

ภาคผนวกที่ 5-3  
เอกสารผลการสอบเทียบเครื่องมือตรวจวัด  
ครั้งที่ 1/2566  
สถานีโรงเรียนกรุงเทพคริสเตียนวิทยาลัย  
สถานีโรงพยาบาลเซนต์หลุยส์  
วันที่ตรวจวัดวันที่ 26-31 กรกฎาคม 2566



TSP High Volume Sampler Calibration

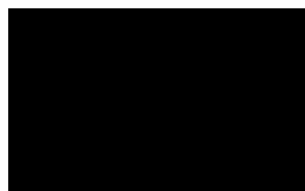
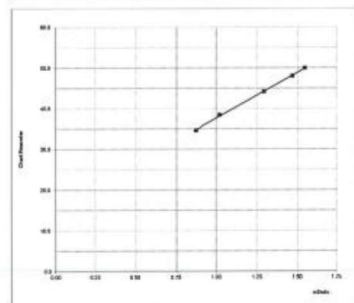
Verification Report No.  
SO2300195-E002 -TSP 01

☐ PM ☒ Onsite  
Site: โรงเรียนกรุงเทพคริสเตียน  
UTM : 47P N 1517275 E 664662  
Sampler: ETSP#40  
Recorder: ECRDCPR4169240  
Date: 26 Jul 23  
Technical: [Redacted]  
Approver: [Redacted]

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		

CALIBRATIONS					LINEAR REGRESSION
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	
1	10.46	1.543	52.0	49.96	Slope = 22.4116 Intercept = 15.2723 Corr. coeff = 0.9996 # of Observations: 5 Range of Chart at 1.1 - 1.7 m3/min: 42 55
2	9.45	1.468	50.0	48.34	
3	7.31	1.293	46.0	44.20	
4	4.52	1.021	40.0	38.43	
5	3.26	0.870	36.0	34.59	



26 July 2023



TSP High Volume Sampler Calibration

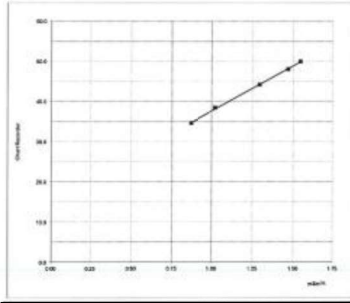
Verification Report No.  
SO2300195-E002 -TSP 02

☐ PM ☒ Onsite  
Site: โรงเรียนกรุงเทพคริสเตียน  
UTM : 47P N 1517318 E 664990  
Sampler: ETSP#44  
Recorder: ECRANG15315224  
Date: 26 Jul 23  
Technical: [Redacted]  
Approver: [Redacted]

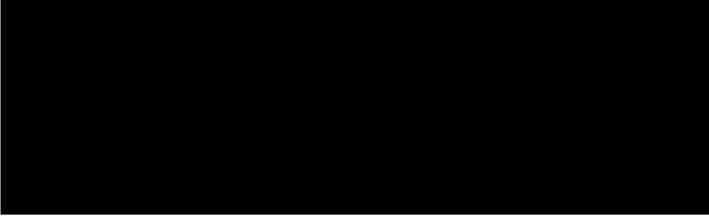
CONDITIONS			
Barometric Press. (hPa): 951.0	Corrected Pressure (mm Hg): 713.3		
Temperature (deg C): 30.0	Temperature (deg K): 303.0		
Average Press. (hPa): 1013.0	Corrected Avg. Press. (mm Hg): 759.8		
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0		

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

CALIBRATIONS					LINEAR REGRESSION
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	
1	10.48	1.545	52.0	49.96	Slope = 21.5576 Intercept = 15.0207 Corr. coeff = 0.9947 # of Observations: 5 Range of Chart at 1.1 - 1.7 m3/min: 42 54
2	9.12	1.442	48.0	46.12	
3	7.35	1.297	46.0	44.20	
4	4.55	1.024	40.0	38.43	
5	3.26	0.870	36.0	34.59	



26 July 2023



**PM10 High Volume Sampler Calibration**

Verification Report No. SO2300195-E002 -PM 01

☒ PM ☐ Onsite

Site: กรุงเทพมหานคร  
 UTM: 47P N 1517275 E 664662  
 Sampler: EPM#15  
 Recorder: ECRDS01618124  
 Date: 26 Jul 23  
 Technical: [REDACTED]  
 Approval: [REDACTED]

**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

**CALIBRATIONS**

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	7.22	1.391	46.0	29.36	Slope = 17.4113 Intercept = 5.3566 Corr. coeff. = 0.9922 SFR = 1.204 SSP = 40.37 # of Observations: 5 Range of Chart at SFR ±10%: 38 / 43
2	6.85	1.355	44.0	28.58	
3	5.32	1.197	40.0	26.37	
4	4.76	1.133	38.0	24.77	
5	3.86	1.022	36.0	23.46	

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**PM10 High Volume Sampler Calibration**

Verification Report No. SO2300195-E002 -PM 02

☒ PM ☐ Onsite

Site: กรุงเทพมหานคร  
 UTM: 47P N 1517318 E 664990  
 Sampler: EPM#17  
 Recorder: ECRDS01618125  
 Date: 26 Jul 23  
 Technical: [REDACTED]  
 Approval: [REDACTED]

**CONDITIONS**

Barometric Press. (hPa): 945.7 Corrected Pressure (mm Hg): 709.3  
 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 Slope: 1.27576  
 Model: TE-5025A Intercept: -0.02337  
 Serial#: 759 Date Certified: 18 Jan 23

**CALIBRATIONS**

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	7.40	1.417	46.0	30.16	Slope = 16.7518 Intercept = 6.6062 Corr. coeff. = 0.9948 SFR = 1.218 SSP = 41.20 # of Observations: 5 Range of Chart at SFR ±10%: 39 / 43
2	6.28	1.306	44.0	28.85	
3	5.22	1.193	40.0	26.23	
4	4.22	1.074	38.0	24.92	
5	3.25	0.945	34.0	22.29	

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### Verification Test Report

Report No.:

SO2300195-E002 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1517275 E 664662

Calibrated Date: 26 July 2023

Site : โรงเรียนกรุงเทพคริสเตียน

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 2199

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No.1351075

Date of Calibration : 16 Mar 2023

### Result of Test

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

This report shall not be

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### Verification Test Report

Report No.:

SO2300195-E002 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1517318 E 664990

Calibrated Date: 26 July 2023

Site : โรงพยาบาลเซนต์หลุยส์

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 2198

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

This report shall not

ประกาศใช้ 01/02/2566

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RECALIBRATION  
DUE DATE:  
January 18, 2024

## Certificate of Calibration

Calibration Certification Information			
Cal. Date: January 18, 2023	Rootsmer S/N: 438320	Ta: 294 °K	
Operator: Jim Tisch		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 (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	0.9893	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=	2.09736	QA	m=	1.27576
	b=	-0.03733		b=	-0.02337
	r=	0.99997		r=	0.99997

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

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

RECALIBRATION	
US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 31, 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 : 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	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 B C D E  
0.0001 0.0001 0.0000 0.0000 0.0000 g



Repeatability  
Load test : 100 g  
Stddev. : 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-00021/56 11 Jul 2023 Success Gateway Co., Ltd., Accredited by TISI Calibration No.0268

## 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: E04NI99E15A00V3  
Cylinder Number: EB0140762  
Laboratory: 124 - Plumsteadville - PA  
PGVP Number: A12021  
Gas Code: CO,NO,NOX,SO2,BALN

Reference Number: 160-402021734-1  
Cylinder Volume: 144.4 Cubic Feet  
Cylinder Pressure: 2015 PSIG  
Valve Outlet: 660  
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.

ANALYTICAL RESULTS					
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				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	200611-04	CC707988	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%	Feb 02, 2025
PRM	12396	DB65025	9.31 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMS	124206889	CC323737	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL001190	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022
NTRM	08012341	KAL004716	4867 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Jan 27, 2021
Nicolet IS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet IS50 FTIR AUP2010245 NO2	FTIR	Jan 21, 2021
Nicolet IS50 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-S6607005

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Jul-23				
Time	15:20				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	637	620	
PMT Detector	0 - 5000	mV	24.2	24.2	
Norm PMT Detector	0 - 5000	mV	19.3	40.5	
HVPS	400-800 constant	V	632	630	
DCPS	2500 (+/- 200)	mV	-	-	
CELL TEMP	50 (+/- 1)	Dreogee C	50	50	
BOX TEMP	20-40	Dreogee C	35.4	36.0	
PMT TEMP	7 (+/-1)	Dreogee C	8.5	8.0	
UV lamp	1000-4000	mV	2900	2900	
Lamp Ratio	30-120	%	82.9	82.9	
STR. Light (Zero Gas)	<100	PPB	25.4	25.4	
Dark PMT	(-40) - (+200)	mV	12.5	12.5	
Dark lamp	(-50) - (+200)	mV	1.5	1.5	
SAMP PRES	20-30 constant	IN-Hg-A	27.6	28.3	
<b>Electric Test/Optic Test</b>					
PMT Volts	2000 (+/- 500)	mV	2010	2022	
SO2 Conc	1000 (+/- 250)	PPB	1005	1011	
SO2 Slope	1 (+/- 0.3)	-	1.040	0.824	
SO2 Offset	< 250	mV	51.9	145.5	
Stability at Zero	< 0.2	PPB	0.2	0.6	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
<b>Gas Test Response</b>					
Zero Gas (0.00 PPB)	0	ppb	2.7	0.9	
Span Gas (400 PPB)	400	ppb	406.0	403.0	± 5% of Range

### SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6607003

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

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#### Instruments Information

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API S/N: ESOA1100E01002
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#### Calibration System

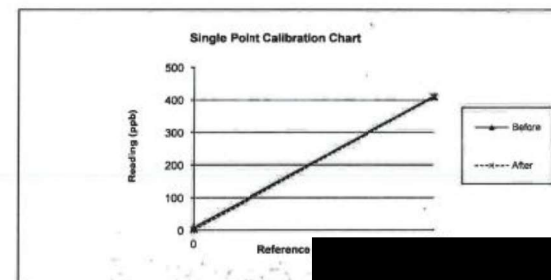
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19,2024 EB0140762

Environment: Temperature 27.5 °C

Humidity: 55 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	7.6	7.6	400.0	411.0	1.4
After	0.0	1.3	1.3	400.0	409.0	1.1



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## SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6607003

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Jul-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	59.7	65.2	
IVPS	400-900 constant	V	607.0	607.0	
DCPS	2500 (+/- 200)	mV	+	+	
CELL TEMP	50 (+/- 1)	Dreogee C	50.0	50.0	
BOX TEMP	20-40	Dreogee C	34.0	34.1	
PMT TEMP	7 (+/-1)	Dreogee C	8.0	8.0	
IV Imp	1000-4100	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	(-80) - (+200)	mV	3.8	3.6	
Dark Imp	(-80) - (+200)	mV	56.5	57.0	
BAMP PRES	20-30 constant	IN-Hg-A	29.3	29.3	
<b>Electric Test/Optic Test</b>					
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	
<b>Gas Test Response</b>					
Zero Gas (0.00 PPB)	0	ppb	7.6	1.3	
Span Gas (400 PPB)	400	ppb	411.0	409.0	± 5% of Range

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## NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6607006

Calibrated Date: 1-Jul-23

Page:1/1

☒ PM ☐ Onsite

### Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20002467
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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

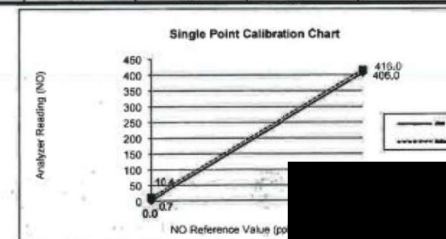
Environment: Temperature 27.2 °C Humidity 54 %RH

### Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	8.5	0.0	8.5	415.0	400.0	1.8
NO <sub>2</sub>	1.9	0.0	1.9	1.0	0.0	0.1
NOx	10.4	0.0	10.4	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	0.5	0.0	0.5	402.0	400.0	0.2
NO <sub>2</sub>	0.2	0.0	0.2	4.0	0.0	0.5
NOx	0.7	0.0	0.7	406.0	400.0	0.7



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### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6607006

Page: 1/1

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Jul-23				
Time	13:20				
Range	0.00 - 500.00 PPB	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	sc/min	474.0	441.0	
Ozone Flow	80-80	sc/min	76.0	76.0	
PMT Detector	0-5000	mV	24.5	62.2	
AZERO	-20-150	mV	6.6	67.5	
HVPS	400-800 constant	V	839.0	836.0	
DCPS	2500 +/- 200	mV	-	-	
CELL TEMP	50 +/- 1	Omegae C	50.0	50.0	
BOX TEMP	20-35	Omegae C	34.5	30.5	
PMT TEMP	7 +/- 1	Omegae C	7.0	7.1	
IS TEMP	50 +/- 4	Omegae C	-	-	
MOLY Temp	315 +/- 5	Omegae C	315.0	314.4	
ICEL 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	
<b>Span and Cal Values</b>					
Zero Value	NO	0	ppb	8.5	0.5
	NOx	0	ppb	10.4	0.7
Span Value	NO	400	ppb	415.0	402.0
	NOx	400	ppb	416.0	406.0

This report

### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6607003

Page: 1/1

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

#### Instruments Information

Analyzer Type: NONO2/NOx Analyzer Model: T200	Manufacturer: API S/N: ENOAIT20002470
--	--

#### 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 27.6 °C

Humidity: 49 %RH

#### Calibration Check ( Before adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-1.7	0.0	-1.7	240.2	400.0	-25.0
NO <sub>2</sub>	-0.2	0.0	-0.2	0.9	0.0	0.2
NOx	-1.9	0.0	-1.9	241.1	400.0	-24.8

#### Calibration Check ( After adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	5.3	0.0	5.3	399.9	400.0	0.0
NO <sub>2</sub>	-0.2	0.0	-0.2	1.4	0.0	0.2
NOx	5.1	0.0	5.1	401.3	400.0	0.2

#### Single Point Calibration Chart

450

This report shall not be

### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N0007005

Page: 1/1

Calibrated Date: 1-Jul-23

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Page: 2/2

Test Function/Value	Nominal range	Unit	Before	After	Note
Date	1-Jul-23				
Time	10:10				
Range	0.00 - 500.00 PPM	PPM	500	500	
Stability (Zero Gas)	< 0.2	PPM	0.5	0.2	
Sample Flow	500 ± 50	sc/min	511	532	
Ozone Flow	60-80	sc/min	80	80	
PMT Detector	0-5000	mV	27.4	16.4	
AZERO	-20-150	mV	54.2	54.2	
HVPS	400-800 constant	V	819	819	
DCPS	2500 ± 200	mV	-	-	
CELL TEMP	50 ± 1	Degree C	50	50	
BOX TEMP	20-35	Degree C	33.7	32.9	
PMT TEMP	7 ± 1	Degree C	7.1	7.1	
IZS TEMP	50 ± 4	Degree C	-	-	
MOLY Temp	315 ± 5	Degree C	314.4	315.0	
REL 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	
<b>Span and Cal Values</b>					
Zero Value	NO	0	ppb	-1.7	5.3
	NOx	0	ppb	-1.9	5.1
Span Value	NO	400	ppb	240.2	399.9
	NOx	400	ppb	241.1	401.3

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### CO Analyzer Verification Test Report

Calibration Report No.: ES-C0607008

Calibrated Date: 1-Jul-23

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Instruments Information

Page: 1/2

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

#### Calibration System

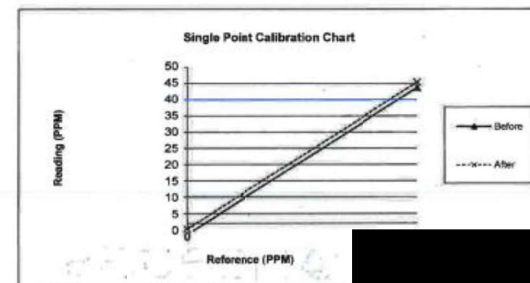
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NO Conc 44.68 PPM
S/N: 792	SO2 Conc 45.34 PPM
ZERO AIR Generator ZAG7001	CO Conc 4500 PPM
S/N: 544	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 28.1 °C

Humidity: 52 %RH

#### Calibration Report

Status	Reference (PPM)	Zero Reading (PPM)	Drift (PPM)	Reference (PPM)	Span Reading (PPM)	Drift%
Before	0.0	-1.521	-1.5	45.0	43.72	-1.4
After	0.0	0.200	0.2	45.0	45.41	0.5



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### CO Analyzer Verification Test Report

Calibration Report No.: ES-C6607008

Calibrated Date: 1-Jul-23

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Page:2/2

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	864.7	mA	Pose 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

### CO Analyzer Verification Test Report

Calibration Report No.: ES-C6607002

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

Page:1/2

#### Instruments Information

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: ECOESACO12E205
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#### Calibration System

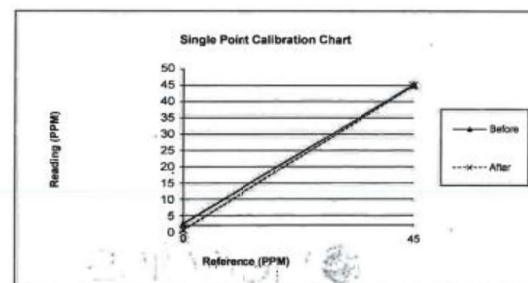
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM
ZERO AIR Generator ZAG7001 S/N: 644	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 27.9 °C

Humidity: 55 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	2.456	2.5	45.0	45.20	0.2
After	0.0	0.522	0.5	45.0	45.00	0.0



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## CO Analyzer Verification Test Report

Calibration Report No.: ES-C6507002

Calibrated Date: 1-Jul-23

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Page: 2/2

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	Pose 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

Request No. 21-66/0381

MTC No. EEL BP: 70/0366

## CALIBRATION CERTIFICATE

Submitted by : Envilab Co.,Ltd.

Address : 540, 540/1 Soi Bangkhae 7, Bangkhae, Bangkok, Bangkok 10160.

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 :

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 :

22037,

214.

**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.

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 1
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 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.

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 2 September, 2022

Certification No. 314/22

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิ

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2507

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 1009.6 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 1206295586)

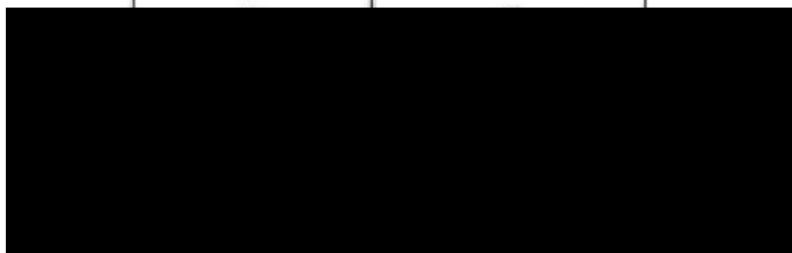


### The Result of Calibration

Sensor model EWSNV110WS2507 Certification No. 314/22  
2 September, 2022 Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.04	-	-	-	7.0	0.04
9.02	-	-	-	8.9	0.12
11.01	-	-	-	11.1	-0.09
13.01	-	-	-	13.2	-0.19
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.2	-0.18
20.02	-	-	-	20.5	-0.48

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



### The Result of Calibration

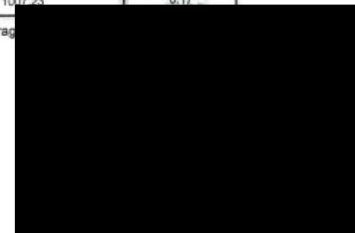
Sensor model EWSNV110WS2507

Certification No. 314/22

2 September, 2022 Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.31	1009.89	0.42
1010.80	1010.16	0.44
1010.38	1009.89	0.49
1010.23	1009.63	0.60
1009.93	1009.34	0.59
1009.66	1009.09	0.57
1009.41	1009.09	0.32
1009.13	1008.83	0.30
1008.96	1008.56	0.40
1008.58	1008.29	0.29
1008.25	1008.03	0.22
1007.57	1007.23	0.34
1007.27	1006.96	0.31
1007.04	1006.70	0.34
1006.63	1006.43	0.20
1010.02	1009.63	0.39
1008.77	1008.29	0.48
1008.67	1008.03	0.64
1007.63	1007.50	0.13
1007.40	1007.23	0.17

Average





### The Result of Calibration

Sensor model EWSNV110WS2507 Certification No. 314/22  
2 September, 2022 Page : 4 of 6

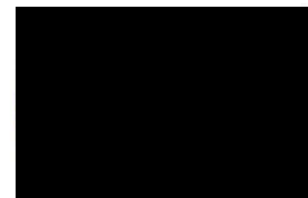
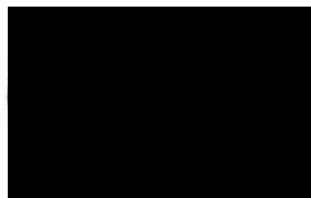
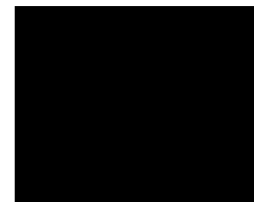
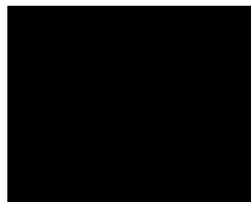
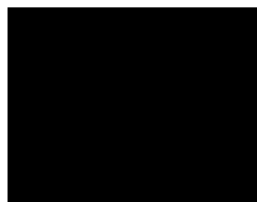
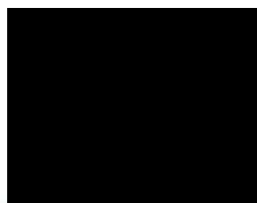
Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.5	45.4	0.1
30.5	30.4	0.1
15.2	15.2	0.0



### The Result of Calibration

Sensor model EWSNV110WS2507 Certification No. 314/22  
2 September, 2022 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.6	83.4	2.2
60.4	60.0	0.4
42.3	43.4	-1.1



Date of Issue 2 September, 2022

Certification No. 314/22

Page : 6 of 6

### ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชื่อ Davis แบบ TIPPING BUCKET  
Model 7342.026 ID No.EWSNV110WS2507 ทำการสอบเทียบกับแก้วฝนแบบแก้ว  
ดวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No  
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียด  
(TIP)

### Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 1 September, 2022

Certification No. 311/22

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 1010.1 hPa

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

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

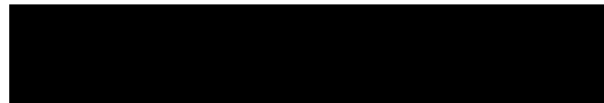
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

: 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 : Dev No 8390194 Wat No 8390194



### The Result of Calibration

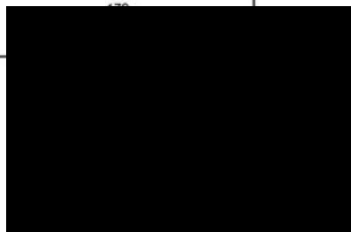
Sensor model EWSNV110WS2508 Certification No. 311/22

1 September, 2022

Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure m/sec	Vacuum inches	Pressure inches	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	3.1	-0.08
5.00	-	-	-	5.2	-0.20
7.04	-	-	-	7.4	-0.36
9.02	-	-	-	9.0	0.02
11.01	-	-	-	11.1	-0.09
13.01	-	-	-	13.0	0.01
15.01	-	-	-	15.2	-0.19
17.02	-	-	-	17.2	-0.18
20.02	-	-	-	20.5	-0.48

Wind Aloft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	87
180	
270	



### The Result of Calibration

Sensor model EWSNV110WS2508

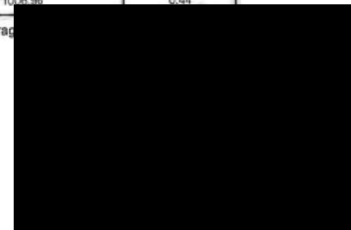
Certification No. 311/22

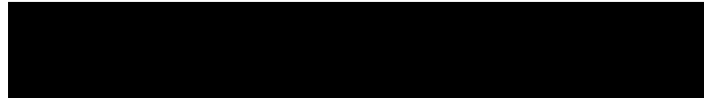
1 September, 2022

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1010.31	1009.62	0.69
1010.60	1010.15	0.45
1010.38	1009.89	0.49
1010.23	1009.62	0.61
1009.93	1009.35	0.58
1009.66	1009.03	0.63
1009.41	1008.90	0.52
1009.13	1008.82	0.31
1008.96	1008.56	0.40
1008.58	1008.29	0.29
1008.25	1008.02	0.23
1007.57	1007.23	0.34
1007.27	1006.96	0.31
1007.04	1006.69	0.35
1006.63	1006.43	0.20
1010.02	1009.62	0.40
1008.77	1008.29	0.48
1008.67	1008.02	0.65
1007.63	1007.23	0.40
1007.40	1006.96	0.44

Average

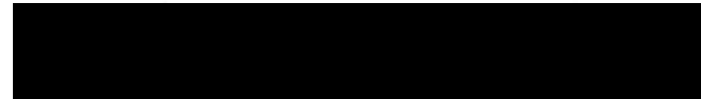




### The Result of Calibration

Sensor model EWSNV110WS2508 Certification No. 311/22  
1 September, 2022 Page : 4 of 6

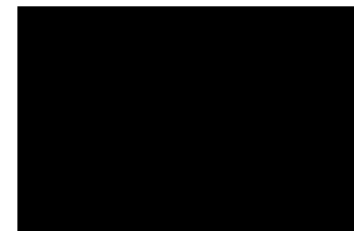
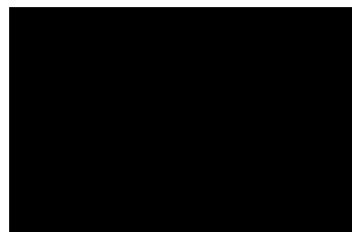
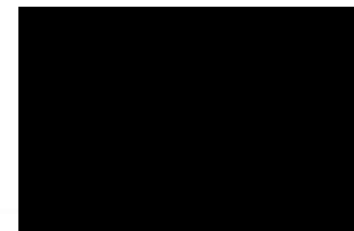
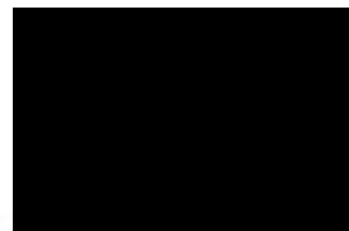
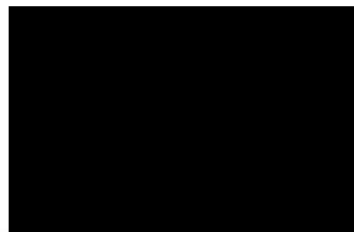
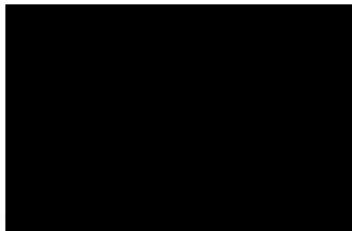
Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.5	45.4	0.1
30.5	30.5	0.0
15.2	15.4	-0.2



### The Result of Calibration

Sensor model EWSNV110WS2508 Certification No. 311/22  
1 September, 2022 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.6	81.2	4.4
60.4	56.8	3.6
42.3	39.7	2.6



Date of Issue 1 September, 2022

Certification No. 311/22

Page : 6 of 6

### ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝุ่น ชื่อ Davis แบบ TIPPING BUCKET  
Model 7342.026 [REDACTED] ทำการสอบเทียบกับแก้วฝุ่นแบบแก้ว  
ดวง GAUGE DIAMETER 8.0 INCHES , NEGRET  
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียด



## เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

สถานีโรงพยาบาลเซนต์หลุยส์

สถานีโรงเรียนกรุงเทพคริสเตียนวิทยาลัย

ครั้งที่ 2/2566

วันที่ตรวจวัดวันที่ 26-31 ตุลาคม 2566

TSP High Volume Sampler Calibration

**Verification Report No.**  
 SO2300288-E001 -TSP 01

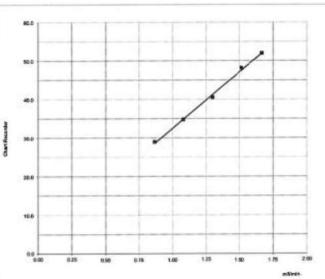
☐ PM   ☒ Onsite  
 Site: โรงบำบัดกรุงเทพมหานคร  
 UTM : 47P 664629 1517399      Date: 26 Oct 23  
 Sampler: ETSP#34      Technician: XXXXXXXXXX  
 Recorder: ECRDS016353497      Approver: XXXXXXXXXX

**CONDITIONS**  
 Barometric Press. (hPa): 956.0      Corrected Pressure (mm Hg): 717.1  
 Temperature (deg C): 29.0      Temperature (deg K): 302.0  
 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

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.20	1.670	54.0	52.10
2	10.07	1.518	50.0	48.24
3	7.35	1.299	42.0	40.53
4	5.05	1.079	36.0	34.74
5	3.24	0.867	30.0	28.95

**LINEAR REGRESSION**  
 Slope = 29.2554  
 Intercept = 3.2683  
 Corr. coeff. = 0.9986  
 # of Observations: 5  
 Range of Chart at 1.1 - 1.7 m3/min.      37 / 54



TSP High Volume Sampler Calibration

**Verification Report No.**  
 SO2300288-E001 -TSP 02

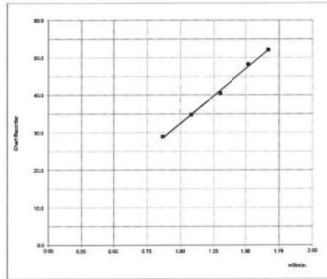
☐ PM   ☒ Onsite  
 Site: โรงบำบัดกรุงเทพมหานคร  
 UTM : 47P 664975 1517276      Date: 26 Oct 23  
 Sampler: ETSP#17      Technician: XXXXXXXXXX  
 Recorder: ECRDCPR4169240      Approver: XXXXXXXXXX

**CONDITIONS**  
 Barometric Press. (hPa): 956.0      Corrected Pressure (mm Hg): 717.1  
 Temperature (deg C): 29.0      Temperature (deg K): 302.0  
 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

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.23	1.530	52.0	50.17
2	9.41	1.468	50.0	48.24
3	7.31	1.296	46.0	44.38
4	4.42	1.010	40.0	38.60
5	3.26	0.870	36.0	34.74

**LINEAR REGRESSION**  
 Slope = 22.5803  
 Intercept = 15.3443  
 Corr. coeff. = 0.9987  
 # of Observations: 5  
 Range of Chart at 1.1 - 1.7 m3/min.      42 / 55



**PM10 High Volume Sampler Calibration**

Verification Report No. SO2300288-E001-PM 01

L PM ☐ Onsite  
 Site: กรุงเทพมหานคร  
 UTM : 47P 664629 1517399  
 Sampler: EPM10M37  
 Recorder: ECRDS016449814  
 Date: 26 Oct 23  
 Technician:   
 Approver:

**CONDITIONS**

Barometric Press. (hPa): 956.0	Corrected Pressure (mm Hg): 717.1
Temperature (deg C): 29.0	Temperature (deg K): 302.0
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**

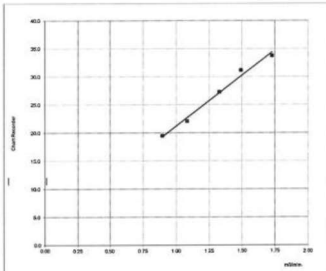
Brand: Tisch Environmental, Inc	Qstd Slope: 1.27368
Model: TE-5025A	Qstd Intercept: -0.01657
Serial#: 759	Date Certified: 18 Jan 2023

**CALIBRATIONS**

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	11.34	1.729	52.0	33.75
2	8.45	1.494	48.0	31.15
3	6.64	1.326	42.0	27.26
4	4.40	1.082	34.0	22.07
5	2.95	0.894	30.0	19.47

**LINEAR REGRESSION**

Slope = 18.0560  
 Intercept = 3.1753  
 Corr. coeff = 0.9935  
 SFR = 1.193  
 SSP = 38.10  
 # of Observations: 5  
 Range of Chart at SFR ±10%: 36 to 40



**PM10 High Volume Sampler Calibration**

Verification Report No. SO2300288-E001-PM 02

L PM ☐ Onsite  
 Site: กรุงเทพมหานคร  
 UTM : 47P 664975 1517276  
 Sampler: EPM10M15  
 Recorder: ECRDS01618124  
 Date: 26 Oct 23  
 Technician:   
 Approver:

**CONDITIONS**

Barometric Press. (hPa): 949.0	Corrected Pressure (mm Hg): 711.8
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**

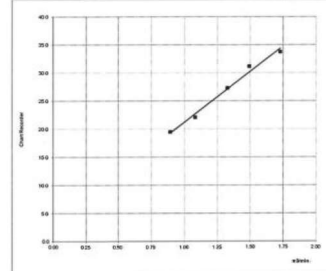
Brand: Tisch Environmental, Inc	Qstd Slope: 1.27368
Model: TE-5025A	Qstd Intercept: -0.01657
Serial#: 759	Date Certified: 18 Jan 2023

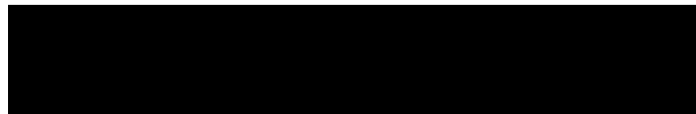
**CALIBRATIONS**

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.22	1.653	50.0	32.68
2	7.35	1.404	44.0	28.75
3	5.32	1.196	40.0	26.14
4	4.76	1.132	38.0	24.83
5	3.52	0.976	36.0	23.53

**LINEAR REGRESSION**

Slope = 13.7481  
 Intercept = 9.6994  
 Corr. coeff = 0.9954  
 SFR = 1.210  
 SSP = 40.29  
 # of Observations: 5  
 Range of Chart at SFR ±10%: 39 to 42





### Verification Test Report

Report No.:

SO2300288-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 664653 1517399

Calibrated Date: 26 October 2023

Site : โรงเรียนกรุงเทพคริสเตียน

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1899

Environment: Temperature 29 °C Humidity 65 %RH

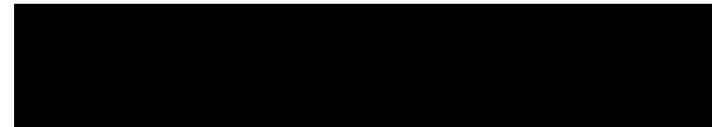
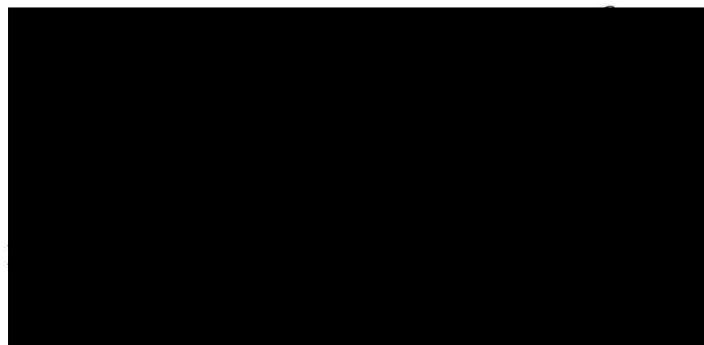
Reference Standard: Acoustic Calibrator Class 1 Model 4230,Bruel&Kjaer

Serial No.1351075

Date of Calibration : 16 March 2023

### Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.73	-0.05	93.78



### Verification Test Report

Report No.:

SO2300288-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P 664914 1517258

Calibrated Date: 26 October 2023

Site : โรงพยาบาลเซนต์หลุยส์

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1877

Environment: Temperature 29 °C Humidity 65 %RH

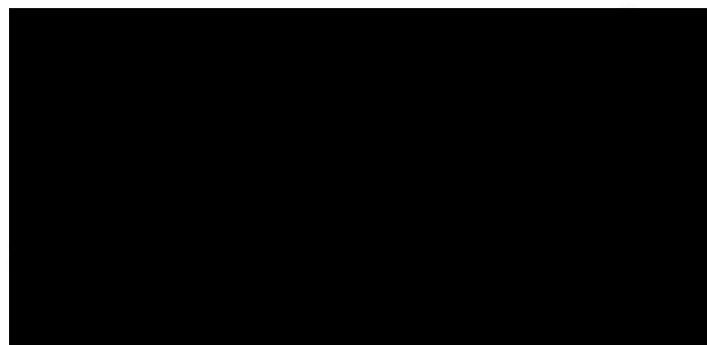
Reference Standard: Acoustic Calibrator Class 1 Model 4230,Bruel&Kjaer

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



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

## Certificate of Calibration

Calibration Certification Information							
Cal. Date: January 18, 2023	Rootsometer S/N: 438320	Ta: 29.4 °K					
Operator: [REDACTED]		Pa: 750.1 mm Hg					
Calibration Model #: TE-S025A	Calibrator S/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	0.8894
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
<b>QSTD</b>		m= 2.03736	<b>QA</b>		m= 1.27576
		b= -0.03733			b= -0.02337
		r= 0.99997			r= 0.99997

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

For subsequent flow rate calculations:

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

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg

**Key**

ΔH: calibrator manometer reading (in H2O)

ΔP: rootsmeter manometer reading (mm Hg)

Ta: actual absolute temperature (°K)

Pa: actual barometric pressure (mm Hg)

b: intercept

m: slope

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

## Certificate of Calibration

Page : 1 of 2

Certificate No. : 66-200066-1

Submitted by : [REDACTED]

Equipment : Electronic Balance

Manufacturer : Sartorius      Model : SBCURA125-1S

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 : Akaradath Thippichai

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

Edition 7 - November 2022

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

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	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	B	C	D	E
0.0001	0.0001	0.0000	0.0000	0.0000 g



Repeatability Load test : 100 g

Stdv. : 0.0004 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 : Chortip 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 SC-H-00021/66 11 Jul 2023 Success Gateway Co., Ltd., Accredited by TISI Calibration No.0268

## 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: E04N199E15A00V3 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.

ANALYTICAL RESULTS					
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				

CALIBRATION STANDARDS					
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	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL803190	49.87 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022
NTRM	09012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD578	NDR	Jan 27, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Jan 21, 2021
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Jan 21, 2021

Triad Data Available Upon Request

NOTES:  
Gross Weight: 28.4 Kg  
Net Weight: 4.5 Kg  
PO# 522/000405



**SO2 Analyzer Verification Test Report**

Calibration Report No.: AP-S6610004  
Calibrated Date: 1-Oct-23  
☒ PM ☐ Onsite

**Instruments Information** Page: 1/2

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API S/N: ESOAIT10003032
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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 E80160267

Environment: Temperature 23.5 °C Humidity: 60 %RH

**Calibration Report**

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	4.2	4.2	400.0	410.1	1.2
After	0.0	0.8	0.8	400.0	400.4	0.0

**SO2 Analyzer Verification Test Report**

Calibration Report No.: AP-S6610004  
Calibrated Date: 1-Oct-23  
☒ PM ☐ Onsite

Page: 2/2

Date	1-Oct-23			
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	26.2
Norm PMT Detector	0 - 5000	mV	31.4	34.3
HVPS	400-800 constant	V	725	725
DCPS	2500 (+/- 200)	mV	-	-
CELL TEMP	50 (+/- 1)	Draeger C	50	50
BOX TEMP	20-40	Draeger C	32.6	35.1
PMT TEMP	7 (+/- 1)	Draeger C	8.3	8.3
UV lamp	1000-4800	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	27.8	27.8
Dark lamp	(-50) - (+200)	mV	3.6	3.6
SAMP PRES	20-30 constant	IN-Hg-A	28.9	27.3
PMT Vots	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
Zero Gas (0.00 PPB)	0	ppb	4.2	0.8
Span Gas (400 PPB)	400	ppb	410.1	400.4

± 5% of Range



### SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6610003

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

#### Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: T100	Manufacturer API S/N: ESOAIT10002034
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#### Calibration System

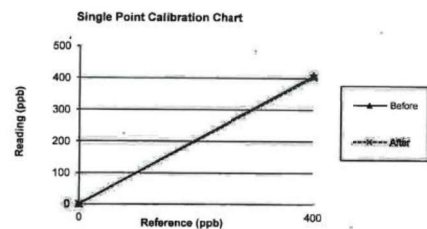
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 23.5 °C

Humidity: 61 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.9	0.9	400.0	408.0	1.0
After	0.0	0.5	0.5	400.0	403.0	0.4



### SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6610003

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Page:2/2

Date	1-Oct-23			
Time	11:50			
Range	50 - 20000	PPB	500	500
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2
Sample Flow	650 (+/- 50)	cc/min	650	619
PMT Detector	0 - 5000	mV	34.7	26.4
Norm PMT Detector	0 - 5000	mV	44.0	25.9
HVPS	400-900 constant	V	723	723
DCPS	2500 (+/- 200)	mV	-	-
CELL TEMP	50 (+/- 1)	Dregeee C	50	50
BOX TEMP	20-40	Dregeee C	35.5	33.9
PMT TEMP	7 (+/-1)	Dregeee 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
PMT Volts	2000 (+/- 500)	mV	2012	2008
SO2 Conc	1000 (+/- 250)	PPB	1008	1004
SO2 Slope	1 (+/- 0.3)	-	0.959	0.959
SO2 Offset	< 250	mV	30.3	1
Stability at Zero	< 0.2	PPB	0.3	17.7
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.5	0.2
Zero Gas (0.00 PPB)	0	ppb	0.9	0.5
Span Gas (400 PPB )	400	ppb	408.0	403.0

### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610003

Page:1/1

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

#### Instruments Information

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

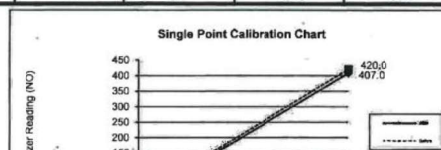
Environment: Temperature 23.2 °C Humidity: 56 %RH

#### Calibration Check ( Before adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.7	0.0	3.7	418.0	400.0	2.2
NO <sub>2</sub>	3.1	0.0	3.1	2.0	0.0	0.2
NOx	6.8	0.0	6.8	420.0	400.0	2.4

#### Calibration Check ( After adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.4	0.0	0.4	404.0	400.0	0.5
NO <sub>2</sub>	0.5	0.0	0.5	3.0	0.0	0.4
NOx	0.9	0.0	0.9	407.0	400.0	0.9



### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610003

Page:1/1

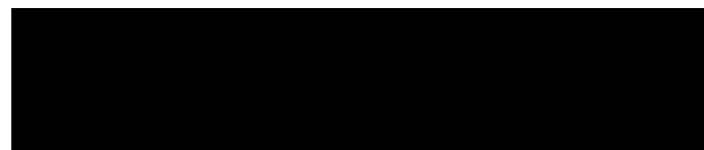
Calibrated Date: 1-Oct-23

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Page 22

Date	1-Oct-23				
Time	10:15				
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	488	
Ozone Flow	60-90	cc/min	70	80	
PMT Detector	0-5000	mV	33.2	25.1	
AZERO	-20-150	mV	23.4	23.0	
HVTS	400-900 constant	V	733	733	
DCPS	2500 +/- 200	mV	-	-	
RCCL TEMP	50 +/- 1	Dreages C	48.9	50.0	
BOX TEMP	20-35	Dreages C	34.2	33.5	
PMT TEMP	7 +/- 1	Dreages C	7.0	7.0	
US TEMP	50 +/- 4	Dreages C	-	-	
MOLY Temp	315 +/- 5	Dreages C	314.9	314.9	
RCCL 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 +/- 0.3		0.850	1.095	
Nox Slope	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	
Zero Value	NO	0	ppb	3.7	0.4
	NOx	0	ppb	6.8	0.9
Span Value	NO	400	ppb	418.0	404.0
	NOx	400	ppb	420.0	407.0



### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610007

Page:1/1

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

#### Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20002469
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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 23.6 °C

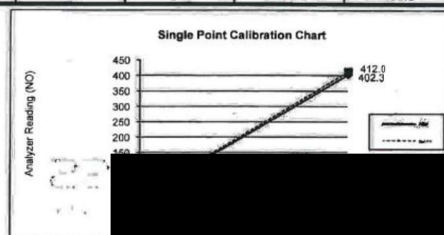
Humidity: 63 %RH

#### Calibration Check (Before adjust)

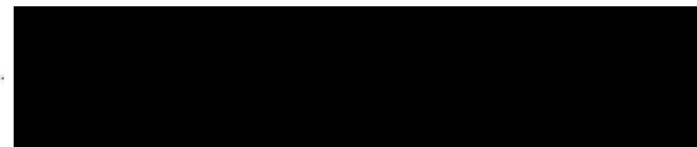
GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.4	0.0	2.4	408.6	400.0	1.1
NO <sub>2</sub>	1.3	0.0	1.3	3.4	0.0	0.4
NOx	3.7	0.0	3.7	412.0	400.0	1.5

#### Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.5	0.0	0.5	400.0	400.0	0.0
NO <sub>2</sub>	0.3	0.0	0.3	2.3	0.0	0.3
NOx	0.8	0.0	0.8	402.3	400.0	0.3



This report shall not be reproduced except



### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610007

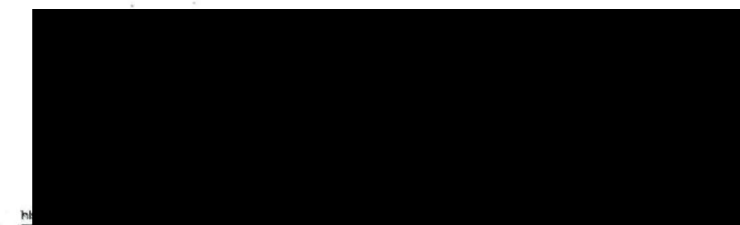
Page:1/1

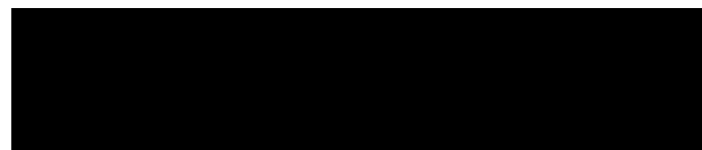
Calibrated Date: 1-Oct-23

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Date	1-Oct-23				
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	400-800 constant	V	755	755	
DCPS	2500 ± 200	mV	-	-	
RCCELL TEMP	50 ± 1	Dreagee C	50	50	
BOX TEMP	20-35	Dreagee C	30.2	32.0	
PMT TEMP	7 ± 1	Dreagee C	7.2	7.2	
ISB TEMP	50 ± 4	Dreagee C	-	-	
MOLY Temp	315 ± 5	Dreagee C	315.0	315.0	
RCCL PRES	4-10 constant	IN-Hg-A	4	5	
SAMP PRES	20-30 constant	IN-Hg-A	29	29	
NO Slope	1 ± 0.3		0.890	1.118	
Nox Slope	1 ± 0.3		0.911	1.046	
NO Offset	-10 to + 150	mV	12.9	2.2	
NOx Offset	-10 to + 150	mV	-2.4	8.1	
Zero Value	NO	0	ppb	2.4	0.5
	NOx	0	ppb	3.7	0.8
Span Value	NO	400	ppb	408.6	400.0
	NOx	400	ppb	412.0	402.3





### CO Analyzer Verification Test Report

Calibration Report No.: ES-C6610003

Calibrated Date: 1-Oct-23

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#### Instruments Information

Page:1/2

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

#### Calibration System

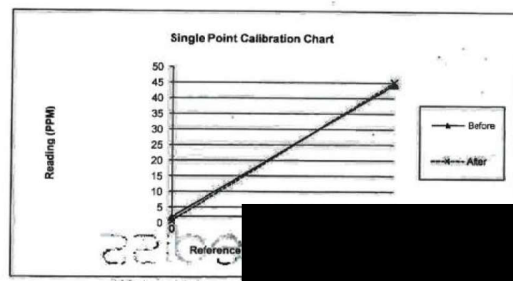
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792	NOx Conc: 46.50 PPM
ZERO AIR Generator ZAG7001 S/N: 644	NO Conc: 46.50 PPM
	So2 Conc: 45.59 PPM
	Co Conc: 4507 PPM
	Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 23.1 °C

Humidity: 58 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.684	1.7	45.0	44.35	-0.7
After	0.0	0.496	0.5	45.0	45.09	0.1



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### CO Analyzer Verification Test Report

Calibration Report No.: ES-C6610003

Calibrated Date: 1-Oct-23

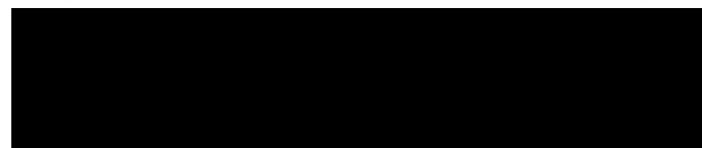
☒ PM ☐ Onsite

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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	Pbse current	818.2	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
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-C66100002

Calibrated Date: 1-Oct-23

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#### Instruments Information

Page:1/2

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

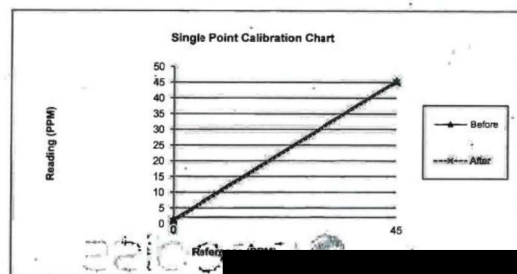
#### Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 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

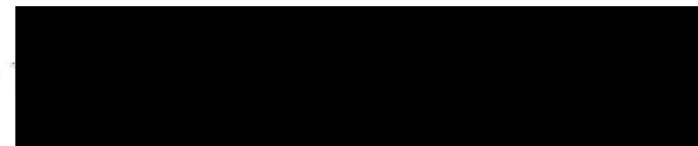
Environment: Temperature 23.1 °C Humidity: 56 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.309	1.3	45.0	45.50	0.6
After	0.0	0.627	0.6	45.0	45.02	0.0



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### CO Analyzer Verification Test Report

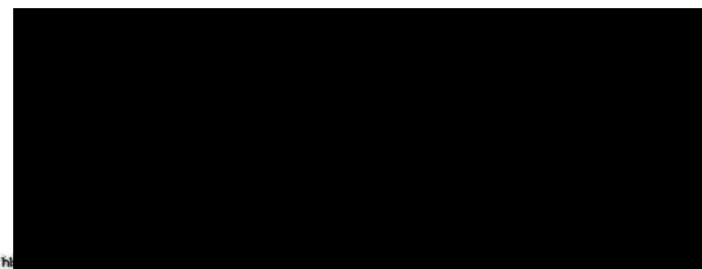
Calibration Report No.: ES-C66100002

Calibrated Date: 1-Oct-23

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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	Pbse current	618.2	mV
Optical T <sub>1</sub>	48.0	deg.C	Pbse T <sub>1</sub>	-24.2	deg.C
Measure sig <sub>1</sub>	506.4	mV	Refer Sig <sub>1</sub>	456.4	mV
Min sig <sub>1</sub>	945.0	mV	Max Sig <sub>1</sub>	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



Request No. 21-66/0381

MTC No. EEL. BP. 70/0366

### CALIBRATION CERTIFICATE

Submitted by

Address

Calibrated at

Instrument Calibrated :

Ambient Environment

Description : Sound Level Calibrator

Temperature : (23 ± 3) °C

Manufacturer : Briel & Kjaer

Relative Humidity : (50 ± 15) %

Model : 1130

Pressure : (101.325 ± 1.500) kPa

Serial No.

Standards used

**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.

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 20µPa at 1000 Hz

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

#### 1. Sound Pressure Level

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

#### 2. Frequency

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

#### 3. Total distortion

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

Note : 1. No adjustment.

Calibrated by

Approved



### 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

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



### The Result of Calibration

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

21 February, 2023

Serial No. 1225

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	-	-	-	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



The Result of Calibration

Sensor Presure Model TPH-1 C  
Serial No. 6276  
Certification No. 066/23  
21 February, 2023  
Page : 3 of 6

Standard Barometer		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
1009.87	1009.00	0.87
1009.66	1008.80	0.86
1009.40	1008.50	0.90
1008.71	1007.90	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
1007.89	1007.10	0.99
Average		

The Result of Calibration

Sensor Temperature Model TPH-1 C  
Serial No. 6276  
Certification No. 066/23  
21 February, 2023  
Page : 4 of 6

Standard Temp.	Temperature Sensor Reading	
	Reading	Correction
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 เครื่องวัดฝน ชีต Davis แบบ TIPPING BUCKET  
Model 7342.026 ID No.EWSCMS1200151 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. 069/23

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิมหาวิทยาลัย

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

edrich :

neider No

meter Vis



### 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	inches H <sub>2</sub> O	inches H <sub>2</sub> O	m/sec	m/sec	m/sec
1.00	0.00	0.00	0.0	0.4	0.60
3.02	0.00	0.00	0.0	2.8	0.22
5.00	0.00	0.00	0.0	4.5	0.50
7.04	0.00	0.00	0.0	7.0	0.04
9.02	0.00	0.00	0.0	9.0	0.02
11.01	0.00	0.00	0.0	11.0	0.01
13.01	0.00	0.00	0.0	12.8	0.21
15.01	0.00	0.00	0.0	14.8	0.21
17.02	0.00	0.00	0.0	16.8	0.22
20.02	0.00	0.00	0.0	20.3	-0.28

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

### The Result of Calibration

Sensor model EWSNV110WS2503

Certification No. 069/23

21 February, 2023

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Standard Barometer Pressure	Tested Barometer Pressure	Correction
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

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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

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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

หนังสือฉบับนี้ขอรับรองว่าเครื่องวัดฝน ชีตส์ Davis แบบ TIPPING BUCKET  
ID No. [REDACTED] ตรวจสอบเทียบกับแก้วฝนแบบแก้วดวง GAUGE  
DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON N. 71923-1055  
สามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของ [REDACTED]