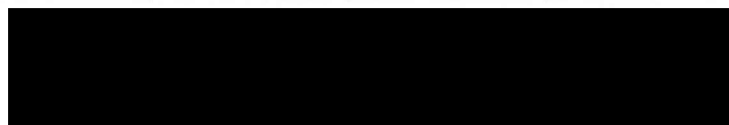


## ภาคผนวกที่ 5

### เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

**ภาคผนวกที่ 5-1**  
**เอกสารผลการสอบเทียบเครื่องมือตรวจวัด**  
**ครั้งที่ 1/2566**  
**โรงเรียนแสงหิรัญ**  
**และสถาบันการบินพลเรือน**  
**วันที่ตรวจวัดวันที่ 26-31 กรกฎาคม 2566**



TSP High Volume Sampler Calibration

Verification Report No.  
SO2300201-E001 -TSP 02

☐ PM ☒ Onsite  
 Site: การบินพลเรือน  
 UTM : 47P N 1526256 E 667901  
 Sampler: ETPSP16  
 Recorder: ECRANG15315224  
 Date: 26 Jul 23  
 Technical:   
 Approval:

CONDITIONS

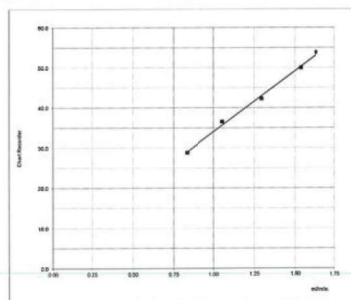
Barometric Press. (hPa): 951.0  
 Temperature (deg C): 30.0  
 Average Press. (hPa): 1013.0  
 Average Temp. (deg C): 30.0  
 Corrected Pressure (mm Hg): 713.3  
 Temperature (deg K): 303.0  
 Corrected Avg. Press. (mm Hg): 759.8  
 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc  
 Model: TE-5025A  
 Serial#: 759  
 Qstd Slope: 2.03736  
 Qstd Intercept: -0.03733  
 Date Certified: 18 Jan 23

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	12.22	1.667	52.0	49.96	Slope = 30.5848
2	9.14	1.444	46.0	44.20	Intercept = -0.8665
3	7.47	1.307	40.0	38.43	Corr. coeff. = 0.9980
4	4.77	1.048	32.0	30.74	
5	2.98	0.832	26.0	24.98	
					# of Observations: 5
					Range of Chart at 1.1 - 1.7 m3/min: 35
					53



Calibrated by:   
 26 July 2023

Approved by:   
 26 July 2023



PM10 High Volume Sampler Calibration

Verification Report No.  
SO2300201-E001 -PM 02

☒ PM ☐ Onsite  
 Site: การบินพลเรือน  
 UTM : 47P N 1526256 E 667901  
 Sampler: EPM#22  
 Recorder: ECRDS01618125  
 Date: 26 Jul 23  
 Technical:   
 Approval:

CONDITIONS

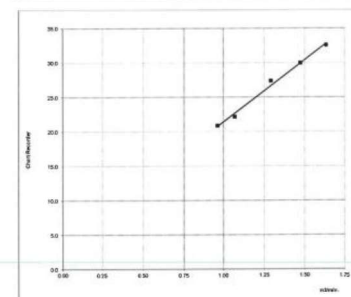
Barometric Press. (hPa): 945.7  
 Temperature (deg C): 32.0  
 Average Press. (hPa): 1013.0  
 Average Temp. (deg C): 30.0  
 Corrected Pressure (mm Hg): 709.3  
 Temperature (deg K): 305.0  
 Corrected Avg. Press. (mm Hg): 759.8  
 Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc  
 Model: TE-5025A  
 Serial#: 759  
 Slope: 1.27576  
 Intercept: -0.02337  
 Date Certified: 18 Jan 23

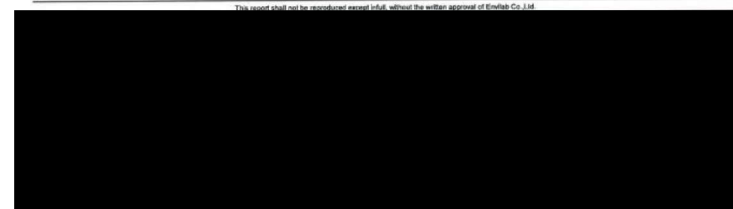
CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	11.73	1.779	56.0	36.72	Slope = 13.9535
2	10.38	1.674	52.0	34.10	Intercept = 2.6328
3	7.33	1.410	44.0	28.85	Corr. coeff. = 0.9979
4	4.82	1.147	38.0	24.92	SFR = 1.218
5	2.99	0.907	30.0	19.67	SSP = 39.23
					# of Observations: 5
					Range of Chart at SFR ±10%: 37
					42



Calibrated by:   
 26 July 2023

Approved by:   
 26 July 2023



TSP High Volume Sampler Calibration

Verification Report No.  
 SO2300201-E001 -TSP 01

☐ PM ☒ Onsite  
 Site: โรงเรือนเลี้ยงไก่  
 UTM : 47P N 1516341 E 672857  
 Sampler: ETSP#15  
 Recorder: ECRDCPR4169240  
 Date: 26 Jul 23  
 Technical: XXXXXXXXXX  
 Approval: XXXXXXXXXX

**CONDITIONS**  
 Barometric Press. (hPa): 951.0      Corrected Pressure (mm Hg): 713.3  
 Temperature (deg C): 30.0      Temperature (deg K): 303.0  
 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: 2.03736  
 Model: TE-5025A      Qstd Intercept: -0.03733  
 Serial#: 759      Date Certified: 18 Jan 23

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.73	1.633	56.0	53.80
2	10.38	1.538	52.0	49.96
3	7.33	1.295	44.0	42.27
4	4.82	1.054	38.0	36.51
5	2.99	0.834	30.0	28.62

**LINEAR REGRESSION**  
 Slope = 30.2683  
 Intercept = 3.8117  
 Corr. coeff. = 0.9979  
 # of Observations: 5  
 Range of Chart at 1.1 - 1.7 m3/min: 39 / 57

Calibrated by: XXXXXXXXXX  
 26 July 2023  
 Approved by: XXXXXXXXXX  
 26 July 2023

PM10 High Volume Sampler Calibration

Verification Report No.  
 SO2300201-E001 -PM 01

☐ PM ☒ Onsite  
 Site: โรงเรือนเลี้ยงไก่  
 UTM : 47P N 1516341 E 672857  
 Sampler: EPM39  
 Recorder: ECRDS01618124  
 Date: 26 Jul 23  
 Technical: XXXXXXXXXX  
 Approval: XXXXXXXXXX

**CONDITIONS**  
 Barometric Press. (hPa): 951.0      Corrected Pressure (mm Hg): 713.3  
 Temperature (deg C): 30.0      Temperature (deg K): 303.0  
 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      Slope: 1.27576  
 Model: TE-5025A      Intercept: -0.02337  
 Serial#: 759      Date Certified: 18 Jan 23

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.00	1.634	50.0	32.59
2	8.11	1.473	46.0	29.98
3	6.21	1.291	42.0	27.37
4	4.23	1.069	34.0	22.16
5	3.43	0.964	32.0	20.66

**LINEAR REGRESSION**  
 Slope = 16.0414  
 Intercept = 3.3833  
 Corr. coeff. = 0.9959  
 SFR = 1.204  
 SSP = 38.51  
 # of Observations: 5  
 Range of Chart at SFR ±10%: 36 / 41

Calibrated by: XXXXXXXXXX  
 26 July 2023  
 Approved by: XXXXXXXXXX  
 26 July 2023



### Verification Test Report

Report No.:

SO2300201-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1516347 E 672857

Calibrated Date: 26 July 2023

Site : โรงเรียนแสงหิรัญ

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1862

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No.1351075

Date of Calibration : 16 Mar 2023

#### Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.58	-0.20	93.78

Calibrated By:

Date: 26 July 2023

Approve By:

Date: 26 July 2023

### Verification Test Report

Report No.:

SO2300201-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1526256 E 667901

Calibrated Date: 26 July 2023

Site : โรงเรียนการันพลเรือน

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1799

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No.1351075

Date of Calibration : 16 Mar 2023

#### Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.70	-0.08	93.78

Calibrated By:

Date: 26 July 2023

Approve By:

Date: 26 July 2023

**RECALIBRATION**  
**DUE DATE:**  
**January 18, 2024**

## Certificate of Calibration

Calibration Certification Information			
Cal. Date: January 18, 2023	Rootsmeter S/N: 438320	Ta: 294	°K
Operator: [REDACTED]		Pa: 750.1	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: 0759		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (ln H2O)
1	1	2	1	1.3960	3.2	2.00
2	3	4	1	0.9950	6.4	4.00
3	5	6	1	0.8850	8.0	5.00
4	7	8	1	0.8450	8.8	5.50
5	9	10	1	0.6990	12.8	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left( \frac{Ta}{Pa} \right)}$ (y-axis)
0.9961	0.7135	1.4145	0.9957	0.7133	0.8854
0.9918	0.9968	2.0004	0.9915	0.9964	1.2521
0.9897	1.1183	2.2365	0.9893	1.1179	1.3999
0.9886	1.1700	2.3456	0.9883	1.1695	1.4683
0.9833	1.4067	2.8289	0.9829	1.4062	1.7708
QSTD		m= 2.03736	QA		m= 1.27576
		b= -0.03733			b= -0.02337
		r= 0.99997			r= 0.99997

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

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. : 66-200066-1 Page : 1 of 2

Submitted by : [REDACTED]

Equipment : Electronic Balance  
 Manufacturer : Sartorius Model : SECURA125-1S  
 Serial No. : 0034606552 ID No. : ELABBALANCEN05  
 Capacity : 120 g Resolution : 0.0001 g

Environment : On site calibration was carried out at the B304 Balance Room, Envilab Co., Ltd.  
 Ambient Temperature : (21.7 to 22.0) °C  
 Relative Humidity : (47.0 to 47.1) %  
 Air Pressure : (1015.0 to 1016.0) mbar

Date of Received : 01 March 2023

Date of Calibration : 01 March 2023

Date of Issue : 04 March 2023

Calibrated by : [REDACTED]

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

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E261-E264	C02222345	10 Nov 2023	National Institute of Metrology (Thailand), (NIMT)

Approved by

### Certificate of Calibration

Certificate No. : 66-200066-1

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)
0.1	0.0000	0.000083
0.5	0.0000	0.000084
1	0.0000	0.000085
2	0.0000	0.000099
5	0.0000	0.000110
10	0.0000	0.000092
20	0.0000	0.000120
50	0.0000	0.00012
100	0.0000	0.00020
120	-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  $k = 2.00$ , providing a level of confidence of approximately 95%

Eccentric error Load test : 20 g  
A B C D E  
0.0001 0.0001 0.0000 0.0000 0.0000 g



Repeatability Load test : 100 g  
Std. dev. : 0.00004 g

### Certificate of Calibration

Certificate No. : 66-410024-1

Page : 1 of 2

Submitted by :

Equipment :

Digital Thermo-Hygrometer

Manufacturer : Jedto

Model : HTC-1

Range Temperature : N/A °C

Resolution : 0.1 °C

Range Humidity : N/A %R.H.

Resolution : 1 %R.H.

Serial No. : PONPE5852094

ID No. : ELABTMHTC10003

Environment :

Ambient Temperature : (23 ± 2) °C

Relative Humidity : (50 ± 15) %

Date of Received : 08 March 2023

Date of Calibration : 09 March 2023

Date of Issue : 09 March 2023

Calibrated by :

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4013 by compared with standard probe sensor humidity/temperature into humidity/temperature chamber.

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

Digital Indicator with Standard Probe Temp&Hum

ID No. Cert No. Due Date Traceability

400034 & 400036 SG-H-00021/66

11 Jul 2023

Success Gateway Co., Ltd., Accredited by TISI Calibration No.0268

Certificate No. : 66-410024-1

Page : 2 of 2

UUC Condition As-Received : Good

Result of Calibration : Without Adjustment

Function : Temperature measurement

Reference Humidity @ 50 %R.H.

Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (±°C)
25.01	25.0	0.0	0.46

Result of Calibration : Without Adjustment

Function : Humidity measurement

Reference Temperature @ 25 °C

Standard Humidity (%R.H.)	UUC Reading (%R.H.)	Correction (%R.H.)	Uncertainty (±%R.H.)
50.00	49	1	2.2

Remark

UUC: Unit Under Calibration

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

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

## CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04NI99E15A00V3 Reference Number: 160-402021734-1  
Cylinder Number: EB0140762 Cylinder Volume: 144.4 Cubic Feet  
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG  
PGVP Number: A12021 Valve Outlet: 660  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Feb 19, 2021

Expiration Date: Feb 19, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800/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.

Do Not Use This Cylinder below 120 psig, i.e. 0.7 megapascals.

ANALYTICAL RESULTS					
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	44.66 PPM	G1	±1.4% NIST Traceable	02/12/2021, 02/19/2021
NITRIC OXIDE	45.00 PPM	44.82 PPM	G1	±1.4% NIST Traceable	02/12/2021, 02/19/2021
SULFUR DIOXIDE	45.00 PPM	45.34 PPM	G1	±1.1% NIST Traceable	02/12/2021, 02/19/2021
CARBON MONOXIDE	4500 PPM	4500 PPM	G1	±1.0% NIST Traceable	02/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	200611-04	CC707966	49.82 PPM NITRIC OXIDE/NITROGEN	±1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2023
GMIS	124206888	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.87 PPM SULFUR DIOXIDE/NITROGEN	±1.0%	Jun 23, 2022
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	±0.6%	Jun 07, 2024

The SRM, 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 N1K0579	NDIR	Jan 27, 2021
Nicolet iS50 FTIR AJP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AJP2010245 NO2	FTIR	Jan 21, 2021
Nicolet iS50 FTIR AJP2010245 SO2	FTIR	Jan 21, 2021

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.4 Kg

Net Weight: 4.5 Kg

PO# 5221000405

## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04NI99E15A00V3 Reference Number: 160-402021734-1  
Cylinder Number: EB0140762 Cylinder Volume: 144.4 Cubic Feet  
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG  
PGVP Number: A12021 Valve Outlet: 660  
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Feb 19, 2021

Expiration Date: Feb 19, 2024

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.

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	44.88 PPM	G1	+/- 1.4% NIST Traceable	02/12/2021, 02/19/2021
NITRIC OXIDE	45.00 PPM	44.82 PPM	G1	+/- 1.4% NIST Traceable	02/12/2021, 02/19/2021
SULFUR DIOXIDE	45.00 PPM	45.34 PPM	G1	+/- 1.1% NIST Traceable	02/12/2021, 02/19/2021
CARBON MONOXIDE	4500 PPM	4500 PPM	G1	+/- 1.0% NIST Traceable	02/15/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	200611-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12366	D865025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMS	124206889	CC323707	4.026 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.87 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.5%	Jun 07, 2024

The SRM, PRM or GMS 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	Jan 27, 2021
Nicolet iS60 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS60 FTIR AUP2010245 NO2	FTIR	Jan 21, 2021
Nicolet iS60 FTIR AUP2010245 SO2	FTIR	Jan 21, 2021

Triad Data Available Upon Request

#### NOTES:

Gross Weight: 28.4 Kg  
Net Weight: 4.5 Kg  
PO# 5221000405

## SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6607002

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

### Instruments Information

Page: 1/2

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

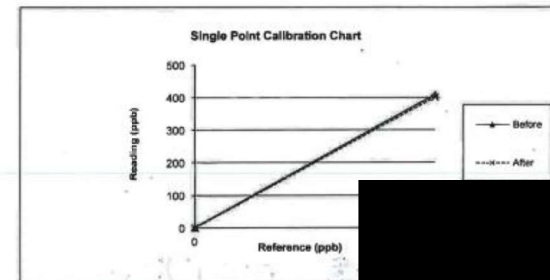
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NO Conc 44.68 PPM
ZERO AIR Generator ZAG7001 S/N: 644	SO2 Conc 45.34 PPM
	CO Conc 4500 PPM
	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 27.5 °C

Humidity: 55 %RH

### Calibration Report

Status	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.9	0.9	400.0	408.0	1.0
After	0.0	0.2	0.2	400.0	401.0	0.1



This report shall not be reproduced except in full without the written



## SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6807002

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal Range	Unit	Before	After	Note
Date	1-Jul-23				
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	
mVPS	400-800 constant	V	719	648	
OCPS	2500 (+/- 200)	mV	-	-	
CELL 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	
I/V Imp	1000-4900	mV	4034.0	4034.0	
Lamp Relo	30-120	%	114.0	114.0	
STR. Light (Zero Gas)	<100	PPB	29	29	
Dark PMT	(-50) - (+200)	mV	44.7	44.7	
Dark Imp	(-50) - (+200)	mV	5.1	5.1	
SAMP PRES	20-30 constant	IN-Hg-A	28.1	27.8	
<b>Electric Test/Optic Test</b>					
PMT Volta	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
<b>Gas Test Response</b>					
Zero Gas (0.00 PPB)	0	ppb	0.9	0.2	
Span Gas (400 PPB)	400	ppb	408.0	401.0	± 5% of Range

## SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6807010

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

Page:1/2

### Instruments Information

Analyzer Type: SO2 Analyzer Model: 10CE	Manufacturer API S/N: ESOA1100E01225
--	---

### 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 EB0140782

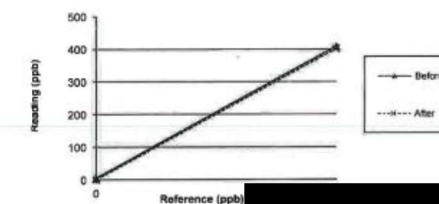
Environment: Temperature 25.7 °C

Humidity: 51 %RH

### Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	4.1	4.1	400.0	408.3	1.0
After	0.0	0.4	0.4	400.0	401.4	0.2

Single Point Calibration Chart



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### SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6607010

Calibrated Date: 1-Jul-23

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Jul-23				
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	-	-	
PCELL TEMP	50 (+/- 1)	Dreagoo C	50	50	
BOX TEMP	20-40	Dreagoo C	34.1	32.7	
PMT TEMP	7 (+/-1)	Dreagoo 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	
<b>Electric Test/Optic Test</b>					
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.820	0.868	
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	
<b>Gas Test Response</b>					
Zero Gas (0.00 PPB)	0	ppb	4.1	0.4	
Span Gas (400 PPB)	400	ppb	408.3	401.4	± 5% of Range

### CO Analyzer Verification Test Report

Calibration Report No.: ES-C6607006

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

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#### Instruments Information

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

#### Calibration System

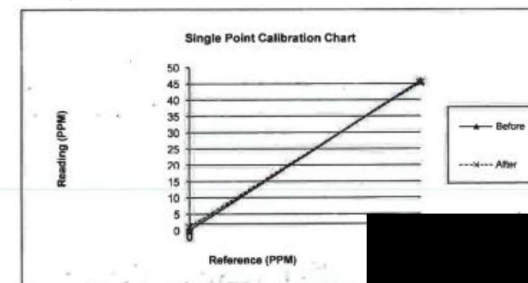
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM
ZERO AIR Generator ZAG7001 S/N: 644	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature: 25.8 °C

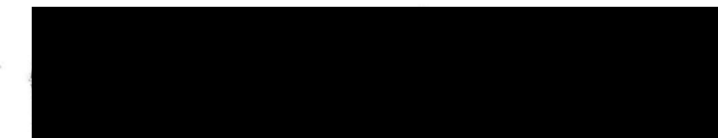
Humidity: 59 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.014	0.0	45.0	45.77	0.8
After	0.0	0.955	1.0	45.0	45.34	0.4



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### CO Analyzer Verification Test Report

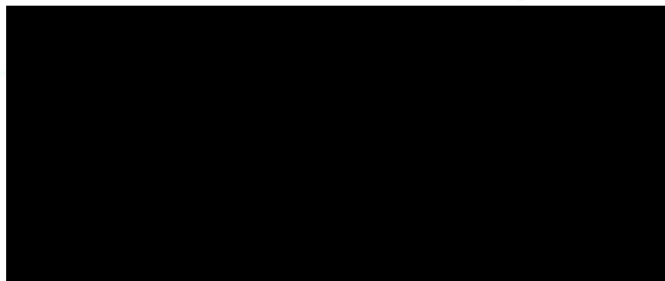
Calibration Report No.: ES-C6607006

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

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Analyzer Signal Values					
Date	1-Jul-23	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.	455.4	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



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### CO Analyzer Verification Test Report

Calibration Report No.: ES-C6607009

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

Page:1/2

#### Instruments Information

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

#### Calibration System

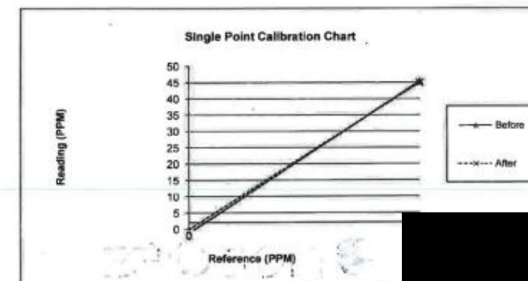
Calibrator Unit	Standard Gas
Dilutor Model ESA MGCT01 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 23.6 °C

Humidity: 56 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	-1.349	-1.3	45.0	45.32	0.4
After	0.0	-0.219	-0.2	45.0	44.94	-0.1



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### CO Analyzer Verification Test Report

Calibration Report No.: ES-C6607009

Calibrated Date: 1-Jul-23

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Analyzer Signal Values					
Date	1-Jul-23	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					
R current ratio	884.7	mA	Pbase current	618.2	mV
Optical T.	46.0	deg.C	Pbase 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.	26.9	deg.C
Source Temp.	46.0	deg.C	Gas Pressure	997	hPa
Up Pressure	947.0	hPa	Flow	59	l/h

### NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6607010

Calibrated Date: 1-Jul-23

Page: 1/1

☒ PM ☐ Onsite

#### Instruments Information

Analyzer Type: NO/NO<sub>2</sub>/NO<sub>x</sub> Analyzer  
Model: AC32e

Manufacturer: Environnement SA, France  
S/N: NNOESAAC32E278

#### 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 SO <sub>2</sub> Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 27.5 °C

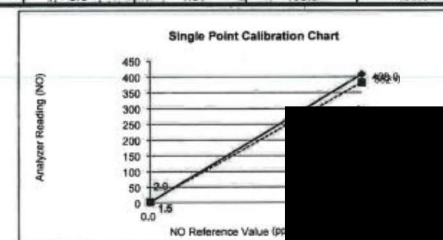
Humidity: 53 %RH

#### Calibration Check ( Before adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	4.007	0.0	4.0	379.0	400.0	-2.7
NO <sub>2</sub>	-1.100	0.0	-1.1	3.0	0.0	0.4
NO <sub>x</sub>	2.907	0.0	2.9	382.0	400.0	-2.3

#### Calibration Check ( After adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.308	0.0	1.3	405.0	400.0	0.6
NO <sub>2</sub>	0.196	0.0	0.2	3.0	0.0	0.4
NO <sub>x</sub>	1.504	0.0	1.5	408.0	400.0	1.0



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### NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6607010

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Calibrated Date: 1-Jul-23

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Analyzer Signal Values					
Date	1-Jul-23	Time	14:14		
Power Supplies					
Option	-13.52	mV	+5 V Sensor	4.99	V
+3.3 V	3.3	V	+24 V	23.96	V
+12 V	11.86	V	+5 V	4.99	V
+4 V	3974.3	mV	+24V	2.4	A
I O3	82.74	mA			
Optical Bench					
Dark PM sig.	0.0	mV	PM NO sig.	84.28	mV
PM Nox sig.	107.0	mV	PM Ny sig.	86.71	mV
Sample					
Chamber T	60	deg.C	Internal Temp.	33.33	deg.C
Chamber P	1720.6	hPa	PM T.	1.46	deg.C
Flow	47.21	Nl/h	Sample Pr.	993.2	hPa

### NOx Analyzer Verification Test Report

Calibration Report No.: SV-W6607009

Page:1/1

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

#### Instruments Information

Analyzer Type: NONO2/NOx Analyzer Model: AC32e	Manufacturer: Environnement SA., France S/N: NNOESAC32E277
---	---

#### Calibration System

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

Environment: Temperature 27.9 °C

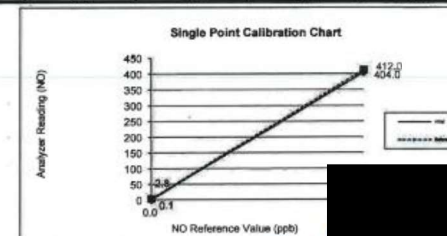
Humidity: 52 %RH

#### Calibration Check ( Before adjust )

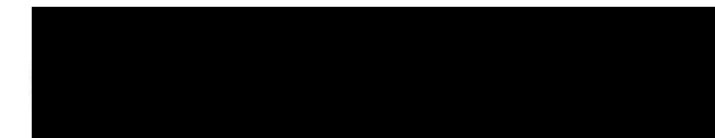
GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.584	0.0	2.6	409.0	400.0	1.1
NO <sub>2</sub>	0.222	0.0	0.2	3.0	0.0	0.4
NOx	2.786	0.0	2.8	412.0	400.0	1.5

#### Calibration Check ( After adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.037	0.0	0.0	402.0	400.0	0.2
NO <sub>2</sub>	0.073	0.0	0.1	2.0	0.0	0.2
NOx	0.110	0.0	0.1	404.0	400.0	0.5



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## NOx Analyzer Verification Test Report

Calibration Report No.: SV-W6607008

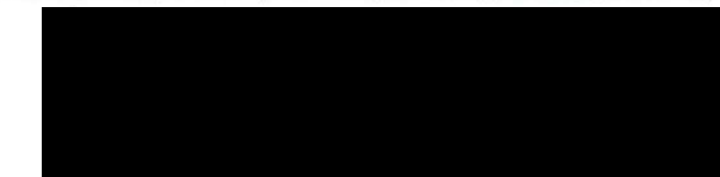
Page: 1/1

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

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Analyzer Signal Values					
Date	1-Jul-23	Time	13:00		
Voltage					
+24 V (23-25)	24.0	V	I+ 24V (1.5-3)	2.4	A
+12 V	12.0	V	I Peltier (0.5-1.2)	1.2	A
+5 V	5.0	V	I O <sub>2</sub> (40-100)	90.7	mA
+4 V	4.0	V			
+3.3 V	3.3	V	PMT V (450-750)	633.0	V
Sensor					
Chamber T (38-61)	60.0	deg. C	Cham P(140-230)	199.0	hPa
Converter T (338-342)	340.0	deg. C	Sam P(850-1150)	962	hPa
Internal T (10-50)	30.5	deg. C	Flow (39-46)	40.00	N/h
PM T (-0.5+0.5)	0.0	deg. C			
Calculation					
Dark PM sig(20-150)	79.66	mV			



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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0381

MTC No. EEL, BP, 70/0366

## CALIBRATION CERTIFICATE

Submitted by

Address

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.

Instrument Calibrated :

Ambient Environment

Description : Sound Level Calibrator

Temperature : (23 ± 3) °C

Manufacturer : Bruel & Kjaer

Relative Humidity : (50 ± 15) %

Model : 4230

Ambient Pressure : (101.325 ± 1.500) kPa

Serial No. : 1351075

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

2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.

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

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

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

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

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

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

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

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

Date of Receipt : 14 Mar. 2023

Date of Calibration : 16 Mar. 2023

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. 21-66/0381 MTC No. EEL. BP. 70/0366

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

Nominal Output of Unit Under Test = 94 dB re 20 $\mu$ Pa at 1000 Hz

Acoustic Output in dB re 20 $\mu$ Pa, 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	93.78	-0.22	$\pm 0.10$	$\pm 0.40$ 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	999.0	-1.0	$\pm 1.5$	$\pm 1.0\%$

**3. Total distortion**

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class I
1/2 inch Bruel&Kjaer 4180	1.05	$\pm 0.50$	$\pm 3.0\%$

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

Date of Issue: [Redacted] End of Certificate 2/2

**Calibration Certificate**

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 21 February, 2023 Certification No. 065/23

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิ

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130150 ID No. : EWSDCMS1200150

Customer : [Redacted]

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1010.6 hPa

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

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

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

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

### The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 065/23

21 February, 2023

Serial No. 1224

Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	4.9	0.10
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.0	0.02
11.01	-	-	-	10.9	0.11
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	90
180	180
270	

### The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6275

Certification No. 065/23

21 February, 2023

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1015.44	1013.8	1.64
1012.89	1011.2	1.69
1012.60	1010.9	1.70
1012.46	1010.8	1.66
1011.79	1010.2	1.59
1011.30	1009.7	1.60
1009.87	1008.3	1.57
1009.66	1008.1	1.56
1009.40	1007.8	1.60
1008.71	1007.2	1.51
1009.00	1007.4	1.60
1009.28	1007.7	1.58
1009.94	1008.3	1.64
1010.66	1009.0	1.66
1011.21	1009.5	1.71
1013.01	1011.1	1.91
1013.40	1011.7	1.70
1012.91	1011.2	1.71
1012.44	1010.8	1.64
1008.09	1006.5	1.59

Average



**The Result of Calibration**

Sensor Temperature Model TPH-1 C Certification No. 065/23

21 February, 2023

Serial No. 6275

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.1	45.3	-0.2
30.2	30.3	-0.1
15.6	15.7	-0.1

**The Result of Calibration**

Sensor Humidity Model TPH-1 C Certification No. 065/23

21 February, 2023

Serial No. 6275

Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
88.5	80.5	8.0
61.4	57.8	3.6
41.2	38.8	2.4

Date of Issue 21 February, 2023

Certification No. 065/23

Page : 6 of 6

### ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชื่อ Davis แบบ TIPPING BUCKET  
Model 7342.026 ID No.EWSDCMS1200150 ทำการสอบเทียบกับแก้วฝนแบบแก้วดวง  
GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No 71082  
และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียด

### Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 21 February, 2023

Certification No. 066/23

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130151 ID No. : EWSDCMS1200151

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1011.2 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

: Thermocouple

### The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 066/23

21 February, 2023

Serial No. 1225

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer	(inches H <sub>2</sub> O)	(inches H <sub>2</sub> O)	(m/sec)	(m/sec)	(m/sec)
1.00	-	-	-	1.0	0.00
3.02	-	-	-	3.0	0.02
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.0	0.02
11.01	-	-	-	11.0	0.01
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

Wind Aloft Plotting Board.

U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU

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

### The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6276

Certification No. 066/23

21 February, 2023

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1015.44	1014.60	0.84
1012.89	1012.00	0.89
1012.60	1011.70	0.90
1012.46	1011.60	0.86
1011.79	1010.90	0.89
1011.30	1010.40	0.90
1009.67	1009.00	0.67
1009.66	1008.80	0.86
1009.40	1008.50	0.90
1008.71	1007.80	0.91
1009.00	1008.10	0.90
1009.28	1008.40	0.88
1009.94	1009.00	0.94
1010.66	1009.70	0.96
1011.21	1010.30	0.91
1013.01	1011.90	1.11
1013.40	1012.40	1.00
1012.91	1011.90	1.01
1012.44	1011.40	1.04
1008.09	1007.10	0.99

Ave



**The Result of Calibration**

Sensor Temperature Model TPH-1 C Certification No. 066/23

21 February, 2023 Serial No. 6276 Page : 4 of 6

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

**The Result of Calibration**

Sensor Humidity Model TPH-1 C Certification No. 066/23

21 February, 2023 Serial No. 6276 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
88.5	85.4	3.1
61.4	58.6	2.8
41.2	39.2	2.0

Date of Issue 21 February, 2023

Certification No. 066/23

Page : 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า [REDACTED] Davis แบบ TIPPING BUCKET  
Model 7342.026 ID No.EWSCMS [REDACTED] เปรียบเทียบกับแก้วคันแบบแก้วดวง  
GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No 71082  
และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของ [REDACTED]

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด  
โรงเรียนแสงหิรัญและสถาบันการบินพลเรือน  
ครั้งที่ 2/2566  
ตรวจวัดวันที่ 26-21 ตุลาคม 2566

**TSP High Volume Sampler Calibration**

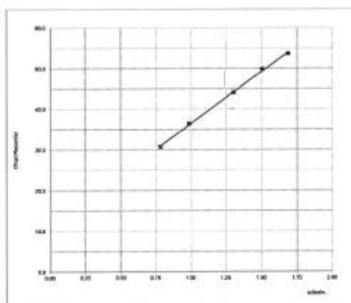
Verification Report No. SO2300290-E001 -TSP 01

☐ PM ☒ Onsite  
Site: โรงเรียนการันพลเรือน  
UTM: 47P 667893 1526248  
Sampler: ETSP#40  
Recorder: ECRDCPR4169240  
Date: 26 Oct 23  
Technical: [REDACTED]  
Approval: [REDACTED]

CONDITIONS			
Barometric Press. (hPa): 952.0	Corrected Pressure (mm Hg): 714.1		
Temperature (deg C): 32.0	Temperature (deg K): 305.0		
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: 2.03404		
Model: TE-5025A	Qstd Intercept: -0.02658		
Serial#: 759	Date Certified: 18 Jan 2023		

CALIBRATIONS				
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.53	1.687	56.0	53.85
2	10.02	1.504	52.0	49.82
3	7.54	1.307	46.0	44.07
4	4.25	0.984	38.0	36.41
5	2.68	0.784	32.0	30.66
				LINEAR REGRESSION
				Slope = 25.5355
				Intercept = 10.9223
				Corr. coeff. = 0.9991
				# of Observations: 5
				Range of Chart at 1.1 - 1.7 m3/min. 41
				56



26 October 2023

**TSP High Volume Sampler Calibration**

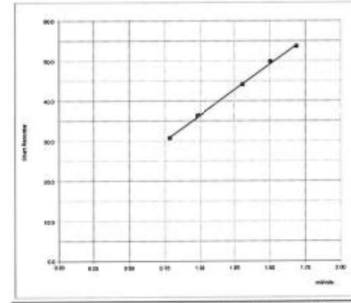
Verification Report No. SO2300290-E001 -TSP 02

☐ PM ☒ Onsite  
Site: โรงเรียนการันพลเรือน  
UTM: 47P 672870 1516341  
Sampler: ETSP#37  
Recorder: ECRANG15315224  
Date: 26 Oct 23  
Technical: [REDACTED]  
Approval: [REDACTED]

CONDITIONS			
Barometric Press. (hPa): 952.0	Corrected Pressure (mm Hg): 714.1		
Temperature (deg C): 32.0	Temperature (deg K): 305.0		
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: 2.03404		
Model: TE-5025A	Qstd Intercept: -0.02658		
Serial#: 759	Date Certified: 18 Jan 2023		

CALIBRATIONS				
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.22	1.591	52.0	49.82
2	9.73	1.482	50.0	47.91
3	7.67	1.318	46.0	44.07
4	5.83	1.150	40.0	38.32
5	3.11	0.844	32.0	30.66
				LINEAR REGRESSION
				Slope = 26.3835
				Intercept = 8.4652
				Corr. coeff. = 0.9970
				# of Observations: 5
				Range of Chart at 1.1 - 1.7 m3/min. 40
				55



26 October 2023

**PM10 High Volume Sampler Calibration**

Verification Report No.  
SO2300290-E001 -PM 01

☒ PM ☐ Onsite

Site: กรุงเทพมหานคร

UTM: 47P 667893 1526248

Sampler: EPM10832

Recorder: ECRDS01618125

Date: 26 Oct 23

Technical: [REDACTED]

Approval: [REDACTED]

**CONDITIONS**

Barometric Press. (hPa): 952.0	Corrected Pressure (mm Hg): 714.1
Temperature (deg C): 32.0	Temperature (deg K): 305.0
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: 1.27368
Model: TE-5025A	Qstd Intercept: -0.01657
Serial#: 759	Date Certified: 18 Jan 2023

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	11.33	1.740	50.0	32.68
2	9.15	1.565	46.0	30.06
3	6.38	1.309	40.0	26.14
4	4.71	1.127	34.0	22.22
5	3.19	0.929	30.0	19.61

**LINEAR REGRESSION**

Slope = 16.4865

Intercept = 4.1475

Corr. coeff = 0.9979

SFR = 1.210

SSR = 36.88

# of Observations: 5

Range of Chart at SFR ±10%: 35 / 39

26 October 2023

**PM10 High Volume Sampler Calibration**

Verification Report No.  
SO2300290-E001 -PM 02

☒ PM ☐ Onsite

Site: กรุงเทพมหานคร

UTM: 47P 672670 1516341

Sampler: EPM10836

Recorder: ECRDS01618124

Date: 26 Oct 23

Technical: [REDACTED]

Approval: [REDACTED]

**CONDITIONS**

Barometric Press. (hPa): 946.0	Corrected Pressure (mm Hg): 709.6
Temperature (deg C): 31.0	Temperature (deg K): 304.0
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: 1.27368
Model: TE-5025A	Qstd Intercept: -0.01657
Serial#: 759	Date Certified: 18 Jan 2023

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.23	1.657	54.0	35.35
2	9.38	1.587	50.0	32.73
3	7.32	1.403	44.0	28.80
4	4.11	1.055	36.0	23.56
5	2.98	0.900	30.0	19.64

**LINEAR REGRESSION**

Slope = 19.3758

Intercept = 2.4307

Corr. coeff = 0.9937

SFR = 1.214

SSP = 39.65

# of Observations: 5

Range of Chart at SFR ±10%: 37 / 42

26 October 2023

### Verification Test Report

Report No.:

SO2300290-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 667884 1526246

Calibrated Date: 26 October 2023

Site : โรงเรียนการันพลเรือน

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 2198

Environment: Temperature 30 °C Humidity 65 %RH

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

Serial No.1351075

Date of Calibration : 16 March 2023

#### Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.72	-0.06	93.78

### Verification Test Report

Report No.:

SO2300290-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P 672886 1516308

Calibrated Date: 26 October 2023

Site : โรงเรียนแสงศิฤฎ์

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 2199

Environment: Temperature 30 °C Humidity 65 %RH

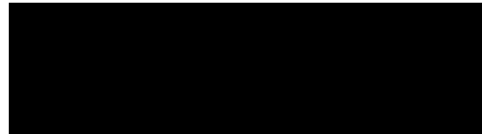
Reference Standard: Acoustic Calibrator Class 1 Model 4230,Bruel&Kjaer

Serial No.1351075

Date of Calibration : 16 March 2023

#### Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.70	-0.08	93.78



RECALIBRATION DUE DATE: January 18, 2024
--

## Certificate of Calibration

Calibration Certification Information			
Cal. Date: January 18, 2023	Rootsmer 5/N: 438320	Ta: 294	°K
Operator: Jim Tisch		Pa: 750.1	mm Hg
Calibration Model #: TE-5025A	Calibrator 5/N: 0759		

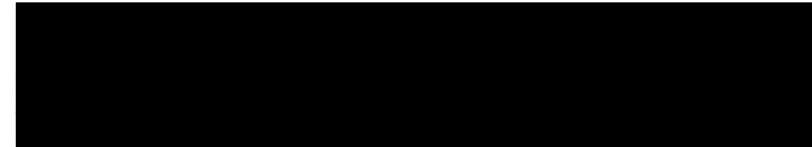
Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3960	3.2	2.00
2	3	4	1	0.9950	6.4	4.00
3	5	6	1	0.8850	8.0	5.00
4	7	8	1	0.8450	8.8	5.50
5	9	10	1	0.6990	12.8	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left( \frac{Ta}{Pa} \right)}$ (y-axis)
0.9961	0.7135	1.4145	0.9957	0.7133	0.8854
0.9918	0.9968	2.0004	0.9915	0.9964	1.2521
0.9897	1.1183	2.2365	0.9883	1.1179	1.3999
0.9886	1.1700	2.3456	0.9883	1.1695	1.4683
0.9833	1.4067	2.8289	0.9829	1.4062	1.7708
QSTD		m= 2.03736	QA		m= 1.27576
		b= -0.03733			b= -0.02337
		r= 0.99997			r= 0.99997

Calculations			
$V_{std} = \Delta Vol((Pa - \Delta P) / P_{std})(T_{std} / T_a)$		$V_a = \Delta Vol((Pa - \Delta P) / Pa)$	
$Q_{std} = V_{std} / \Delta Time$		$Q_a = V_a / \Delta Time$	
For subsequent flow rate calculations:			
$Q_{std} = 1/m \left( \left( \sqrt{\Delta H \left( \frac{Pa}{P_{std}} \right) \left( \frac{T_{std}}{T_a} \right)} - b \right) \right)$		$Q_a = 1/m \left( \left( \sqrt{\Delta H (Ta / Pa)} - b \right) \right)$	

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. : 66-200066-1

Page : 1 of 2

Submitted by :

Equipment :

Electronic Balance

Manufacturer : Sartorius

Model : SECURA125-1S

Serial No. : 0034606552

ID No. : ELABBALANCEN05

Capacity : 120 g

Resolution : 0.0001 g

Environment :

On site calibration was carried out at the B304 Balance Room, Envilab Co., Ltd.

Ambient Temperature : (21.7 to 22.0) °C

Relative Humidity : (47.0 to 47.1) %

Air Pressure : (1015.0 to 1016.0) mbar

Date of Received : 01 March 2023

Date of Calibration : 01 March 2023

Date of Issue : 04 March 2023

Calibrated by : Akaraduth 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

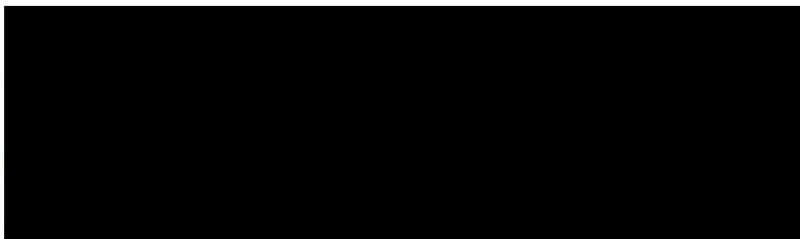
Traceability

E261-E2624

C02222345

10 Nov 2023

National Institute of Metrology (Thailand), (NIMT)





**Certificate of Calibration**

Certificate No. : 66-200066-1 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)
0.1	0.0000	0.000083
0.5	0.0000	0.000084
1	0.0000	0.000085
2	0.0000	0.000099
5	0.0000	0.000110
10	0.0000	0.000092
20	0.0000	0.000120
50	0.0000	0.00012
100	0.0000	0.00020
120	-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  $k = 2.00$ , providing a level of confidence of approximately 95%

Eccentric error

Load test	20 g
A	0.0001
B	0.0001
C	0.0000
D	0.0000
E	0.0000

g

Repeatability

Load test	100 g
Stdv.	0.00004

g

-0.0001

**Certificate of Calibration**

Certificate No. : 66-410024-1 Page : 1 of 2

Submitted by : [REDACTED]

Equipment : Digital Thermo-Hygrometer

Manufacturer : Jodto Model : HTC-1

Range Temperature : N/A °C Resolution : 0.1 °C

Range Humidity : N/A %R.H. Resolution : 1 %R.H.

Serial No. : PONPE5852094 ID No. : ELABTMHTC10003

Environment : Ambient Temperature : (23 ± 2) °C

Relative Humidity : (50 ± 15) %

Date of Received : 08 March 2023

Date of Calibration : 09 March 2023

Date of Issue : 09 March 2023

Calibrated by : Chertip Samchusri

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4013 by compared with standard probe sensor humidity/temperature into humidity/temperature chamber.

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

Digital Indicator with Standard Probe Temp&Hum

ID No.	Cert. No.	Due Date	Traceability
400034 & 400036	SG-H-00021/66	11 Jul 2023	Success Gateway Co., Ltd., Accredited by TISI Calibration No.0268

The uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced without the prior written approval of the calibration provider.



**Certificate of Calibration**

Certificate No. : 66-410024-1 Page : 2 of 2

UUC Condition As Received : Good

Result of Calibration : Without Adjustment

Function : Temperature measurement

Reference Humidity @ 50 %R.H.

Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (±°C)
25.01	25.0	0.0	0.46

Result of Calibration : Without Adjustment

Function : Humidity measurement

Reference Temperature @ 25 °C

Standard Humidity (%R.H.)	UUC Reading (%R.H.)	Correction (%R.H.)	Uncertainty (±%R.H.)
50.00	49	1	2.2

Remark

UUC : Unit Under Calibration

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

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

**CERTIFICATE OF ANALYSIS**

**Grade of Product: EPA Protocol**

Part Number: ED4NI99E15A00V3 Reference Number: 160-402021734-1

Cylinder Number: EB0140762 Cylinder Volume: 144.4 Cubic Feet

Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG

PGVP Number: A12021 Valve Outlet: 660

Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Feb 19, 2021

**Expiration Date: Feb 19, 2024**

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800M-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.

Do Not Use This Cylinder below 100 psig, i.e. 6.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	44.88 PPM	G1	±1.4% NIST Traceable	02/12/2021, 02/19/2021
NITRIC OXIDE	45.00 PPM	44.82 PPM	G1	±1.4% NIST Traceable	02/12/2021, 02/19/2021
SULFUR DIOXIDE	45.00 PPM	45.34 PPM	G1	±1.1% NIST Traceable	02/12/2021, 02/19/2021
CARBON MONOXIDE	4500 PPM	4500 PPM	G1	±1.0% NIST Traceable	02/15/2021
NITROGEN	Balance				

Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	200811-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	±1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2026
GMIS	124206889	CC323787	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.87 PPM SULFUR DIOXIDE/NITROGEN	±1.0%	Jun 20, 2022
NTRM	08012341	KAL004718	4857 PPM CARBON MONOXIDE/NITROGEN	±1.0%	Jun 07, 2024

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

Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Jan 27, 2021
Nicolet ISSO FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet ISSO FTIR AUP2010245 NO2	FTIR	Jan 21, 2021
Nicolet ISSO FTIR AUP2010245 SO2	FTIR	Jan 21, 2021

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.4 Kg

Net Weight: 4.5 Kg

PO# 5221000406

## SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6610001

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

### Instruments Information

Page: 1/2

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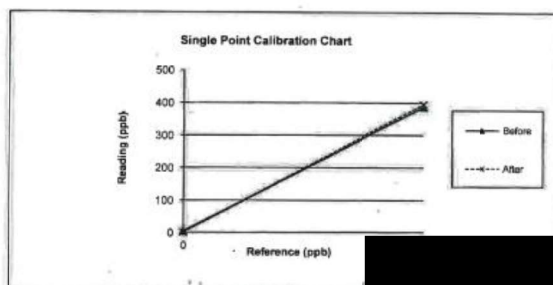
### Calibration System

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

Environment: Temperature 23.5 °C Humidity 59 %RH

### Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	3.4	3.4	400.0	387.0	-1.7
After	0.0	0.7	0.7	400.0	395.0	-0.6



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## SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6610001

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Page: 2/2

Date	1-Oct-23			
Time	13:45			
Range	50 - 20000	PPB	500.0	500.0
Stability (Zero Gas)	< 0.2	PPB	0.2	0.1
Sample Flow	850 (+/- 50)	cc/min	592.0	591.0
PMT Detector	0 - 5000	mV	255.6	61.0
Norm PMT Detector	0 - 5000	mV	58.7	65.2
HVPS	400-600 constant	V	607.0	607.0
DCPS	2500 (+/- 200)	mV		
CELL TEMP	50 (+/- 1)	Dragee C	50.0	50.0
BOX TEMP	20-40	Dragee C	34.0	34.1
PMT TEMP	7 (+/- 1)	Dragee C	8.0	8.0
UV Lamp	1000-4000	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	3.8
Dark Lamp	(-50) - (+200)	mV	56.5	57.0
SAMP PRES	20-30 constant	IN-Hg-A	29.3	29.3
PMT Vults	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
Zero Gas (0.00 PPB)	0	ppb	3.4	0.7
Span Gas (400 PPB)	400	ppb	387.0	395.0
				± 5% of Range

Calibrate

Do

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**SO2 Analyzer Verification Test Report**

Calibration Report No.: AP-S6610007  
 Calibrated Date: 1-Oct-23  
☒ PM ☐ Onsite

**Instruments Information** Page: 1/2

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API S/N: ESOA100A01175
--	--

**Calibration System**

<b>Calibrator Unit</b> Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	<b>Standard Gas</b> NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31, 2025 EB0160267
--	---

Environment: Temperature 23.8 °C Humidity: 65 %RH

**Calibration Report**

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.5	1.5	400.0	390.0	-1.3
After	0.0	0.6	0.6	400.0	401.0	0.1

Single Point Calibration Chart

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**SO2 Analyzer Verification Test Report**

Calibration Report No.: AP-S6610007  
 Calibrated Date: 1-Oct-23  
☒ PM ☐ Onsite

**Calibration Report** Page: 2/2

Date	1-Oct-23				
Time	13:10				
Range	50 - 2000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	850 (+/- 50)	cc/min	863	859	
PMT Detector	0 - 5000	mV	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
HVPS	400-800 constant	V	719	648	
PCPS	2500 (+/- 200)	mV	-	-	
CELL TEMP	50 (+/- 1)	Dreagoo C	50	50	
BOX TEMP	20-40	Dreagoo C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Dreagoo C	8.0	8.0	
UV Temp	1000-4000	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 Temp	(-50) - (+200)	mV	5.1	5.1	
GAMP PRES	20-30 constant	IN-Hg-A	28.1	27.8	
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	
Zero Gas (0.00 PPB)	0	ppb	1.5	0.6	
Span Gas (400 PPB)	400	ppb	390.0	401.0	± 5% of Range

Calibrate By: \_\_\_\_\_

Date: \_\_\_\_\_

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### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610002

Page:1/1

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

#### Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENOA1200A02243
---	---

#### 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 EBO160267

Environment: Temperature 23.2 °C

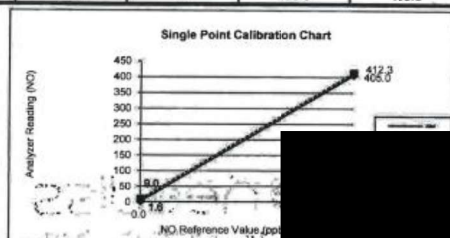
Humidity: 62 %RH

#### Calibration Check ( Before adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.3	0.0	3.3	410.1	400.0	1.2
NO <sub>2</sub>	5.7	0.0	5.7	2.2	0.0	0.3
NOx	9.0	0.0	9.0	412.3	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	0.7	0.0	0.7	403.2	400.0	0.4
NO <sub>2</sub>	0.9	0.0	0.9	1.8	0.0	0.2
NOx	1.6	0.0	1.6	405.0	400.0	0.6



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### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610002

Page:1/1

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Page:2/2

Date	1-Oct-23				
Time	10:10				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	≤ 0.2	PPB	0.4	0.2	
Sample Flow	500 +/- 50	cc/min	482	494	
Ozone Flow	80-90	cc/min	74	77	
PMT Detector	0-5000	mV	51	26	
AZERO	-20-150	mV	53.3	33.3	
IN/PS	400-900 constant	V	821	821	
DCPS	2500 +/- 200	mV	2558	2558	
RCCL TEMP	50 +/- 1	Temperature C	50	50	
BOX TEMP	20-35	Dryness C	30.2	32.8	
PMT TEMP	7 +/- 1	Dryness C	7.5	7.5	
IS TEMP	50 +/- 4	Dryness C	-	-	
MOLY Temp	315 +/- 5	Dryness C	315.0	314.6	
RCCL 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	
Zero Value	NO	0	ppb	3.9	0.7
	NOx	0	ppb	9.0	1.8
Span Value	NO	400	ppb	410.1	403.2
	NOx	400	ppb	412.3	405.0

Calibrate By

Date

This report shall not be



## NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610001

Page:1/1

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

### Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENOAI200A01679
---	---

### 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

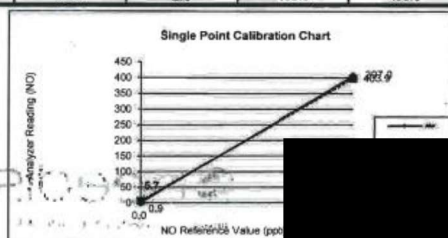
Humidity: 64% RH

### Calibration Check ( Before adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.2	0.0	3.2	392.5	400.0	-0.9
NO <sub>2</sub>	2.5	0.0	2.5	4.5	0.0	0.6
NOx	5.7	0.0	5.7	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	0.3	0.0	0.3	400.3	400.0	0.0
NO <sub>2</sub>	0.6	0.0	0.6	3.6	0.0	0.4
NOx	0.9	0.0	0.9	403.9	400.0	0.5



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## NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610001

Page:1/1

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Page:2/2

Date	1-Oct-23				
Time	10:10				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	600 +/- 50	cc/min	482	494	
Ozone Flow	80-90	cc/min	74	77	
PMT Detector	0-5000	mV	51	28	
AZERO	20-150	mV	53.3	33.3	
HVPS	400-900 constant	V	821	821	
DCPS	2500 +/- 200	mV	2556	2556	
CELL TEMP	50 +/- 1	Dragee C	50	50	
BOX TEMP	20-35	Dragee C	30.2	32.8	
PMT TEMP	7 +/- 1	Dragee C	7.5	7.5	
ISZ TEMP	50 +/- 4	Dragee C	-	-	
MOLY Temp	315 +/- 5	Dragee C	315.0	314.5	
CELL 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	
Zero Value	NO	0	ppb	3.2	0.3
	NOx	0	ppb	5.7	0.9
Span Value	NO	400	ppb	392.5	400.3
	NOx	400	ppb	397.0	403.9

Calibrate By:

Date:

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### CO Analyzer Verification Test Report

Calibration Report No.: ES-C8610009

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

#### Instruments Information

Page:1/2

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

#### Calibration System

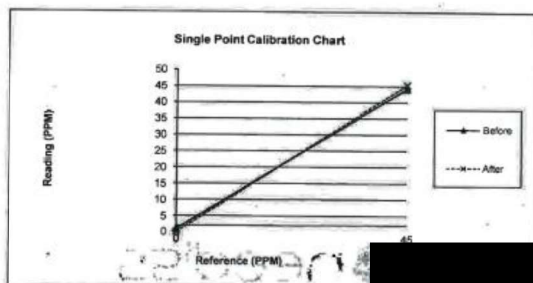
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.6 °C

Humidity: 62 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift (%)
Before	0.0	0.980	1.0	45.0	44.20	-0.9
After	0.0	0.054	0.1	45.0	45.32	0.4



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### CO Analyzer Verification Test Report

Calibration Report No.: ES-C8610009

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Page:2/2

Date	1-Oct-23	Time	10:09:00		
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
IR current ratio	884.7	mA	Pose current	618.2	mV
Optical T <sub>1</sub>	46.0	deg C	Pose T <sub>1</sub>	-24.2	deg C
Measure sig.	506.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Inst. Ratio	1.109		Ratio	1.105	
Ref. ratio	1.109		Internal Temp.	28.9	deg C
Source Temp.	46.0	deg C	Gas Pressure	997	hPa
Up Pressure	947.0	hPa	Flow	59	l/h

Calibrate By:

Date:

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**CO Analyzer Verification Test Report**

Calibration Report No.: ES-C6610010  
Calibrated Date: 1-Oct-23  
☒ PM ☐ Onsite

**Instruments Information** Page: 1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: ECOESACO12E203
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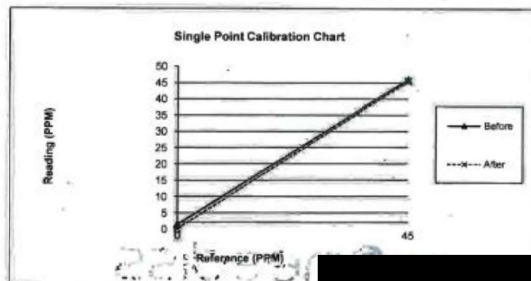
**Calibration System**

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 EB0180267

Environment: Temperature 24.7 °C Humidity: 62 %RH

**Calibration Report**

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.345	1.3	45.0	45.90	1.0
After	0.0	0.098	0.1	45.0	45.40	0.4



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**CO Analyzer Verification Test Report**

Calibration Report No.: ES-C6610010  
Calibrated Date: 1-Oct-23  
☒ PM ☐ Onsite

Page: 2/2

Date	1-Oct-23	Time	10:09:00		
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
IR current ratio	834.7	mA	Pbase current	618.2	mV
Optical T <sub>1</sub>	46.0	deg.C	Pbase T <sub>1</sub>	-24.2	deg.C
Measure sig.	506.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Inst. Ratio	1.109		Ratio	1.105	
Ref. ratio	1.109		Internal Temp.	28.9	deg.C
Source Temp.	46.0	deg.C	Gas Pressure	997	hPa
Up Pressure	947.0	hPa	Flow	59	l/h

Calibrate By:

Date:

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Request No. 21-66/0381 MTC No. EEL. BP. 70/0366

### CALIBRATION CERTIFICATE

Submitted by: [REDACTED]  
 Address: [REDACTED]  
 Calibrated at: Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre,  
 Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

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

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

**Standards used:**  
 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.  
 2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.  
 3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.  
 4. Digital Multimeter Agilent 34401A S/N MY44005560.  
 5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.  
 6. Audio Analyzer Keithley 2015-P S/N 4106495.  
 7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

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

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

The information on actual reading is attached herewith and [REDACTED] measured values only.

**Date of Receipt:** 14 Mar. 2023  
**Date of Calibration:** 16 Mar. 2023

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. 21-66/0381 MTC No. EEL. BP. 70/0366

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

**Nominal Output of Unit Under Test = 94 dB re 20 $\mu$ Pa at 1000 Hz**  
**Acoustic Output in dB re 20 $\mu$ Pa, Corrected to Reference Conditions : 101.325 kPa, 23.0 $^\circ$ C and 50 %RH**

### 1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.78	-0.22	$\pm 0.10$	$\pm 0.40 \text{ dB}$

### 2. Frequency

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

### 3. Total distortion

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

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

Calibrated by: [REDACTED] Ap [REDACTED]

**Date of Calibration:** 16 Mar. 2023  
**Date of Issue:** 17 Mar. 2023

End of Certificate 2 / 2

The results relate only to the items tested/calibrated 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.





## 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 : เครื่องมือตรวจวัดอุณหภูมิตามอากาศ

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130152 ID No. : NWSDCMS1200152

Customer :



Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.9 hPa

NATIONAL STANDARD WIND TUNNEL : Micromanometer Theodor Friedrichs FCD14 Serial 9310119

: HOOK GAGE NO 1425

: Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731/241460

: Ultrasonic Anemometer

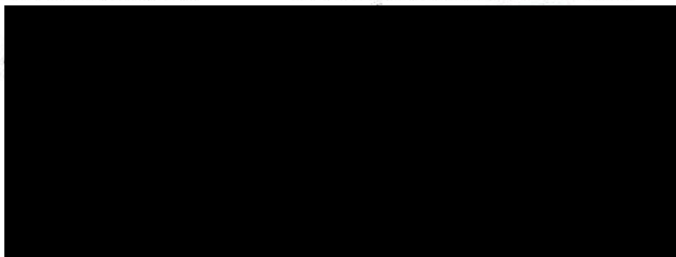
Model DA-650-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

STANDARD THERMOMETER

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



## The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F

Certification No. 341/23

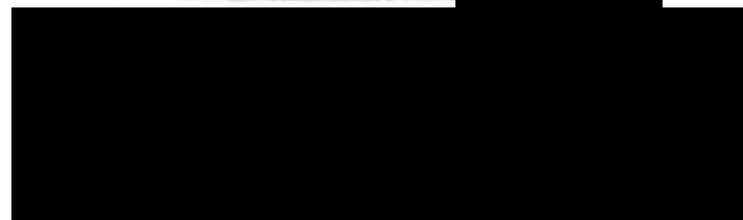
2 October, 2023

Serial No. 1226

Page : 2 of 5

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

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



### 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

### 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

Date of Issue 2 October, 2023

Certification No. 341/23

Page: 5 of 5

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชื่อ Davis Instruments แบบ TIPPING  
BUCKET Product No. 7342.026 Mfg. Code. EWSDCMS1200152 ทำการสอบเทียบกับแก้ววัด  
ฝนแบบแก้วทวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON  
No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/TIP)

## Calibration Certificate

Issued by : Calibration & Test Section Meteorological Instruments Bureau

Date of Issue 21 February, 2023

Certification No. 069/23

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2503

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1011.9 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

: Ultrasonic Anemometer Model DA-850-3TV (sensor TR-90AH)

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

STANDARD THERMOMETER

: Theodor Friedrich : Do No. 8390/94 Wet No. 8389/94

: Thermosc

### The Result of Calibration

Sensor model EWSNV110WS2503 Certification No. 069/23  
21 February, 2023 Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer					
m/sec	inches H <sub>2</sub> O	inches H <sub>2</sub> O	m/sec	m/sec	m/sec
1.00	0.00	0.00	0.4	0.4	0.60
3.02	0.00	0.00	2.8	2.8	0.22
5.00	0.00	0.00	4.5	4.5	0.50
7.04	0.00	0.00	7.0	7.0	0.04
9.02	0.00	0.00	9.0	9.0	0.02
11.01	0.00	0.00	11.0	11.0	0.01
13.01	0.00	0.00	12.8	12.8	0.21
15.01	0.00	0.00	14.8	14.8	0.21
17.02	0.00	0.00	16.8	16.8	0.22
20.02	0.00	0.00	20.3	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	

### The Result of Calibration

Sensor model EWSNV110WS2503

Certification No. 069/23

21 February, 2023

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1015.44	1015.91	-0.47
1012.89	1013.72	-0.83
1012.60	1013.45	-0.85
1012.46	1013.11	-0.65
1011.79	1012.83	-0.84
1011.30	1012.09	-0.79
1009.87	1010.71	-0.84
1009.66	1010.44	-0.78
1009.40	1010.16	-0.76
1008.71	1009.89	-1.18
1009.00	1010.16	-1.16
1009.28	1010.44	-1.16
1009.94	1010.71	-0.77
1010.66	1011.53	-0.87
1011.21	1011.81	-0.60
1013.01	1013.45	-0.44
1013.40	1014.27	-0.87
1012.91	1013.45	-0.54
1012.44	1013.17	-0.73
1008.09	1009.34	-1.25

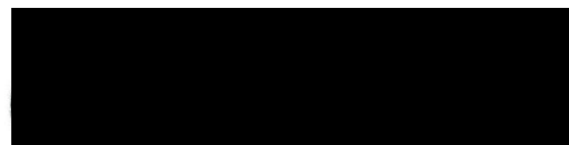
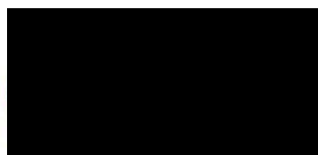
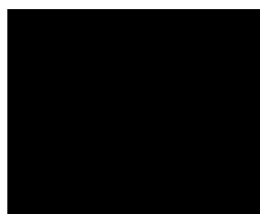
Average



### The Result of Calibration

Sensor model EWSNV110WS2503 Certification No. 069/23  
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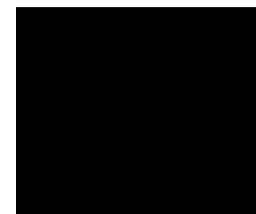
Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.5	45.1	0.4
30.2	30.1	0.1
15.4	15.6	-0.2



### The Result of Calibration

Sensor model EWSNV110WS2503 Certification No. 069/23  
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Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
83.5	79.5	4.0
62.4	59.9	2.5
42.5	41.2	1.3



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### ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝุ่น ชื่อ Davis แบบ TIPPING BUCKET  
ID No.EWSNV110WS2503 ทำการสอบเทียบกับแก้วฝนแบบแก้วดวง GAUGE  
DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA L  
สามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่อง