24

This report shall not be reproduced or

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710002

Page: 1/1

Calibrated Date: 1-Oct-24

☒ 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 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.2 °C

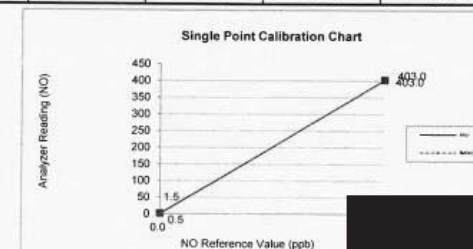
Humidity: 57 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.2	0.0	1.2	396.0	400.0	-0.5
NO ₂	0.3	0.0	0.3	7.0	0.0	0.9
NOx	1.5	0.0	1.5	403.0	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	0.3	0.0	0.3	401.0	400.0	0.1
NO ₂	0.2	0.0	0.2	2.0	0.0	0.2
NOx	0.5	0.0	0.5	403.0	400.0	0.4



This report shall not be reproduced or

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710002

Page:1/1

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Normal range	Unit	Before	After	Note
Date	1-Oct-24				
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	79	72	
PMT Detector	0-5000	mV	26.2	29.3	
AZERO	-20-150	mV	56.0	55.0	
HVPS	400-900 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	
IZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	315.0	315.0	
RCCELL 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	1.2	0.3
	NOx	0	ppb	1.5	0.5
Span Value	NO	400	ppb	396.0	401.0
	NOx	400	ppb	403.0	403.0

Calibrate By

Date

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer:

Part Number: 160-402685487-1
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 Gasous 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. 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	45.50 PPM	G1	+/- 1.0% NIST Traceable	03/24/2023, 03/31/2023
CARBON MONOXIDE	4500 PPM	4507 PPM	G1	+/- 1.4% NIST Traceable	03/24/2023
NITROGEN	Balance				

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	D887860	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	49.02 PPM SULFUR DIOXIDE/NITROGEN	+/- 0.8%	Mar 22, 2028
GMIS	072129228109	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 N1K0579	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 Date Available

NOTES: Gross

Net Weight: 4.1

POW 52230011

THAI METEOROLOGICAL DEPARTMENT

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 6 April, 2024 Certification No. 172/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2503

Customer : [REDACTED]

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1009.2 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

: Thermoschneider No.9188 : testo, testo 645 Serial No. 02649057

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V12201146

[REDACTED]

THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2503 Certification No. 172/24

6 April, 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
1.00	-	-	-	0.3	0.70
3.02	-	-	-	2.4	0.62
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.9	0.14
9.02	-	-	-	8.8	0.22
11.01	-	-	-	10.9	0.11
13.01	-	-	-	12.8	0.21
15.01	-	-	-	15.1	-0.09
17.02	-	-	-	16.8	0.22
20.02	-	-	-	20.1	-0.08

Wind Aloft Plotting Board.

US DEPARTMENT OF COMMERCE WEATHER BUREAU

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

Calibrated

[REDACTED]



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2503

Certification No. 172/24

6 April, 2024

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1009.59	1010.02	-0.43
1009.45	1009.95	-0.50
1010.10	1010.53	-0.43
1010.94	1011.36	-0.42
1011.46	1011.85	-0.39
1011.84	1012.34	-0.50
1012.06	1012.47	-0.41
1013.04	1013.48	-0.44
1013.18	1013.56	-0.38
1012.89	1013.27	-0.38
1013.20	1013.61	-0.41
1013.44	1013.85	-0.41
1013.81	1014.21	-0.40
1014.19	1014.68	-0.49
1015.96	1016.32	-0.36
1016.23	1016.65	-0.42
1015.64	1016.03	-0.39
1015.23	1015.68	-0.45
1012.87	1013.31	-0.44
1013.63	1014.10	-0.47



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2503

Certification No. 172/24

6 April, 2024


Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	46.0	-0.4
30.1	30.3	-0.2
15.4	15.7	-0.3

Calib

Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

6 April, 2024

Sensor model EWSNV110WS2503


Certification No. 172/24

Page : 5 of 6


Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.2	91.5	-6.3
62.4	67.7	-5.3
41.5	46.2	-4.7


Calibrated by

Mechanical Engineer



Calibration & Test Section
Meteorological Instruments Bureau





Date of Issue 6 April, 2024

Certification No. 172/24


Page: 6 of 6

ใบรับรอง


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

Calibrated by

Mechanical Engineer



Calibration & Test Section
Meteorological Instruments Bureau



วิศวกรชำนาญการ

THAI METEOROLOGICAL DEPARTMENT



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. : 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.918602



THAI METEOROLOGICAL DEPARTMENT

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 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

Calibrated



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2509

Certification No. 358/24

24 October, 2024

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1010.12	1009.52	0.60
1010.35	1009.78	0.57
1010.56	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	1011.68	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

Average

Ca

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2509 Certification No. 358/24

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	14.9	0.2

Ca

Mechanical Engineer






THAI METEOROLOGICAL DEPARTMENT

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



Mechanical Engineer






Date of Issue 24 October, 2024 Certification No. 358/24

Page: 6 of 6


ใบรับรอง



หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีทส์ Davis Instruments แบบ TIPPING
 BUCKET Product No. [Redacted] ทำการสอบเทียบกับแก้ววัด
 ฝนแบบแก้ววง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON
 No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.01.inches/TIP)

ลงชื่อ



วิศวกรชำนาญการ



Request No. 21-67/0391 MTC No. EEL. BP. 30/0467

CALIBRATION CERTIFICATE

Submitted by [Redacted]
Address [Redacted]
Calibrated at [Redacted]

Instrument Calibrated : Description : Sound Level Calibrator Manufacturer : Bruel & Kjaer Model : 4230 Serial No. : 1351075	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 Keithley 2015-P S/N4106495.
- Condenser Microphone B&K 4180 S/N 2889871.

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



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

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

Date of Receipt : 9 Apr. 2024
Date of Calibration : 10 Apr. 2024

1 / 2

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.

Request No. 21-67/0391 MTC No. EEL. BP. 30/0467

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

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

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total Distortion

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

Note :

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

Calibrated by : [Redacted] Approved by : [Redacted]

Electric [Redacted] y

Date of Calibration : 10 Apr. 2024
Date of Issue : 11 Apr. 2024

Industrial Metrology and Testing Service Centre
Ref : 2011267040901374001

End of Certificate

2 / 2

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.

ภาคผนวกที่ 5-3
เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
ครั้งที่ 1/2567
สถานีโรงเรียนกรุงเทพคริสเตียนวิทยาลัย
สถานีโรงพยาบาลเซนต์หลุยส์
วันที่ตรวจวัดวันที่ 1-6 สิงหาคม 2567

TSP High Volume Sampler Calibration

Verification Report No.
 SO2400220-E001 -TSP_01

☐ PM ☒ Onsite
 Site: กรุงเทพมหานครเขตวัฒนา
 UTM : 47P 664614 m E 1517406 m N
 Sampler: ETSP#39
 Recorder: ECRDCPR4169240
 Date: 1 Aug 24
 Technical Approval: [REDACTED]

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

CALIBRATIONS				
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.30	1.725	54.0	53.25
2	9.50	1.518	50.0	49.31
3	7.80	1.359	46.0	45.36
4	4.50	1.049	34.0	33.53
5	2.80	0.830	28.0	27.61

LINEAR REGRESSION
 Slope = 29.9847
 Intercept = 2.9498
 Corr. coeff. = 0.9932
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min: 37 / 54

Calibrated by: [REDACTED]
 1 August 2024
 Approved by: [REDACTED]
 1 August 2024

TSP High Volume Sampler Calibration

Verification Report No.
 SO2400220-E001 -TSP_02

☐ PM ☒ Onsite
 Site: โรงพยาบาลเชลล์
 UTM : 47P 664905 m E 1517279 m N
 Sampler: ETSP#44
 Recorder: EVFCDPR02TC012
 Date: 1 Aug 24
 Technical Approval: [REDACTED]

CONDITIONS
 Barometric Press. (hPa): 1004.0 Corrected Pressure (mm Hg): 753.1
 Temperature (deg C): 32.0 Temperature (deg K): 305.0
 Average Press. (hPa): 1004.0 Corrected Avg. Press. (mm Hg): 753.1
 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

CALIBRATIONS				
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.80	1.614	50.0	49.20
2	8.60	1.441	48.0	47.23
3	7.10	1.311	42.0	41.33
4	3.40	0.911	34.0	33.45
5	2.50	0.783	30.0	29.52

LINEAR REGRESSION
 Slope = 23.9850
 Intercept = 11.0712
 Corr. coeff. = 0.9920
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min: 39 / 52

Calibrated by: [REDACTED]
 1 August 2024
 Approved by: [REDACTED]
 1 August 2024

PM10 High Volume Sampler Calibration

Verification Report No.
 SO2400220-E001 -PM 01

L ☐ PM ☒ Onsite
 Site: กรุงเทพมหานครวัดโสมนัส
 UTM : 47P 664614 m E 1517406 m N
 Sampler: EPM10#
 Recorder: ECRDS01618124

Date: 1 Aug 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

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

Corrected Pressure (mm Hg): 751.6
 Temperature (deg K): 303.0
 Corrected Avg. Press. (mm Hg): 751.6
 Average Temp. (deg K): 305.0

CALIBRATION ORIFICE

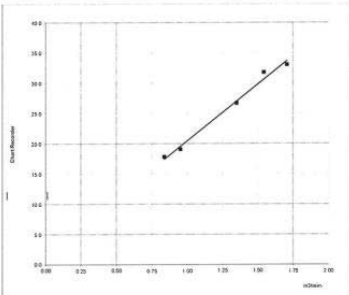
Brand: Tisch Environmental, Inc.
 Model: TE-S025A
 Serial#: 5411

Qstd Slope: 1.26504
 Qstd Intercept: -0.01667
 Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	11.40	1.708	52.0	33.02
2	9.30	1.544	50.0	31.75
3	7.10	1.351	42.0	26.67
4	3.50	0.952	30.0	19.05
5	2.70	0.838	28.0	17.78

LINEAR REGRESSION
 Slope = 18.6903
 Intercept = 1.7569
 Corr. coeff = 0.9944
 SFR = 1.123
 SSP = 35.81
 # of Observations: 5



Calibrated by : XXXXXXXXXX
 1 August 2024

 Approved by : XXXXXXXXXX
 1 August 2024

PM10 High Volume Sampler Calibration

Verification Report No.
 SO2400220-E001 -PM 02

L ☐ PM ☒ Onsite
 Site: โรงพยาบาลเชลียง
 UTM : 47P 664905 m E 1517279 m N
 Sampler: EPM10#44
 Recorder: ECRDS016431075

Date: 1 Aug 24
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1004.0
 Temperature (deg C): 32.0
 Average Press. (hPa): 1004.0
 Average Temp. (deg C): 32.0

Corrected Pressure (mm Hg): 753.1
 Temperature (deg K): 305.0
 Corrected Avg. Press. (mm Hg): 753.1
 Average Temp. (deg K): 305.0

CALIBRATION ORIFICE

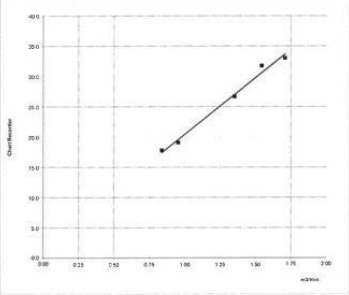
Brand: Tisch Environmental, Inc.
 Model: TE-S025A
 Serial#: 5411

Qstd Slope: 1.26504
 Qstd Intercept: -0.01667
 Date Certified: 9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.80	1.666	52.0	33.09
2	8.90	1.514	46.0	29.27
3	6.90	1.335	40.0	25.46
4	3.50	0.954	30.0	19.09
5	2.70	0.840	28.0	17.82

LINEAR REGRESSION
 Slope = 18.2736
 Intercept = 1.8887
 Corr. coeff = 0.9950
 SFR = 1.130
 SSP = 35.41
 # of Observations: 5



Calibrated by : XXXXXXXXXX
 1 August 2024

 Approved by : XXXXXXXXXX
 1 August 2024

Verification Test Report

Report No.:
SO2400220-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 664661 m E 1517398 m N

Calibrated Date: 1 August 2024
Site : โรงเรียนกรุงเทพคริสเตียน
Equipment: Sound Level Meter
Manufacturer: PUJ SAR
Model: 44
Serial : 1974

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	94.00	0.28	93.72

Calibrated By:
Date: 1 August 2024

Approve By:
Date: 1 August 2024

Verification Test Report

Report No.:
SO2400220-E001 -SLM 02

☒ PM ☐ Onsite UTM : 47P 664904 m E 1517256 m N

Calibrated Date: 1 August 2024
Site : โรงพยาบาลเซนต์หลุยส์
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, 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:
Date: 1 August 2024

Approve By:
Date: 1 August 2024



Certificate of Calibration

Calibration Certification Information			
Cal. Date:	February 9, 2024	Rootsmer S/N:	438320
Operator:	Jim Tisch	Ta:	295 °K
Calibration Model #:	TE-5025A	Pa:	749.0 mm Hg
		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	8.6	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=	$\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$	Va=	$\Delta Vol((Pa-\Delta P)/Pa)$
Qstd=	$Vstd/\Delta Time$	Qa=	$Va/\Delta Time$
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:	rootsmer 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 Calibration

Certificate No. : 67-200034-1 Page : 1 of 2

Submitted by :

Equipment :

Electronic Balance

Manufacturer : Sartorius Model : SECURA224-1S

Serial No. : 0034803270 ID No. : ELABBALANCEN04

Capacity : 220 g Resolution : 0.0001 g

Environment :

Ambient Temperature : (22.8 to 23.6) °C

Relative Humidity : (44.6 to 45.3) %

Air Pressure : 1014.0 mbar

Date of Received : 01 February 2024

Date of Calibration : 01 February 2024

Date of Issue : 06 February 2024

Calibrated by : 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	C02232088	08 Nov 2024	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

Certificate of Calibration

Certificate No. : 67-200034-1 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	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00038

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

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

Eccentric error

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

Repeatability

Load test :	200	g
Stdev. :	0.00005	g



Airgas Specialty Gases
Airgas USA LLC
6141 Easton Road
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708005

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENOA1200E03217
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 46.50 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 46.50 PPM
	SO2 Conc 45.59 PPM
	CO Conc 4507 PPM
	Expire Date: Mar 31,2026 EB0160267

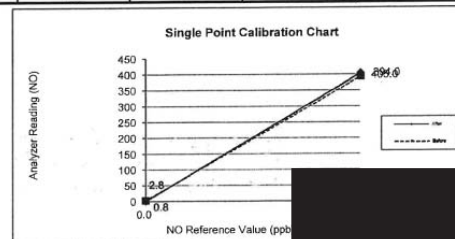
Environment: Temperature 25.1 °C Humidity: 62 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.9	0.0	1.9	391.0	400.0	-1.1
NO ₂	0.9	0.0	0.9	3.0	0.0	0.4
NOx	2.8	0.0	2.8	394.0	400.0	-0.8

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.5	0.0	0.5	403.0	400.0	0.4
NO ₂	0.3	0.0	0.3	2.0	0.0	0.2
NOx	0.8	0.0	0.8	405.0	400.0	0.6



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708005

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Normal range	Unit	Before	After	Note
Date	1-Aug-24				
Time	15:30				
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	
Ozone Flow	60-90	cc/min	80.0	76.0	
PMT Detector	0-5000	mV	24.8	19.6	
AZERO	-20-150	mV	11.7	7.3	
HVFS	400-900 constant	V	768.0	714.0	
DCPS	2500 +/- 200	mV	-	-	
RCCL TEMP	50 +/- 1	Degree C	50.3	50.3	
BOX TEMP	20-35	Degree C	28.0	27.5	
PMT TEMP	7 +/- 1	Degree C	7.7	7.8	
IZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	313.1	315.0	
RCCL PRES	4-10 contant	IN-Hg-A	7.30	7.30	
SAMP PRES	20-30 contant	IN-Hg-A	31.4	31.3	
NO Slope	1 +/- 0.3		0.647	0.983	
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	1.9	0.5
	NOx	0	ppb	2.8	0.8
Span Value	NO	400	ppb	391.0	403.0
	NOx	400	ppb	394.0	405.0

Calibrate By :

Date:

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708002

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENOAI200E01170
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 25.6 °C

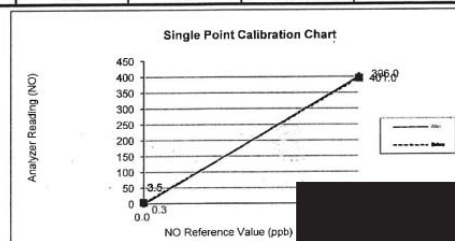
Humidity: 65 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.0	0.0	3.0	389.0	400.0	-1.4
NO ₂	0.5	0.0	0.5	7.0	0.0	0.9
NOx	3.5	0.0	3.5	396.0	400.0	-0.5

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.3	0.0	0.3	400.0	401.0	-0.1
NO ₂	0.0	0.0	0.0	1.0	0.0	-0.1
NOx	0.3	0.0	0.3	401.0	403.0	-0.2



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6708002

Page:1/1

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Aug-24				
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	60-90	cc/min	74	77	
PMT Detector	0-5000	mV	51	26	
AZERO	20-150	mV	53.3	33.3	
HVPS	400-900 constant	V	821	821	
DCPS	2500 +/- 200	mV	2556	2556	
RECELL TEMP	50 +/- 1	Dreagee C	50	50	
BOX TEMP	20-35	Dreagee C	30.2	32.6	
PMT TEMP	7 +/- 1	Dreagee C	7.5	7.5	
IZS TEMP	50 +/- 4	Dreagee C	-	-	
MOLY Temp	315 +/- 5	Dreagee C	315.0	314.5	
RECEL 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	3.0	0.3
	NOx	0	ppb	3.5	0.3
Span Value	NO	400	ppb	389.0	400.0
	NOx	400	ppb	396.0	401.0

Calibrate By: _____

Date: _____

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6708002

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: T100	Manufacturer API S/N: ESOAIT10002033
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Calibration System

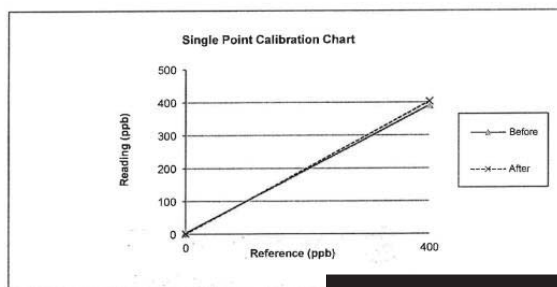
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.50 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.50 PPM
	SO2 Conc 45.59 PPM
	CO Conc 4500 PPM
	Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 26.1 °C

Humidity: 65 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	3.8	3.8	400.0	391.2	-1.1
After	0.0	0.6	0.6	400.0	403.0	0.4



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6708002

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Aug-24				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	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)	Dreegee C	50	50	
BOX TEMP	20-40	Dreegee C	34.1	32.7	
PMT TEMP	7 (+/-1)	Dreegee 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 constant	IN-Hg-A	28.1	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	0.866	
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	3.6	0.6	
Span Gas (400 PPB)	400	ppb	391.2	403.0	± 5% of Range

Calibrate By:

Date:

Needisa Supply Instru

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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6708006

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

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

Calibration System

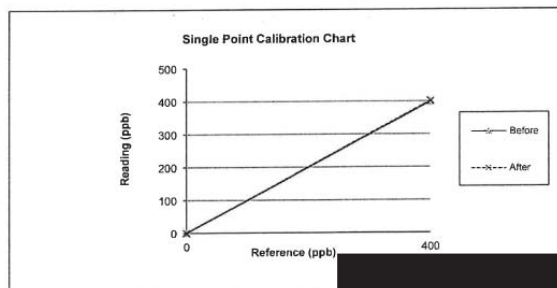
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM SO2 Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 26.0 °C

Humidity: 65 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.4	0.4	400.0	399.0	-0.1
After	0.0	0.1	0.1	400.0	400.6	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6708006

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page: 2/2

Analyzer Signal Values					
Date	1-Aug-24	Time	13:11:00		
Power Supplies					
Option	0.00	mV	+5 V Sensor	5	V
+4 V	4068	mV	+3.3 V	3.3	V
+24 V	24.1	V	+12 V	11.9	V
+5 V	5	V	UV lamp	44.3	mA
+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-Aug-24

Date: 1-Aug-24

This report shall not be reproduced except in full without the written approval of Needles Supply Instrument Co., Ltd.

CO Analyzer Verification Test Report

Calibration Report No.: TD-C6708006

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

Calibration System

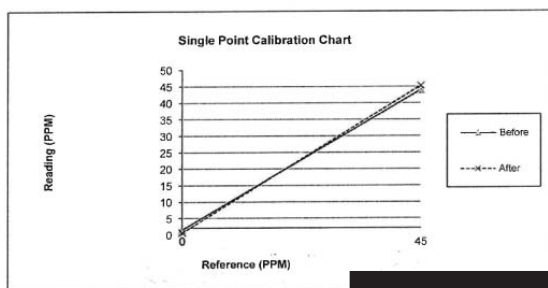
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 26.1 °C

Humidity: 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.5	1.5	45.0	44.0	-1.1
After	0.0	0.6	0.6	45.0	45.3	0.3



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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6708006

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Page:2/2

Detail	Range	Unit	Before	After	Note
Date	1-Aug-24				
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	1.5	0.6	
Span Gas	45	PPM	44.0	45.3	± 5% of Range

Calibrate By :

Date:

This report shall not be reproduced except in full without the written approval of Needles Supply Instrument Co.Ltd.

CO Analyzer Verification Test Report

Calibration Report No.: AP-C6708001

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: 300E	Manufacturer API S/N: ECOAI300E00449
---	---

Calibration System

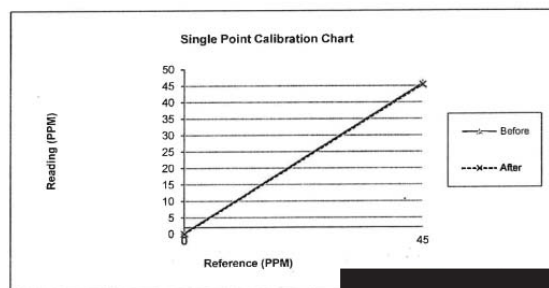
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 25.8 °C

Humidity: 60 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.30	0.3	45.0	45.7	0.8
After	0.0	0.02	0.0	45.0	45.3	0.3



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CO Analyzer Verification Test Report

Calibration Report No.: AP-C6708001

Calibrated Date: 1-Aug-24

☒ PM ☐ Onsite



Page:2/2

Detail	Range	Unit	Before	After	Note
Date	1-Aug-24				
Time	11:00				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.73	1.11	
CO Measure	2500 - 4800 MV.	mV	2913.3	2923.5	
CO Reference	2500 - 4800 MV.	mV	2444.3	2421.4	
MR Ratio	1.2 +/- 0.5		1.18	1.21	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	29.1	29	
Sample Flow	720 - 880 cc/min	cc/min	890	886	
Sample Temp	44 - 52 deg.C	deg.C	50.3	50.4	
Bench Temp	47 - 49 deg.C	deg.C	48	48	
Wheel Temp	66 - 70 deg.C	deg.C	68.3	68.4	
Box Temp	27 - 50 deg.C	deg.C	35.2	35.1	
PHT drive	250 - 4750 mv.	mV	3323.4	3353.6	
Slope	0.800 - 1.200		1.051	1.112	
Offset	0.05 +/- 0.2		0.086	0.088	
Gas Test Response					
Zero Gas	0	PPM	0.3	0.0	
Span Gas	45	PPM	45.7	45.3	± 5% of Range

Calibrate By :

Date:

This report shall not be reproduced except in full without the written approval of Needas Supply Instrument Co.Ltd.

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0391 **MTC No.** EEL. BP. 30/0467

CALIBRATION CERTIFICATE

Submitted by [Redacted]
Address [Redacted]
Calibrated at [Redacted] Service Centre.

Instrument Calibrated : **Ambient Environment**

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

Standards used :

- Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
- Measuring Amplifier Brüel&Kjær 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 Keithley 2015-P S/N4106495.
- Condenser Microphone B&K 4180 S/N 2889871.



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

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

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

Date of Receipt : 9 Apr. 2024
Date of Calibration : 10 Apr. 2024

The results relate only to the items tested/calibrated or 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. 21-67/0391 **MTC No.** EEL. BP. 30/0467

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

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

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total Distortion

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

Note :

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

Calibrated by : [Redacted] App [Redacted]

Date of Calibration : 10 Apr. 2024
Date of Issue : 11 Apr. 2024

End of Certificate

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

THAI METEOROLOGICAL DEPARTMENT

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 2 October, 2023 Certification No. 337/23

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 1006.5 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

THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2508 Certification No. 337/23

2 October, 2023 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	-	-	-	3.0	0.02
5.00	-	-	-	4.7	0.30
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.7	-0.68
11.01	-	-	-	11.1	-0.09
13.01	-	-	-	12.9	0.11
15.01	-	-	-	15.0	0.01
17.02	-	-	-	16.9	0.12
20.02	-	-	-	20.1	-0.08

Wind Aloft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	88
180	179
270	

Calibrate



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2508

Certification No. 337/23

2 October, 2023

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1005.63	1005.12	0.51
1006.25	1005.85	0.40
1006.22	1005.81	0.41
1006.54	1006.00	0.54
1006.88	1006.30	0.58
1007.36	1006.80	0.56
1007.58	1007.12	0.46
1007.52	1007.13	0.39
1005.60	1005.16	0.44
1005.84	1005.41	0.43
1006.28	1005.85	0.43
1006.60	1006.18	0.42
1007.07	1006.67	0.40
1007.26	1006.86	0.40
1007.38	1006.92	0.46
1005.50	1004.98	0.52
1005.83	1005.43	0.40
1006.55	1006.17	0.38
1007.31	1006.86	0.45
1007.01	1006.64	0.37

Average 0.45

Calibr



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2508

Certification No. 337/23

2 October, 2023

Page : 4 of 6

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

Cal





THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor model EWSNV110WS2508 Certification No. 337/23
2 October, 2023 Page : 5 of 6

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

Calibrated by

Mechanical Engineer



Date of Issue 2 October, 2023

Certification No. 337/23

Page: 6 of 6

ใบรับรอง

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



ลงชื่อ..

วิศวกรชำนาญการ

THAI METEOROLOGICAL DEPARTMENT
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 : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130148 ID No. : EWSDCMS1200148

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

: Thermoschneider No.9188 : testo, testo 645 Serial No. 02848057

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. 120629586



THAI METEOROLOGICAL DEPARTMENT

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 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	-	-	-	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	90
180	182
270	

Calibr



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6273

Certification No. 168/24

6 April, 2024

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1009.59	1009.1	0.49
1009.4b	1009.0	0.45
1010.10	1009.5	0.60
1010.94	1010.5	0.44
1011.46	1010.9	0.56
1011.84	1011.3	0.54
1012.06	1011.6	0.46
1013.04	1012.6	0.44
1013.18	1012.6	0.58
1012.89	1012.3	0.59
1013.20	1012.8	0.40
1013.44	1012.9	0.54
1013.81	1013.3	0.51
1014.19	1013.6	0.59
1015.96	1015.4	0.56
1016.23	1015.8	0.43
1015.64	1015.1	0.54
1015.23	1014.8	0.43
1012.87	1012.3	0.57
1013.63	1013.1	0.53

Calib



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor Temperature Model TPH-1 C

Certification No. 168/24

6 April, 2024

Serial No. 6273

Page : 4 of 6

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

Calib

Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

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 % R.H.	Correction % R.H.
85.2	87.8	-2.6
62.4	65.2	-2.8
41.5	43.1	-1.6

Calib

Mechanical Engineer



Date of Issue 6 April, 2024

Certification No. 168/24

Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีท้อ 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)



ลงชื่อ

วิศวกรชำนาญการ

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

สถานีโรงพยาบาลเซนต์หลุยส์

สถานีโรงเรียนกรุงเทพคริสเตียนวิทยาลัย

ครั้งที่ 2/2567

วันที่ตรวจวัดวันที่ 31 ตุลาคม – 5 พฤศจิกายน 2567

TSP High Volume Sampler Calibration

Verification Report No.
SO2400277-E001 -TSP 01

☐ PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM : 47P 1517400 664623
 Sampler: ETSP#42
 Recorder: EVFCDPR02TC010

Date: 31 Oct 24
Technical: XXXXXXXXXX
Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 989.0
Temperature (deg C): 38.0
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 741.8
Temperature (deg K): 311.0
Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

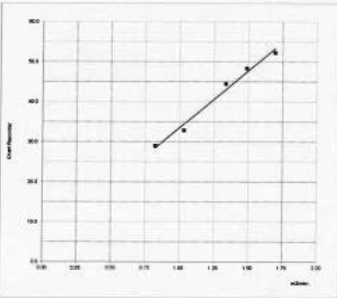
Qstd Slope: 2.02024
Qstd Intercept: -0.02667
Date Certified: 9 Feb 2024

CALIBRATIONS				
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.34	1.695	54.0	52.22
2	9.53	1.491	50.0	48.35
3	7.62	1.335	46.0	44.49
4	4.56	1.035	34.0	32.88
5	2.89	0.827	30.0	29.01

LINEAR REGRESSION

Slope = 28.5227
Intercept = 4.9803
Corr. coeff = 0.9914

of Observations: 5
Range of Chart at 1.1 - 1.7 m3/min: 38 / 55



Calibrated by: XXXXXXXXXX

Approved by: XXXXXXXXXX

TSP High Volume Sampler Calibration

Verification Report No.
SO2400277-E001 -TSP 02

☐ PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM : 47P 1517274 664902
 Sampler: ETSP#40
 Recorder: EVFCDPR02TC008

Date: 31 Oct 24
Technical: XXXXXXXXXX
Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 989.0
Temperature (deg C): 38.0
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 741.8
Temperature (deg K): 311.0
Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

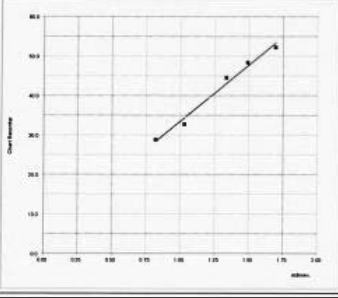
Qstd Slope: 2.02024
Qstd Intercept: -0.02667
Date Certified: 9 Feb 2024

CALIBRATIONS				
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.54	1.639	52.0	50.29
2	9.36	1.478	50.0	48.35
3	7.23	1.300	42.0	40.62
4	3.53	0.913	32.0	30.95
5	2.79	0.813	30.0	29.01

LINEAR REGRESSION

Slope = 27.0910
Intercept = 6.5609
Corr. coeff = 0.9931

of Observations: 5
Range of Chart at 1.1 - 1.7 m3/min: 38 / 54



Calibrated by: XXXXXXXXXX

Approved by: XXXXXXXXXX
31 October 2024

PM10 High Volume Sampler Calibration

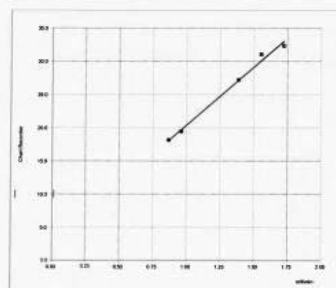
Verification Report No.
SO2400277-E001 -PM 01

L PM ☐ Onsite
 Site: โรงพยาบาลเกษมสัน
 UTM : 47P 1517400 664623
 Sampler: EPM10B40
 Recorder: ECRDS01618124
 Date: 31 Oct 24
 Technical Approval:

CONDITIONS			
Barometric Press. (hPa): 999.0	Corrected Pressure (mm Hg): 741.8	Temperature (deg C): 38.0	Temperature (deg K): 311.0
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: Tiesch 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	11.21	1.727	50.0	32.37
2	9.12	1.559	48.0	31.08
3	7.21	1.388	42.0	27.19
4	3.42	0.950	30.0	19.42
5	2.78	0.857	28.0	18.13
LINEAR REGRESSION				
Slope = 17.4636				
Intercept = 2.9394				
Corr. coeff = 0.9958				
SFR = 1.188				
SSP = 36.58				
# of Observations: 5				
Range of Chart at SFR ±10%: 34				



Calibrated by:

Approved by:
31 October 2024

PM10 High Volume Sampler Calibration

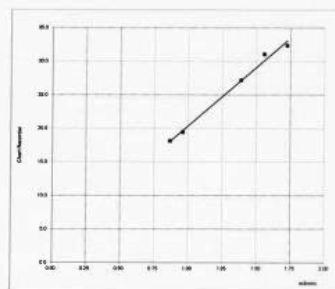
Verification Report No.
SO2400277-E001 -PM 02

L PM ☐ Onsite
 Site: โรงพยาบาลเกษมสัน
 UTM : 47P 1517274 664902
 Sampler: EPM10B27
 Recorder: EVFCDPR02TC017
 Date: 31 Oct 24
 Technical Approval:

CONDITIONS			
Barometric Press. (hPa): 999.0	Corrected Pressure (mm Hg): 741.8	Temperature (deg C): 38.0	Temperature (deg K): 311.0
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: Tiesch 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	11.24	1.729	52.0	33.67
2	8.75	1.527	48.0	31.08
3	7.02	1.369	42.0	27.19
4	3.89	1.023	32.0	20.72
5	2.98	0.897	28.0	18.13
LINEAR REGRESSION				
Slope = 19.0929				
Intercept = 1.1658				
Corr. coeff = 0.9975				
SFR = 1.188				
SSP = 36.83				
# of Observations: 5				
Range of Chart at SFR ±10%: 34				



Calibrated by:
31 October 2024

Approved by:
31 October 2024

Verification Test Report

Report No.:
SO2400277-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 664650 m E 1517398 m N

Calibrated Date: 31 October 2024
Site : โรงเรียนกรุงเทพคริสเตียน
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1865

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	94.00	0.28	93.72

Calibrated By: [Signature]
 Date: 31 October 2024

Approve By: [Signature]

Verification Test Report

Report No.:
SO2400277-E001 -SLM 02

☒ PM ☐ Onsite UTM : 47P 664895 m E 1517268 m N

Calibrated Date: 31 October 2024
Site : โรงพยาบาลเซนต์หลุยส์
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1860

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: [Signature]
 Date: 31 October 2024

Approve By: [Signature]



Certificate of Calibration

Calibration Certification Information			
Cal. Date: February 9, 2024	Roots meter 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			
$Vstd = \Delta Vol \left(\frac{Pa - \Delta P}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)$		$Va = \Delta Vol \left(\frac{Pa - \Delta P}{Pa} \right)$	
$Qstd = Vstd / \Delta Time$		$Qa = Va / \Delta Time$	
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:	roots meter manometer reading (mm Hg)
Ta:	actual absolute temperature (°K)
Pa:	actual barometric pressure (mm Hg)
b:	intercept
m:	slope

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

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 Ambient Air.



Certificate of Calibration

Certificate No. : 67-200034-1 Page : 1 of 2

Submitted by :

Equipment :

Electronic Balance
Manufacturer : Sartorius Model : SECURA224-IS
Serial No. : 0034803270 ID No. : ELABBALANCEN04
Capacity : 220 g Resolution : 0.0001 g

Environment :

On site calibration was carried out at the Balance Room, Envilab Co., Ltd.
Ambient Temperature : (22.8 to 23.6) °C
Relative Humidity : (44.6 to 45.3) %
Air Pressure : 1014.0 mbar

Date of Received :

01 February 2024

Date of Calibration :

01 February 2024

Date of Issue :

06 February 2024

Calibrated by :

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	C02232088	08 Nov 2024	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

Certificate of Calibration

Certificate No. : 67-200034-1 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	0.0001	0.00012
0.1	0.0001	0.00012
1	0.0000	0.00013
2	0.0001	0.00013
5	0.0000	0.00013
10	0.0000	0.00013
20	-0.0001	0.00014
50	-0.0001	0.00015
100	-0.0001	0.00020
200	-0.0001	0.00038

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

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

Eccentric error

Load test : 50 g


A B C D E

-0.0001 -0.0001 -0.0001 0.0001 0.0000 g

Repeatability

Load test : 200 g

Sidev. : 0.00005 g



CO Analyzer Verification Test Report

Calibration Report No.: AP-C6710001

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: 300E	Manufacturer API S/N: ECOAI300E00449
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Calibration System

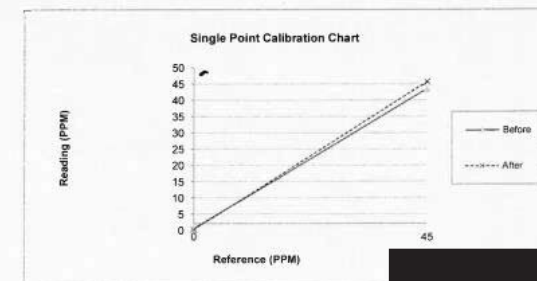
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 21.4 °C

Humidity 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.50	0.5	45.0	43.5	-1.7
After	0.0	0.14	0.1	45.0	45.7	0.8



CO Analyzer Verification Test Report

Calibration Report No.: AP-C6710001

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 2/2

Detail	Range	Unit	Before	After	Note
Date	1-Oct-24				
Time	11:00				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.73	1.11	
CO Measure	2500 - 4800 MV	mV	2913.3	2923.5	
CO Reference	2500 - 4800 MV	mV	2444.3	2421.4	
MR Ratio	1.2 +/- 0.5		1.18	1.21	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	29.1	29	
Sample Flow	720 - 880 cc/min	cc/min	890	886	
Sample Temp	44 - 52 deg.C	deg.C	50.3	50.4	
Bench Temp	47 - 49 deg.C	deg.C	48	48	
Wheel Temp	66 - 70 deg.C	deg.C	68.3	68.4	
Box Temp	27 - 50 deg.C	deg.C	35.2	35.1	
PHT drive	250 - 4750 mv.	mV	3323.4	3353.6	
Slope	0.800 - 1.200		1.051	1.112	
Offset	0.05 +/- 0.2		0.088	0.088	
Gas Test Response					
Zero Gas	0	PPM	0.5	0.1	
Span Gas	45	PPM	43.5	45.7	± 5% of Range

Calib

CO Analyzer Verification Test Report

Calibration Report No.: AP-C6710002

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

Analyzer Type: CO Analyzer Model: 300E	Manufacturer API S/N: ECOAI300E01034
---	---

Calibration System

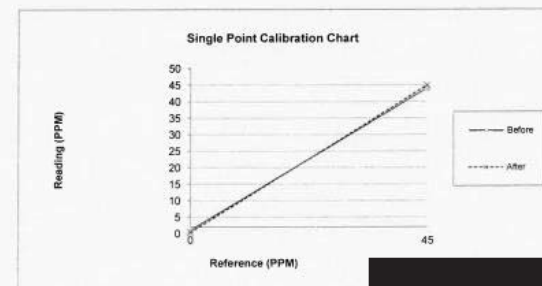
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 46.50 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 46.50 PPM
	So2 Conc 45.59 PPM
	Co Conc 4507 PPM
	Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 21.5 °C

Humidity 63 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.0	1.0	45.0	44.1	-1.0
After	0.0	0.3	0.3	45.0	44.9	-0.1



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CO Analyzer Verification Test Report

Calibration Report No.: AP-C6710002

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 2/2

Detail	Range	Unit	Before	After	Note
Date	1-Oct-24				
Time	16:06				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.01	0.06	
CO Measure	2500 - 4800 MV.	mV	3426.3	3401.3	
CO Reference	2500 - 4800 MV.	mV	2850.7	2832.1	
MR Ratio	1.2 +/- 0.5		1.21	1.21	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	28.5	28.4	
Sample Flow	720 - 880 cc/min	cc/min	790	783	
Sample Temp	44 - 52 deg.C	deg.C	48.2	48.2	
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	35.2	35.4	
PHT drive	250 - 4750 mv.	mV	3114.8	3106.5	
Slope	0.800 - 1.200		0.972	0.981	
Offset	0.05 +/- 0.2		0.01	0.009	
Gas Test Response					
Zero Gas	0	PPM	1.0	0.3	
Span Gas	45	PPM	44.1	44.9	± 5% of Range

Calibrate By :

Date:

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710004

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100E	Manufacturer API S/N: ESOAI100E01218
--	---

Calibration System

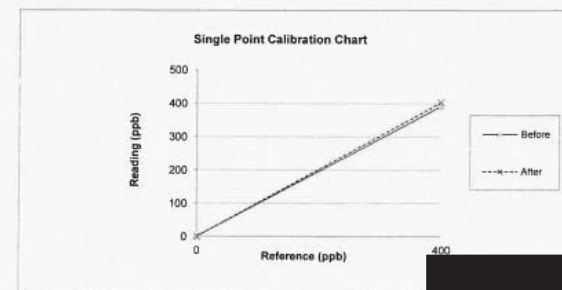
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.50 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 45.50 PPM
	SO2 Conc 45.59 PPM
	CO Conc 4500 PPM
	Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 24.3 °C

Humidity: 56 %RH

Calibration Report

Status	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.7	0.7	400.0	392.0	-1.0
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.: AP-S6710004
 Calibrated Date: 1-Oct-24
☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-24				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
UVPS	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 constant	IN-Htg-A	28.1	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	0.866	
SO2 Offset	< 250	mV	85	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	0.7	0.5	
Span Gas (400 PPB)	400	ppb	392.0	403.0	± 5% of Range

Calibrate By : _____
 Date: _____

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710006
 Calibrated Date: 1-Oct-24
☒ PM ☐ Onsite

Page: 1/2

Instruments Information

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

Calibration System

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

Environment: Temperature 24.4 °C Humidity 57 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.0	1.0	400.0	394.0	-0.8
After	0.0	0.6	0.6	400.0	404.0	0.5

Single Point Calibration Chart

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6710006

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-24				
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	592.0	591.0	
PMT Detector	0 - 5000	mV	255.6	61.0	
Norm PMT Detector	0 - 5000	mV	59.7	65.2	
HVPS	400-800 constant	V	607.0	607.0	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL 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	1882.0	2044.0	
SO2 Conc	1000 (+/- 250)	PPB	841.0	1022.0	
SO2 Slope	1 (+/- 0.3)	-	1.224	1.104	
SO2 Offset	< 250	mV	24.8	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	1.0	0.6	
Span Gas (400 PPB)	400	ppb	394.0	404.0	± 5% of Range

Calibrate By:

Date:

This report shall

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710007

Calibrated Date: 1-Oct-24

Page: 1/1

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200E	Manufacturer API S/N: ENOAI200E02788
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM SO2 Conc 45.50 PPM CO Conc 4507 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 24.3 °C

Humidity: 57 %RH

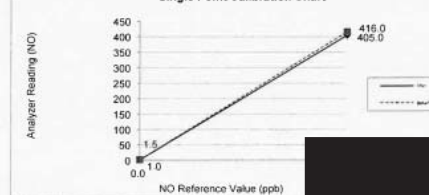
Calibration Check (Before adjust)

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	412.0	400.0	1.5
NO2	0.2	0.0	0.2	4.0	0.0	0.5
NOx	1.5	0.0	1.5	416.0	400.0	2.0

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.6	0.0	0.6	403.6	400.0	0.4
NO2	0.4	0.0	0.4	1.4	0.0	0.2
NOx	1.0	0.0	1.0	405.0	400.0	0.6

Single Point Calibration Chart



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710007

Page:1/1

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-24				
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±1- 50	cc/min	511	532	
Ozone Flow	80-90	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	-	-	
RCELL TEMP	50±1	Dreagee C	50	50	
BOX TEMP	20-35	Dreagee C	33.7	32.9	
PMT TEMP	7 ±1-1	Dreagee C	7.1	7.1	
IZS TEMP	50±1- 4	Dreagee C	-	-	
MOLY Temp	315 ±1- 5	Dreagee C	314.4	315.0	
RCEL PRES	4-10 contant	IN-Hg-A	10	10	
SAMP PRES	20-30 contant	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	1.3	0.6
	NOx	0	ppb	1.5	1.0
Span Value	NO	400	ppb	412.0	403.6
	NOx	400	ppb	416.0	405.0

Calibrate By :

Date :

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710001

Page:1/1

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer	Manufacturer API
Model: 200E	S/N: ENOAI200E00305

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NOx Conc 46.50 PPM
S/N: 792	NO Conc 46.50 PPM
ZERO AIR Generator ZAG7001	So2 Conc 45.59 PPM
S/N: 644	Co Conc 4507 PPM
	Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.1 °C

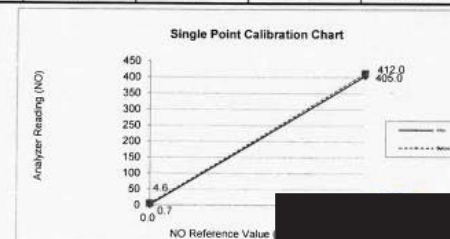
Humidity: 57 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.2	0.0	3.2	410.0	400.0	1.2
NO ₂	1.4	0.0	1.4	2.0	0.0	0.2
NOx	4.6	0.0	4.6	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	0.4	0.0	0.4	403.0	400.0	0.4
NO ₂	0.3	0.0	0.3	2.0	0.0	0.2
NOx	0.7	0.0	0.7	405.0	400.0	0.6



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6710001

Page:1/1

Calibrated Date: 1-Oct-24

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-24				
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	76.0	76.0	
PMT Detector	3-5000	mV	24.5	62.2	
AZERO	-20-150	mV	8.6	67.5	
HVPS	400-900 constant	V	839.0	836.0	
DCPS	2500 ±1.200	mV	-	-	
RCCELL TEMP	50±1.1	Dreagee C	50.0	50.0	
BCX TEMP	20-35	Dreagee C	34.5	30.5	
PMT TEMP	7 ±1.1	Dreagee C	7.0	7.1	
JS TEMP	50±1.4	Dreagee C	-	-	
MOLY Temp	315 ±1.5	Dreagee C	315.0	314.4	
RCEL 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 ±1.0.3		1.256	1.032	
Nox Slope	1 ±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	3.2	0.4
	NOx	0	ppb	4.6	0.7
Span Value	NO	400	ppb	410.0	403.0
	NOx	400	ppb	412.0	405.0

Calibr

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: BANGKOK INDUSTRIAL
 GAS CO LTD
 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-12/031, 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.

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	±1.0%	Feb 22, 2022
GMIS	124206889104	CC322509	4.326 PPM NITROGEN DIOXIDE/AIR	±1.0%	Feb 21, 2025
NTRM	160610-01	CC473196	49.02 PPM SULFUR DIOXIDE/NITROGEN	±0.8%	Mar 22, 2026
GMIS	072120228109	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 N1K0579	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

THAI METEOROLOGICAL DEPARTMENT



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 : เครื่องมือตรวจวัดอุณหภูมิตามวิธี

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.918802

THAI METEOROLOGICAL DEPARTMENT



The Result of Calibration

Sensor model EWSNV110WS2511


Certification No. 359/24

24 October, 2024

Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure m/sec	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction 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	270



THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration


Sensor model EWSNV110WS2511

Certification No. 359/24

24 October, 2024 Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
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
		0.85
		0.80
		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

Calibration



THAI METEOROLOGICAL DEPARTMENT


The Result of Calibration

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



Mechanical Engineer



 THAI METEOROLOGICAL DEPARTMENT [Redacted]															
The Result of Calibration															
Sensor model EWSNV110WS2511 Certification No. 359/24	Date of Issue 24 October, 2024 Certification No. 359/24														
24 October, 2024 Page : 5 of 6	Page: 6 of 6														
<table border="1" style="width: 100%; border-collapse: collapse;"><thead><tr><th rowspan="2">Standard Humidity % R.H.</th><th colspan="2">Relative Humidity Sensor Reading</th></tr><tr><th>Reading % R.H.</th><th>Correction % R.H.</th></tr></thead><tbody><tr><td>92.5</td><td>88.7</td><td>3.8</td></tr><tr><td>65.4</td><td>63.2</td><td>2.2</td></tr><tr><td>45.2</td><td>44.2</td><td>1.0</td></tr></tbody></table>	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	ใบรับรอง หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชื่อ 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)
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													
Calibrated by [Redacted] Mechanical Engineer	 [Redacted] วิศวกรชำนาญการ														

THAI METEOROLOGICAL DEPARTMENT

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 : [REDACTED]

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

STANDARD BAROMETER : Digital Barometer Vaisala Type WMT2200-15

Cal : [REDACTED]

M : [REDACTED]

THAI METEOROLOGICAL DEPARTMENT

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 H ₂ O	inches H ₂ O	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.	
U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	92
180	181
270	

Calibrate : [REDACTED]

Metro : [REDACTED]



THAI METEOROLOGICAL DEPARTMENT


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 Pressure	Tested Barometer Pressure	Correction
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	1008.12	0.20
1009.11	1008.92	0.19
1009.56	1009.23	0.33
1009.86	1009.56	0.30
Average		



Mechanical Engineer







THAI METEOROLOGICAL DEPARTMENT


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:



Mr. Watchapol Subwat
Mechanical Engineer







THAI METEOROLOGICAL DEPARTMENT

The Result of Calibration

Sensor Humidity Model TPH-1 C

24 October, 2024

Certification No. 360/24


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

Cal [Redacted]

Mechanical Engineer







Date of Issue 24 October, 2024

Certification No. 360/24


Page: 6 of 6


ใบรับรอง



หนังสือฉบับนี้รับรองว่า 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)

ลงช [Redacted]

วิศวกรชำนาญการ





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0391 **MTC No.** EEL BP. 30/0467

CALIBRATION CERTIFICATE

Submitted by [Redacted]
Address [Redacted]
Calibrated at [Redacted]

Instrument Calibrated : Description : Sound Level Calibrator Manufacturer : Bruel & Kjaer Model : 4230 Serial No. : 1351075	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 Keithley 2015-P S/N4106495.
- Condenser Microphone B&K 4180 S/N 2889871.

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



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

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

Date of Receipt : 9 Apr. 2024
Date of Calibration : 10 Apr. 2024

1 / 2

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. 21-67/0391 **MTC No.** EEL BP. 30/0467

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

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

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

1. Sound Pressure Level

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

2. Frequency

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

3. Total Distortion

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

Note :

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

Calibrated [Redacted] **Approved by** [Redacted]

Electric [Redacted]

Date of Calibration : 10 Apr. 2024
Date of Issue : 11 Apr. 2024

Industrial Metrology and Testing Service Centre
 Ref : 2011267040901374001

End of Certificate 2 / 2

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.