

## ภาคผนวกที่ 5-2

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด  
สถานีรถไฟฟ้าชองนนทบุรี (อาคารโดมอันทาวเวอร์)  
และสถานีรถไฟฟ้าศาลาแดง (สถานีอาคารหอแว่น)  
ครั้งที่ 1/2566  
วันที่ตรวจวัด วันที่ 26-31 กรกฎาคม 2566



**TSP High Volume Sampler Calibration**

Verification Report No. SO2300200-E001 - TSP\_01

☐ PM ☒ Onsite

Site: BTS ศาลาแดง  
 UTM : 47P N 1518196 E 665858  
 Sampler: ETSP#22  
 Recorder: ECRDCPR4169240

Date: 26 Jul 23  
 Technical: [Redacted]  
 Approval: [Redacted]

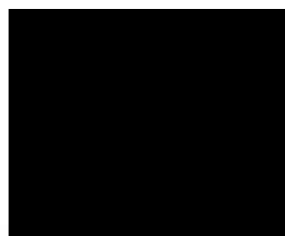
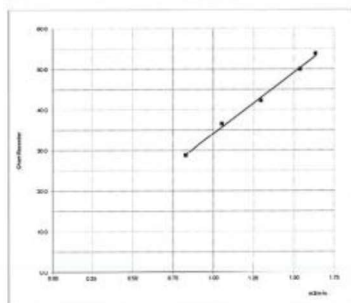
**CONDITIONS**

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 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	11.73	1.633	56.0	53.80	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
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	28.82	



**TSP High Volume Sampler Calibration**

Verification Report No. SO2300200-E001 - TSP\_02

☐ PM ☒ Onsite

Site: BTS ทองหล่อ  
 UTM : 47P N 1517741 E 665375  
 Sampler: ETSP#20  
 Recorder: ECRANG15315224

Date: 26 Jul 23  
 Technical: [Redacted]  
 Approval: [Redacted]

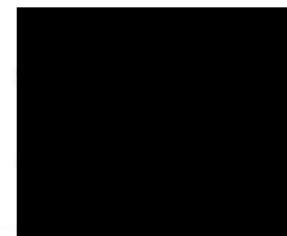
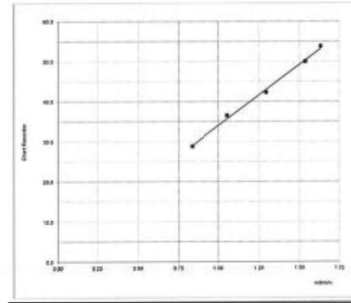
**CONDITIONS**

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 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	11.63	1.627	58.0	55.72	Slope = 29.6650 Intercept = 6.5944 Corr. coeff = 0.9929 # of Observations: 5 Range of Chart at 1.1 - 1.7 m3/min: 41 59
2	10.22	1.526	54.0	51.88	
3	7.34	1.296	46.0	44.20	
4	4.85	1.057	38.0	36.51	
5	2.98	0.832	34.0	32.67	



PM10 High Volume Sampler Calibration

Verification Report No. SO2300200-E001 -PM 01

☐ L ☒ PM ☐ Onsite

Site: BTS ศาลาแดง

UTM : 47P N 1518196 E 665858

Sampler: EPM38

Recorder: ECRD501618124

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): 759.6
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	11.00	1.713	52.0	33.89
2	10.00	1.634	50.0	32.59
3	5.87	1.256	42.0	27.37
4	4.82	1.140	38.0	24.77
5	3.21	0.934	34.0	22.16

LINEAR REGRESSION

Slope = 15.1372

Intercept = 7.9440

Corr. coeff = 0.9981

SFR = 1.204

SSP = 40.14

# of Observations: 5

Range of Chart at SFR ±10%: 38 to 42

PM10 High Volume Sampler Calibration

Verification Report No. SO2300200-E001 -PM 02

☐ L ☒ PM ☐ Onsite

Site: BTS ศาลาแดง

UTM : 47P N 1517741 E 665375

Sampler: EPM20

Recorder: ECRD501618125

Date: 26 Jul 23

Technician: [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): 759.6
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	1.644	50.0	32.79
2	8.11	1.452	46.0	30.16
3	6.21	1.299	42.0	27.54
4	4.23	1.075	34.0	22.29
5	3.43	0.970	32.0	20.98

LINEAR REGRESSION

Slope = 18.0414

Intercept = 3.4059

Corr. coeff = 0.9959

SFR = 1.218

SSP = 38.72

# of Observations: 5

Range of Chart at SFR ±10%: 36 to 41

### Verification Test Report

Report No.:

SO2300200-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1518196 E 665858

Calibrated Date: 26 July 2023

Site : BTS ศาลาแดง

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1897

Environment: Temperature 25 °C Humidity 72 %RH

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

### Verification Test Report

Report No.:

SO2300200-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1517741 E 665375

Calibrated Date: 26 July 2023

Site : BTS ฟองน้ำ

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1900

Environment: Temperature 25 °C Humidity 72 %RH

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



RECALIBRATION  
DUE DATE:  
January 18, 2024

Certificate of Calibration

Calibration Certification Information

Cal. Date: January 18, 2023Rootsmeter S/N: 438320Ta: 294 °K  
Operator: Jim TischPa: 750.1 mm Hg  
Calibration Model #: TE-5025ACalibrator 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= 2.03736		QA	m= 1.27576	
	b= -0.03733			b= -0.02337	
	r= 0.99997			r= 0.99997	

Calculations

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

For subsequent flow rate calculations:

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

Certificate No. : 66-200066-1Page : 1 of 2

Submitted by :

Equipment : Electronic Balance

Manufacturer : SartoriusModel : SECURA125-18

Serial No. : 0034606552ID No. : ELABBALANCEN05

Capacity : 120 gResolution : 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-E264	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

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### 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 SG-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%

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## CERTIFICATE OF ANALYSIS

### Grade of Product: EPA Protocol

Part Number: E04N199E15A00V3  
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	44.68 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	12366	D665025	9.31 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMIS	1242066889	CC323707	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	KAL004715	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 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-S6607001

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

#### Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: T100	Manufacturer API S/N: ESOAIT10002032
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#### Calibration System

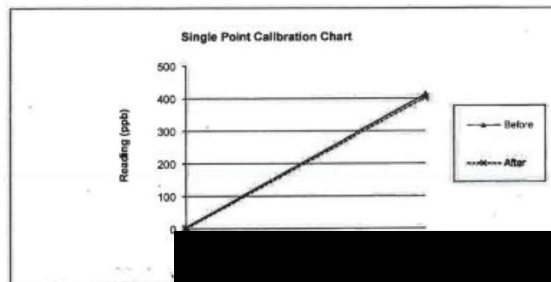
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NO Conc 44.68 PPM
ZERO AIR Generator ZAG7001 S/N: 644	SO2 Conc 45.34 PPM
	CO Conc 4500 PPM
	Expire Date: Feb 19,2024 EBC140762

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	3.6	3.6	400.0	410.5	1.3
After	0.0	0.9	0.9	400.0	402.1	0.3



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### SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6607001

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

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Test Function Value	Normal 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	646	
GCPS	2500 (+/- 200)	mV	-	-	
RCCELL TEMP	50 (+/- 1)	Droogee C	50	50	
BOX TEMP	20-40	Droogee C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Droogee C	8.0	8.0	
UV lamp	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 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 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	85	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
<b>Gas Test Response</b>					
Zero Gas (0.00 PPB)	0	ppb	3.6	0.9	
Span Gas (400 PPB)	400	ppb	410.5	402.1	± 5% of Range

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### SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6607004

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

#### Instruments Information

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Analyzer Type: SO2 Analyzer Model: T100	Manufacturer API S/N: ES0AIT10002033
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#### Calibration System

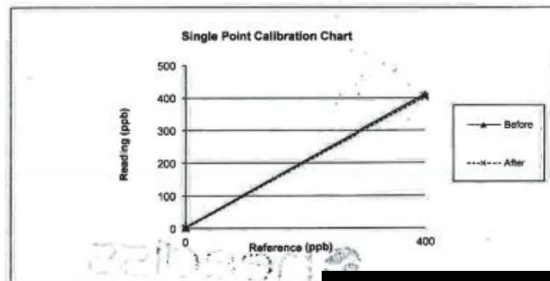
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NO Conc 44.68 PPM
ZERO AIR Generator ZAG7001 S/N: 644	SO2 Conc 45.34 PPM
	CO Conc 4500 PPM
	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 27.5 °C

Humidity: 55 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	2.7	2.7	400.0	410.0	1.2
After	0.0	0.9	0.9	400.0	403.2	0.4



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### SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6607004

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	850 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
HVPS	400-800 constant	V	719	648	
DCPS	2500 (+/- 200)	mV	+	-	
CELL TEMP	50 (+/- 1)	Degree C	50	50	
BOX TEMP	20-40	Degree C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Degree C	8.0	8.0	
UV lamp	1000-4800	mV	4034.0	4034.0	
Lamp Ratio	35-120	%	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)	-	0.920	0.866	
SO2 Offset	< 250	mV	85	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
<b>Gas Test Response</b>					
Zero Gas (0.00 PPB)	0	ppb	2.7	0.9	
Span Gas (400 PPB)	400	ppb	410.0	403.2	± 5% of Range

This report

## NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6607001

Page:1/1

Calibrated Date: 1-Jul-23

☒ PM ☐ Onsite

### Instruments Information

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

Calibrator Unit	Standard Gas
Dilutor Model ESA 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 27.4 °C

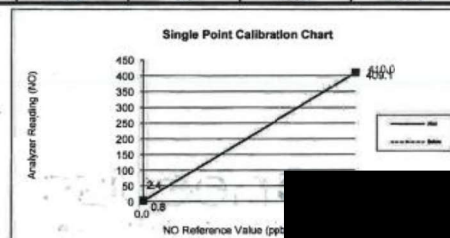
Humidity: 54 %RH

### Calibration Check ( Before adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.0	0.0	2.0	395.7	400.0	-0.5
NO <sub>2</sub>	0.4	0.0	0.4	14.3	0.0	1.8
NOx	2.4	0.0	2.4	410.0	400.0	1.2

### Calibration Check ( After adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.5	0.0	0.5	403.8	400.0	0.5
NO <sub>2</sub>	0.3	0.0	0.3	5.3	0.0	0.7
NOx	0.8	0.0	0.8	409.1	400.0	1.1



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## NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6607001

Page:1/1

Calibrated Date: 1-Jul-23

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Jul-23				
Time	9:25				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	491	485	
Ozone Flow	80-90	cc/min	80	80	
PMT Detector	0-5000	mV	85.0	25.0	
AZERO	-20-150	mV	94.1	14.5	
HVPS	400-800 constant	V	734	734	
DCPS	2500 +/- 200	mV	-	-	
CELL TEMP	50 +/- 1	Degree C	50	50	
BOX TEMP	20-35	Degree C	34.7	33.6	
PMT TEMP	7 +/- 1	Degree C	7.0	7.0	
IZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	314.0	314.0	
RECEL PRES	4-10 centid	IN-Hg-A	5.0	5.0	
SAMP PRES	20-30 centid	IN-Hg-A	28.8	27.9	
NO Slope	1 +/- 0.3		1.135	1.187	
NOx Slope	1 +/- 0.3		1.260	1.114	
NO Offset	-10 to + 150	mV	0.8	-3.6	
NOx Offset	-10 to + 150	mV	-2.6	6.1	
Span and Cal Values					
Zero Value	NO	0	ppb	2.0	0.5
	NOx	0	ppb	2.4	0.8
Span Value	NO	400	ppb	395.7	403.8
	NOx	400	ppb	410.0	409.1

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### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6607002  
Calibrated Date: 1-Jul-23

Page:1/1

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

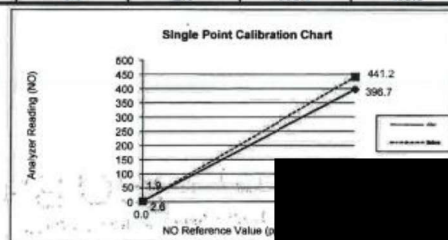
Environment: Temperature 27.8 °C Humidity 54 %RH

#### Calibration Check ( Before adjust )

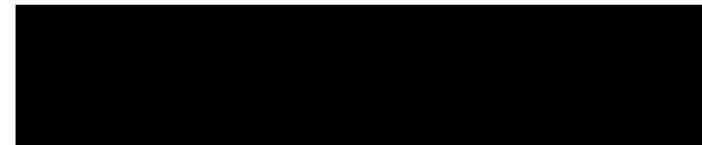
GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-2.8	0.0	-2.8	450.7	400.0	6.0
NO <sub>2</sub>	4.7	0.0	4.7	-9.5	0.0	-1.1
NOx	1.9	0.0	1.9	441.2	400.0	4.9

#### Calibration Check ( After adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-0.9	0.0	-0.9	394.2	400.0	-0.7
NO <sub>2</sub>	3.5	0.0	3.5	2.5	0.0	0.3
NOx	2.6	0.0	2.6	396.7	400.0	-0.4



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### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6607002  
Calibrated Date: 1-Jul-23

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Jul-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	486	
Ozone Flow	60-80	cc/min	80	80	
PMT Detector	0-5000	mV	33.2	25.1	
AZERO	-20-150	mV	23.4	23.0	
HVPS	400-800 constant	V	733	733	
DCPS	2500 ± 200	mV	-	-	
CELL TEMP	50 ± 1	Dragee C	48.9	50.0	
BOX TEMP	20-35	Dragee C	34.2	33.5	
PMT TEMP	7 ± 1	Dragee C	7.0	7.0	
IZS TEMP	50 ± 4	Dragee C	-	-	
MOXY Temp	315 ± 5	Dragee C	314.9	314.9	
RECEL 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	
Span and Cal Values					
Zero Value	NO	0	ppb	-2.8	-0.9
	NOx	0	ppb	1.9	2.6
Span Value	NO	400	ppb	450.7	394.2
	NOx	400	ppb	441.2	396.7

This report



### CO Analyzer Verification Test Report

Calibration Report No.: ES-C6607007

Calibrated Date: 1-Jul-23

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#### Instruments Information

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

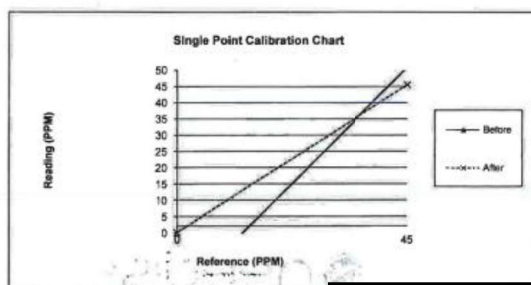
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19,2024 EB0140762

Environment: Temperature 25.8 °C

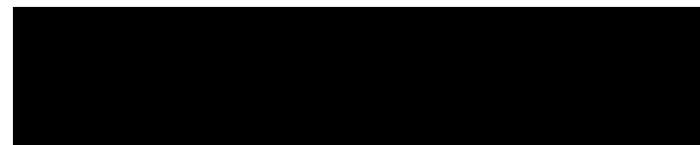
Humidity: 59 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	-20.610	-20.6	45.0	50.93	6.2
After	0.0	0.032	0.0	45.0	45.51	0.6



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### CO Analyzer Verification Test Report

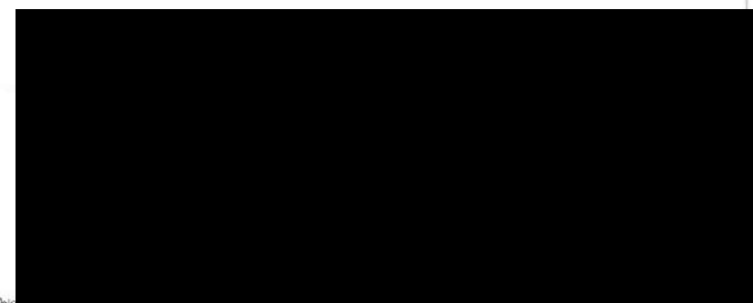
Calibration Report No.: ES-C6607007

Calibrated Date: 1-Jul-23

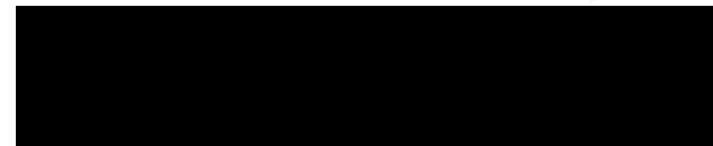
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Analyzer Signal Values					
Date	1-Jul-23	Time	10:09:00		
Power Supplies					
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
Optical Bench					
IR current ratio	884.7	mA	Pbse current	618.2	mV
Optical 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







### CO Analyzer Verification Test Report

Calibration Report No.: TD-C6607004

Calibrated Date: 1-Jul-23

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#### Instruments Information

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Analyzer Type: CO Analyzer Model: T300	Manufacturer API S/N: ECOAIT3000098
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#### Calibration System

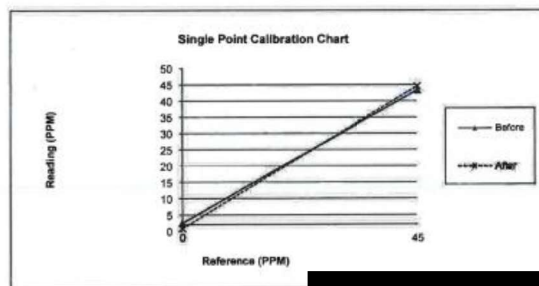
Calibrator Unit	Standard Gas
Dilutor Model ESA MGA101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.66 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19,2024 EB0140762

Environment: Temperature 29.2 °C

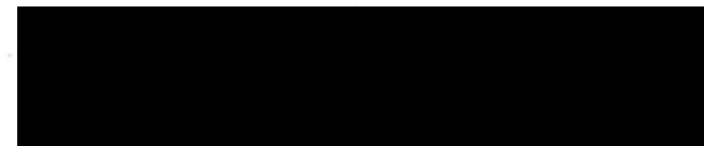
Humidity: 48 %RH

#### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	2.4	2.4	45.0	43.3	-1.9
After	0.0	0.8	0.8	45.0	44.5	-0.6



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### CO Analyzer Verification Test Report

Calibration Report No.: TD-C6607004

Calibrated Date: 1-Jul-23

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Detail	Range	Unit	Before	After	Note
Date	1-Jul-23				
Time	10:51				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB )	ppb	0.04	0.2	
CO Measure	2500 - 4800 MV.	mV	4485.6	4431.3	
CO Reference	2500 - 4800 MV.	mV	3768.5	3730.2	
MR Ratio	1.2 +/- 0.5		1.19	1.20	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	28.7	28.6	
Sample Flow	720 - 880 cc/min	cc/min	904	898	
Sample Temp	44 - 52 deg.C	deg.C	48.5	43.3	
Bench Temp	47 - 49 deg.C	deg.C	48	48	
Wheel Temp	66 - 70 deg.C	deg.C	68	68	
Box Temp	27 - 50 deg.C	deg.C	33.3	34.8	
PHT drive	250 - 4750 mv.	mV	2912.3	2913.5	
Slope	0.800 - 1.200		1.197	1.138	
Offset	0.05 +/- 0.2		-0.015	-0.016	
<b>Gas Test Response</b>					
Zero Gas	0	PPM	0.4	0.0	
Span Gas	45	PPM	44.5	45.0	± 5% of Range

This report

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

**Standards used :** 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.  
 2. Measuring Amplifier Brüel&Kjær 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 Brüel&Kjær 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

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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 20µPa at 1000 Hz**  
**Acoustic Output in dB re 20µPa , Corrected to Reference Conditions : 101.325 kPa , 23.0°C and 50 %RH**

#### 1. Sound Pressure Level

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

#### 2. Frequency

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

#### 3. Total distortion

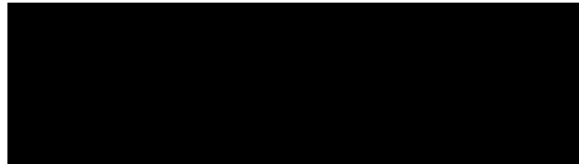
Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjær 4180	1.05	± 0.50	±3.0%

**Note :** 1. No adjustment.  
 2. The calibrator pressure correction was not included.  
 3. The [REDACTED]

**Calibrated by** [REDACTED]  
**Date of Calibration** [REDACTED]  
**Date of Issue** [REDACTED]

2/2

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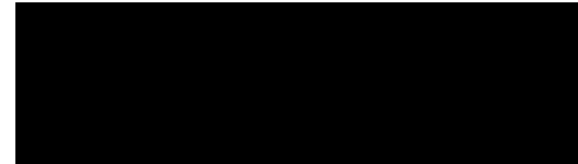
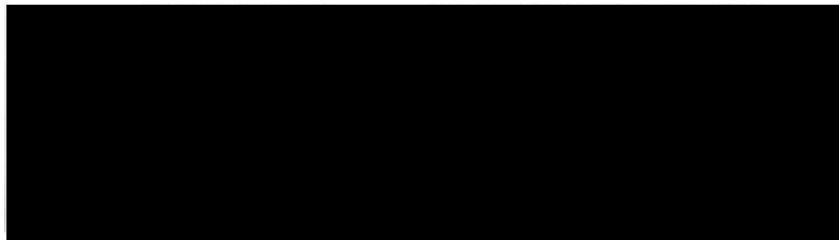


Issued by : Calibration & Test Section : Meteorological Instruments Bureau  
Date of Issue : 1 September, 2022 Certification No. 312/22  
Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิตามเวลา  
Manufacturer : NovaLynx  
Type : Data Logger 110-WS-25DL-D  
Serial No. : EWSNV110WS2510  
Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1009.7 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563  
: HOOK GAGE NO 1425 : Wind Aloft Plotting Board  
N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec  
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)  
Serial Number 110730029 (sensor 120629566)  
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec



### The Result of Calibration

Sensor model EWSNV110WS2510 Certification No. 312/22

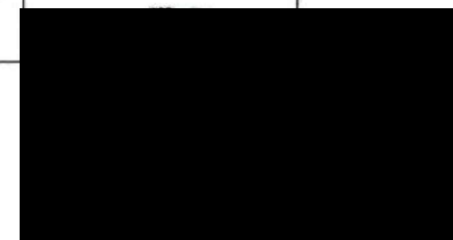
1 September, 2022

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Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic 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	*	*	*	0.4	0.60
3.02	*	*	*	2.7	0.32
5.00	*	*	*	4.6	0.40
7.04	*	*	*	7.1	-0.06
9.02	*	*	*	9.1	-0.08
11.01	*	*	*	10.7	0.31
13.01	*	*	*	12.8	0.21
15.01	*	*	*	14.8	0.21
17.02	*	*	*	17.1	-0.08
20.02	*	*	*	20.3	-0.28

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

Cal



### The Result of Calibration

Sensor model EWSNV110WS2510

Certification No. 312/22

1 September, 2022

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.31	1009.82	0.49
1010.60	1010.36	0.24
1010.38	1010.09	0.29
1010.23	1009.82	0.41
1009.93	1009.56	0.37
1009.66	1009.29	0.37
1009.41	1009.03	0.38
1009.13	1008.76	0.37
1008.96	1008.76	0.20
1008.58	1008.49	0.09
1008.25	1008.23	0.02
1007.57	1007.43	0.14
1007.27	1007.16	0.11
1007.04	1006.90	0.14
1006.63	1006.63	0.00
1010.02	1009.82	0.20
1008.77	1008.49	0.28
1008.67	1008.23	0.44
1007.63	1007.70	-0.07
1007.40	1007.43	-0.03

Average

### The Result of Calibration

Sensor model

EWSNV110WS2510

Certification No. 312/22

1 September, 2022

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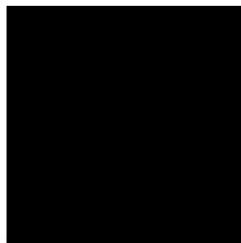
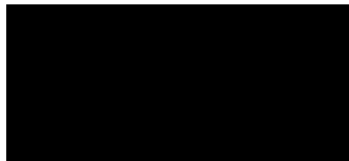
Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.5	45.7	-0.2
30.5	30.4	0.1
15.2	15.5	-0.3



### The Result of Calibration

Sensor model EWSNV110WS2510 Certification No. 312/22  
1 September, 2022 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.6	82.1	3.5
60.4	56.7	3.7
42.3	38.7	3.6



Date of Issue 1 September, 2022

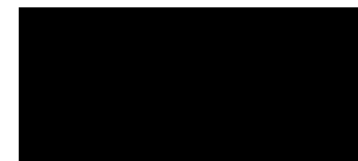
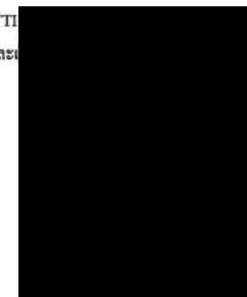


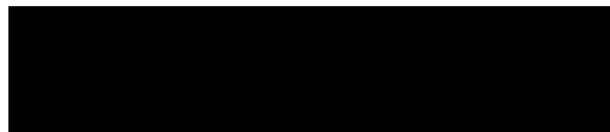
Certification No. 312/22

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### ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีฟส์ Davis แบบ TIPPING BUCKET  
Model 7342.026 ID No.EWSNV110WS2510 ทำการสอบเทียบกับแก้วฝนแบบแก้ว  
ตวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI  
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียด





## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 2 September, 2022

Certification No. 315/22

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2511

Customer : Envislab Co.,Ltd.(Head Office)  
540,540/1 Soi Bangkhae 7, Bangkhae, Bangkhae  
Bangkok 10160,Thailand.

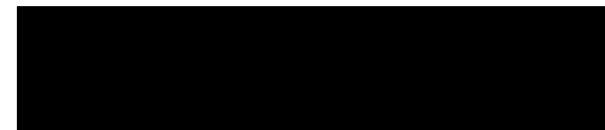
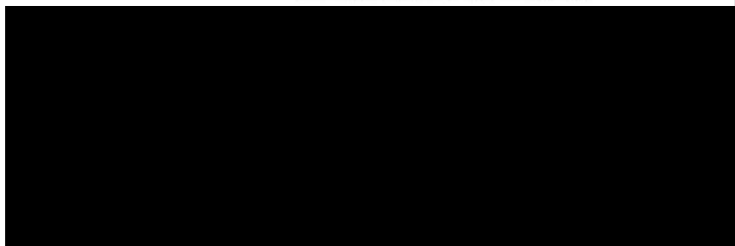
Calibration Condition : Temperature 25.1 °C Barometric Pressure 1010.0 hPa

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)



## The Result of Calibration

Sensor model

EWSNV110WS2511

Certification No. 315/22

2 September, 2022

Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/s/100	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.1	-0.08
11.01	-	-	-	11.1	-0.09
13.01	-	-	-	12.9	0.11
15.01	-	-	-	15.1	-0.09
17.02	-	-	-	17.2	-0.18
20.02	-	-	-	20.2	-0.18

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



### The Result of Calibration

Sensor model EWSNV110WS2511

Certification No. 315/22

2 September, 2022

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1010.31	1008.44	1.87
1010.60	1009.31	1.29
1010.36	1009.02	1.36
1010.23	1008.73	1.50
1009.93	1008.44	1.49
1009.66	1008.14	1.52
1009.41	1007.85	1.56
1009.13	1007.56	1.57
1008.96	1007.27	1.69
1008.58	1006.97	1.61
1008.25	1006.68	1.57
1007.57	1006.09	1.48
1007.27	1005.80	1.47
1007.04	1005.51	1.53
1006.63	1005.22	1.41
1010.02	1009.02	1.00
1008.77	1007.56	1.21
1008.67	1007.27	1.40
1007.63	1006.09	1.54
1007.40	1005.80	1.60

Average

### The Result of Calibration

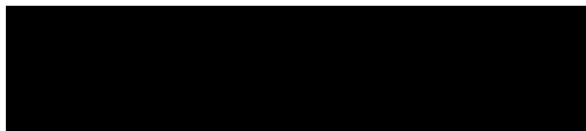
Sensor model EWSNV110WS2511

Certification No. 315/22

2 September, 2022

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.5	45.6	-0.1
30.5	30.5	0.0
15.2	15.4	-0.2



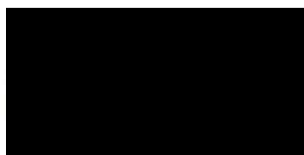
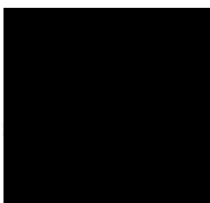
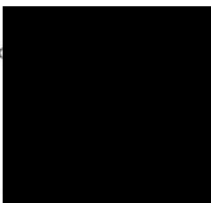
### The Result of Calibration

Sensor model EWSNV110WS2511 Certification No. 315/22

2 September, 2022

Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.6	82.9	2.7
60.4	59.1	1.3
42.3	41.5	0.8



Date of Issue 2 September, 2022

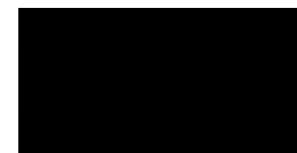
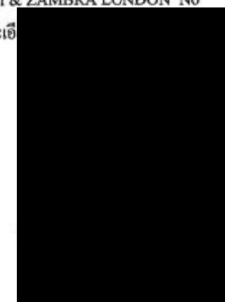


Certification No. 315/22

Page : 6 of 6

### ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน อีห้อ Davis แบบ TIPPING BUCKET Model 7342.026 ID No.EWSNV110WS2511 ทำการสอบเทียบกับแก้วฝนแบบแก้ว ตวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียด (TIP)





**เอกสารผลการสอบเทียบเครื่องมือตรวจวัด  
สถานีรถไฟฟ้าชองนนทบุรี (อาคารโดมอันทาวเวอร์)  
สถานีรถไฟฟ้าศาลาแดง (สถานีอาคารหอแว่น)  
ครั้งที่ 2/2566  
วันที่ตรวจวัด วันที่ 26-31 ตุลาคม 2566**

TSP High Volume Sampler Calibration

Verification Report No.  
 SO2300289-E001 -TSP\_01

☐ PM ☒ Onsite  
 Site: สถานีรถไฟฟ้ามหานคร  
 UTM : 47P 665717 1518166  
 Sampler: ETSP#20  
 Recorder: ECRAN00031077

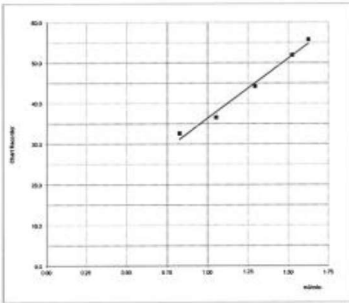
Date: 26 Oct 23  
 Technical: XXXXXXXXXX  
 Approval: XXXXXXXXXX

**CONDITIONS**  
 Barometric Press. (hPa): 952.0      Corrected Pressure (mm Hg): 714.1  
 Temperature (deg C): 30.0      Temperature (deg K): 303.0  
 Average Press. (hPa): 1013.0      Corrected Avg. Press. (mm Hg): 759.6  
 Average Temp. (deg C): 30.0      Average Temp. (deg K): 303.0

**CALIBRATION ORIFICE**  
 Brand: Tisch Environmental, Inc      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	11.63	1.625	58.0	55.75
2	10.22	1.524	54.0	51.91
3	7.34	1.293	46.0	44.22
4	4.85	1.054	38.0	36.53
5	2.98	0.829	34.0	32.68

**LINEAR REGRESSION**  
 Slope = 29.6166  
 Intercept = 6.7547  
 Corr. coeff. = 0.9929  
 # of Observations: 5  
 Range of Chart at 1.1 - 1.7 m3/min: 41 / 59



26 October 2023

TSP High Volume Sampler Calibration

Verification Report No.  
 SO2300289-E001 -TSP\_02

☐ PM ☒ Onsite  
 Site: สถานีรถไฟฟ้ามหานคร  
 UTM : 47P 665348 1517740  
 Sampler: ETSP#41  
 Recorder: ECRAN15315224

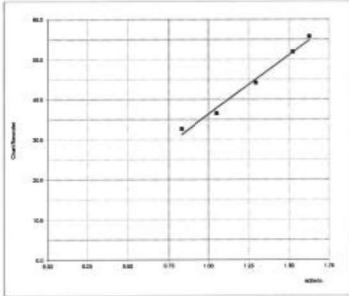
Date: 26 Oct 23  
 Technical: XXXXXXXXXX  
 Approval: XXXXXXXXXX

**CONDITIONS**  
 Barometric Press. (hPa): 952.0      Corrected Pressure (mm Hg): 714.1  
 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: 2.03404  
 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	11.12	1.589	54.0	51.91
2	9.63	1.480	52.0	49.99
3	7.37	1.296	48.0	46.14
4	4.83	1.052	40.0	38.45
5	3.11	0.846	32.0	30.76

**LINEAR REGRESSION**  
 Slope = 23.5141  
 Intercept = 7.7335  
 Corr. coeff. = 0.9916  
 # of Observations: 5  
 Range of Chart at 1.1 - 1.7 m3/min: 41 / 58



26 October 2023

PM10 High Volume Sampler Calibration

Verification Report No.  
 SO2300289-E001-PM 01

L PM    Onsite  
 Site: สถานีรถไฟฟ้ามหานคร  
 UTM: 47P 665717 1518166  
 Sampler: EPM10M41  
 Recorder: ECRDS016431075

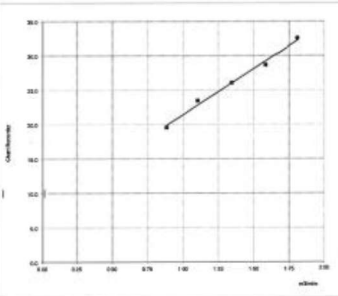
Date: 26 Oct 23  
 Technical: XXXXXXXXXX  
 Approval: XXXXXXXXXX

**CONDITIONS**  
 Barometric Press. (hPa): 952.0      Corrected Pressure (mm Hg): 714.1  
 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: 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	12.33	1.809	50.0	32.57
2	9.44	1.554	44.0	28.56
3	6.78	1.345	40.0	26.06
4	4.56	1.105	36.0	23.45
5	2.91	0.885	30.0	19.54

**LINEAR REGRESSION**  
 Slope = 13.4221  
 Intercept = 1.9941  
 Corr. coeff = 0.9952  
 SFR = 1.202  
 SSP = 37.05  
 # of Observations: 5  
 Range of Chart at SFR ±10%: 35 / 39



26 October 2023

PM10 High Volume Sampler Calibration

Verification Report No.  
 SO2300289-E001-PM 02

L PM    Onsite  
 Site: สถานีรถไฟฟ้ามหานคร  
 UTM: 47P 665348 1517740  
 Sampler: EPM10M40  
 Recorder: ECRDS01618125

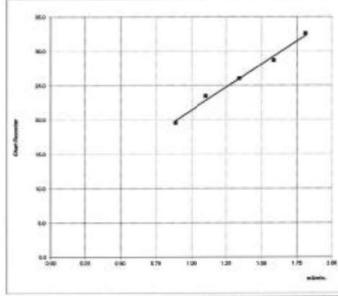
Date: 26 Oct 23  
 Technical: XXXXXXXXXX  
 Approval: XXXXXXXXXX

**CONDITIONS**  
 Barometric Press. (hPa): 947.0      Corrected Pressure (mm Hg): 710.3  
 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

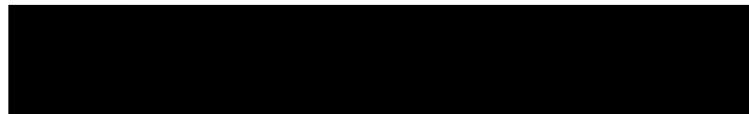
**CALIBRATION ORIFICE**  
 Brand: Tisch Environmental, Inc      Qstd Slope: 1.27368  
 Model: TE-5025A      Qstd Intercept: -0.01657  
 Serial#: 759      Date Certified: 18 Jan 2023

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	11.23	1.731	54.0	35.27
2	10.38	1.665	52.0	33.96
3	7.53	1.420	44.0	28.74
4	4.71	1.126	38.0	24.82
5	3.09	0.914	30.0	19.59

**LINEAR REGRESSION**  
 Slope = 18.5212  
 Intercept = 3.0765  
 Corr. coeff = 0.9969  
 SFR = 1.209  
 SSP = 38.99  
 # of Observations: 5  
 Range of Chart at SFR ±10%: 37 / 41



26 October 2023



### Verification Test Report

Report No.:

SO2300289-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P 665860 1518194

Calibrated Date: 26 October 2023

Site : สถานีรถไฟฟ้าสายแดง

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1900

Environment: Temperature 30 °C Humidity 65 %RH

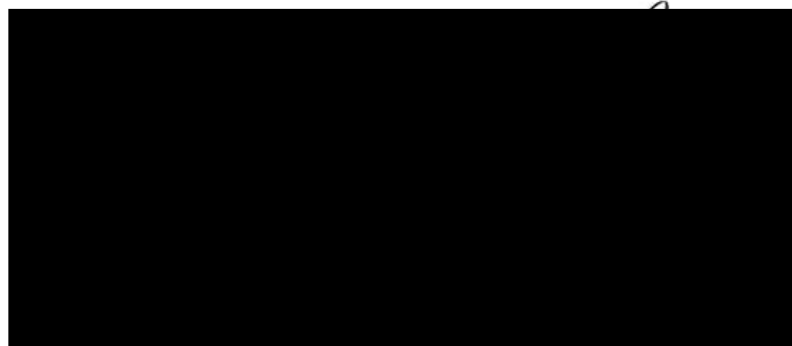
Reference Standard: Acoustic Calibrator Class 1 Model 4230, Bruel&Kjaer

Serial No.1351075

Date of Calibration : 16 March 2023

### Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.74	-0.04	93.78



วันที่ตรวจ 01/02/2566



### Verification Test Report

Report No.:

SO2300289-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P 665361 1517736

Calibrated Date: 26 October 2023

Site : สถานีรถไฟฟ้าขบวนรถไฟ

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1974

Environment: Temperature 30 °C Humidity 65 %RH

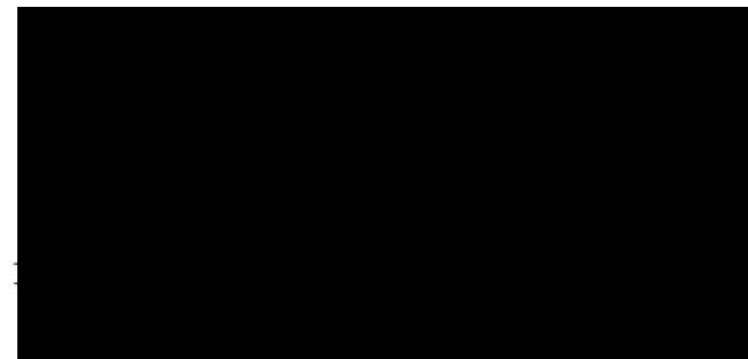
Reference Standard: Acoustic Calibrator Class 1 Model 4230, Bruel&Kjaer

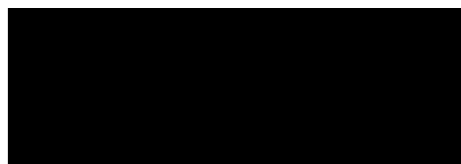
Serial No.1351075

Date of Calibration : 16 March 2023

### Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.71	-0.07	93.78





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 (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= 2.03736	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:	
$Q_{std} = 1/m \left( \sqrt{\Delta H \left( \frac{Pa}{P_{std}} \right) \left( \frac{T_{std}}{T_a} \right)} - b \right)$	$Q_a = 1/m \left( \sqrt{\Delta H (T_a/Pa)} - b \right)$

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

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



## 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 : 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  $k=2$ , 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

Repeatability

Load test	100 g
Sidev.	0.00004 g

- o O o -

**Certificate of Calibration**

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

Submitted by : [Redacted]

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	SG-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:** E04NI99E15A00V3 **Reference Number:** 160-402021734-1

**Cylinder Number:** E00140762 **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. 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	12388	D685025	9391 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMIS	124298889	CC323797	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 ROM 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 NTKD579	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-S6610006  
Calibrated Date: 1-Oct-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 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 23.8 °C Humidity 67 %RH

**Calibration Report**

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.7	0.7	400.0	408.0	1.0
After	0.0	0.4	0.4	400.0	403.0	0.4

Single Point Calibration Chart

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**SO2 Analyzer Verification Test Report**

Calibration Report No.: AP-S6610006  
Calibrated Date: 1-Oct-23  
☒ PM ☐ Onsite

Page: 2/2

Date	1-Oct-23				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.8	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	32.6	
HVPS	400-800 constant	V	719	648	
IVPSR	2500 (+/- 200)	mV	-	-	
CELL TEMP	50 (+/- 1)	Dragee C	50	50	
BOX TEMP	20-40	Dragee C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Dragee C	8.0	8.0	
UV lamp	1000-4800	mV	4034.0	4034.0	
Lamp Ratio	30-120	%	114.0	114.0	
BTR 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	
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	%	0.920	0.898	
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	0.8	0.2	
Zero Gas (0.00 PPB)	0	ppb	0.7	0.4	
Span Gas (400 PPB)	400	ppb	408.0	403.0	± 5% of Range

his report



### SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6610005

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

#### Instruments Information

Page: 1/2

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

#### Calibration System

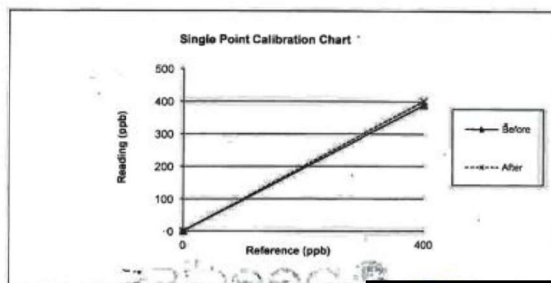
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31, 2026 EBO160267

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	0.9	0.9	400.0	389.0	-1.4
After	0.0	0.2	0.2	400.0	401.0	0.1



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### SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6610005

Calibrated Date: 1-Oct-23

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Date	1-Oct-23			
Time	13:10			
Range	50 - 20000	PPB	500	500
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2
Sample Flow	850 (+/- 50)	cc/min	863	699
PMT Detector	0 - 5000	mV	38.5	34.5
Norm PMT Detector	0 - 5000	mV	34.1	32.8
HVPS	400-900 constant	V	719	948
PCPS	2500 (+/- 200)	mV	-	-
CELL TEMP	50 (+/- 1)	Dragee C	50	50
BOX TEMP	20-40	Dragee C	34.1	32.7
PMT TEMP	7 (+/- 1)	Dragee 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
PMT Volts	2000 (+/- 500)	mV	2004	2020
SO2 Conc	1000 (+/- 250)	PPB	1002	1010
SO2 Slope	1 (+/- 0.3)	-	0.820	0.866
SO2 Offset	< 250	mV	65	130.1
Stability at Zero	< 0.2	PPB	0.1	0.1
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2
Zero Gas (0.00 PPB)	0	ppb	0.9	0.2
Span Gas (400 PPB)	400	ppb	389.0	401.0
				± 5% of Range

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### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610006

Page:1/1

Calibrated Date: 1-Oct-23

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#### Instruments Information

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

#### Calibration System

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

Environment: Temperature 24.3 °C

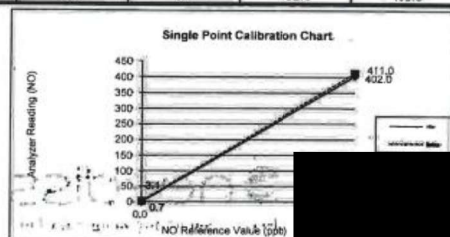
Humidity: 53 %RH

#### Calibration Check ( Before adjust )

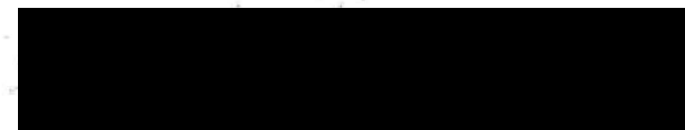
GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.8	0.0	2.8	407.3	400.0	0.9
NO <sub>2</sub>	0.3	0.0	0.3	3.7	0.0	0.5
NOx	3.1	0.0	3.1	411.0	400.0	1.4

#### Calibration Check ( After adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.5	0.0	0.5	400.1	400.0	0.0
NO <sub>2</sub>	0.2	0.0	0.2	1.9	0.0	0.2
NOx	0.7	0.0	0.7	402.0	400.0	0.2



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### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610006

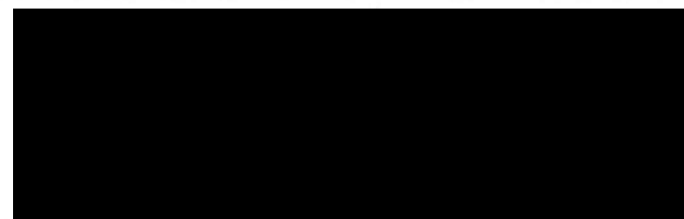
Page:1/1

Calibrated Date: 1-Oct-23

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Date	1-Oct-23				
Time	11:25				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	500 +/- 50	cc/min	500	490	
Ozone Flow	60-90	cc/min	88	80	
PMT Detector	0-5000	mV	50.9	20.4	
AZERO	20-150	mV	48.3	48.1	
HVPS	400-800 constant	V	745	745	
DCPS	2500 +/- 200	mV	-	-	
ROCELL TEMP	50 +/- 1	Degree C	50.0	50.0	
BOX TEMP	20-35	Degree C	33.2	32.8	
PMT TEMP	7 +/- 1	Degree C	7.2	7.2	
I/ZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	313.3	314.5	
ROCELL PRES	4-10 constant	IN-Hg-A	3.7	3.7	
SAMP PRES	20-30 constant	IN-Hg-A	28.3	28.7	
NO Slope	1 +/- 0.3		1.025	1.176	
NOx Slope	1 +/- 0.3		1.066	1.153	
NO Offset	-10 to +150	mV	8.7	-1.8	
NOx Offset	-10 to +150	mV	2.1	2.8	
Zero Value	NO	0	ppb	2.8	0.5
	NOx	0	ppb	3.1	0.7
Span Value	NO	400	ppb	407.3	400.1
	NOx	400	ppb	411.0	402.0



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### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610005

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Calibrated Date: 1-Oct-23

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#### Instruments Information

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

Calibrator Unit	Standard Gas
Dilutor Model ESA 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 EB0160257

Environment: Temperature 24.5 °C

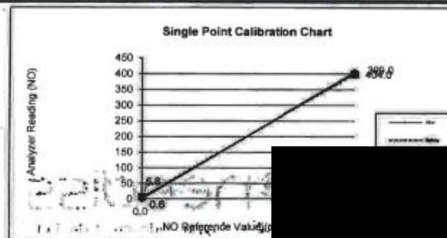
Humidity: 53 %RH

#### Calibration Check ( Before adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.2	0.0	3.2	390.1	400.0	-1.3
NO <sub>2</sub>	2.6	0.0	2.6	8.9	0.0	1.1
NOx	5.8	0.0	5.8	399.0	400.0	-0.1

#### Calibration Check ( After adjust )

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.3	0.0	0.3	402.0	400.0	0.2
NO <sub>2</sub>	0.3	0.0	0.3	2.0	0.0	0.2
NOx	0.6	0.0	0.6	404.0	400.0	0.5



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### NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610005

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Calibrated Date: 1-Oct-23

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Date	1-Oct-23				
Time	9:25				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	491	485	
Ozone Flow	80-90	cc/min	80	80	
PMT Detector	0-5000	mV	85.0	25.0	
AZERO	-20-150	mV	94.5	14.5	
HVPS	400-900 constant	V	734	734	
OCPS	2500 +/- 200	mV	-	-	
CELL TEMP	50 +/- 1	Degree C	50	50	
BOX TEMP	20-35	Degree C	34.7	33.8	
PMT TEMP	7 +/- 1	Degree C	7.0	7.0	
UZS TEMP	55 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	314.0	314.0	
CELL PRES	4-10 constant	IN-Hg-A	5.9	5.9	
SAMP PRES	20-30 constant	IN-Hg-A	29.8	27.8	
NO Slope	1 +/- 0.3		1.135	1.197	
NOx Slope	1 +/- 0.3		1.260	1.114	
NO Offset	-10 to +150	mV	0.8	-3.8	
NOx Offset	-10 to +150	mV	-2.8	6.1	
Zero Value	NO	0	ppb	3.2	0.3
	NOx	0	ppb	5.8	0.6
Span Value	NO	400	ppb	390.1	-402.0
	NOx	400	ppb	399.0	404.0

This report

**CO Analyzer Verification Test Report**

Calibration Report No.: AP-C6610007  
Calibrated Date: 1-Oct-23  
☒ PM ☐ Onsite

**Instruments Information** Page:1/2

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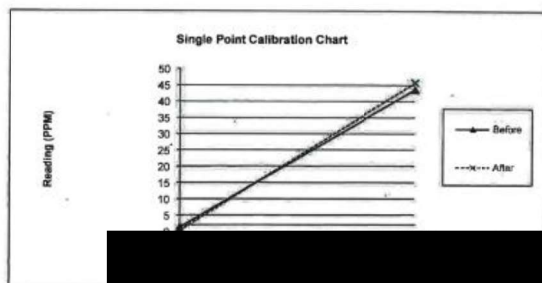
**Calibration System**

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

Environment: Temperature 24.8 °C Humidity 62 %RH

**Calibration Report**

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.20	1.2	45.3	43.6	-2.0
After	0.0	0.23	0.2	45.0	45.7	0.8



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**CO Analyzer Verification Test Report**

Calibration Report No.: AP-C6610007  
Calibrated Date: 1-Oct-23  
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Page:2/2

Date	1-Oct-23				
Time	11:00				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.73	1.11	
CO Measure	2500 - 4800 MV <sub>e</sub>	mV	2913.3	2923.5	
CO Reference	2500 - 4800 MV <sub>e</sub>	mV	2444.3	2421.4	
MR Ratio	1.2 +/- 0.5		1.18	1.21	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	-29.1	29	
Sample Flow	720 - 880 cc/min	cc/min	890	886	
Sample Temp	44 - 52 deg.C	deg.C	50.3	50.4	
Bench Temp	47 - 49 deg.C	deg.C	48	48	
Wheel Temp	66 - 70 deg.C	deg.C	68.3	68.4	
Box Temp	27 - 50 deg.C	deg.C	35.2	35.1	
PHT drive	250 - 4750 mv <sub>e</sub>	mV	3323.4	3353.6	
Slope	0.800 - 1.200		1.051	1.112	
Offset	0.05 +/- 0.2		0.088	0.088	
Zero Gas	0	PPM	1.2	0.2	
Span Gas	45	PPM	43.6	45.7	± 5% of Range

this report



## CO Analyzer Verification Test Report

Calibration Report No.: AP-C6610006

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

### Instruments Information

Page:1/2

Analyzer Type: CO Analyzer Model: 300E	Manufacturer API S/N: ECOAI300E00225
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### Calibration System

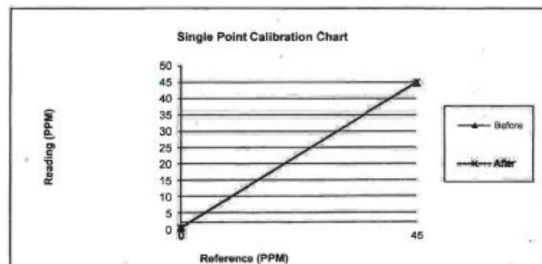
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 48.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.8 °C

Humidity: 62 %RH

### Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.4	0.4	45.0	44.9	-0.1
After	0.0	0.3	0.3	45.0	45.0	0.0



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## CO Analyzer Verification Test Report

Calibration Report No.: AP-C6610006


Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

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Date	1-Oct-23				
Time	15:40:00 AM				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.3	0.4	
CO Measure	2500 - 4800 mV	mV	3467.3	3375	
CO Reference	2500 - 4800 mV	mV	3005.8	2932.1	
MR Ratio	1.2 +/- 0.5		1.16	1.16	
Sample Pressure	26 - 30 in-Hg-A	In-Hg-A	29.3	29.2	
Sample Flow	720 - 880 cc/min	cc/min	876	874	
Sample Temp	44 - 52 deg.C	deg.C	49.3	49.1	
Bench Temp	47 - 49 deg.C	deg.C	48	48	
Wheel Temp	66 - 70 deg.C	deg.C	67.8	68.3	
Box Temp	27 - 50 deg.C	deg.C	32.6	30.2	
PHT drive	250 - 4750 mV	mV	3050.1	3074.2	
Slope	0.800 - 1.200		1.218	1.181	
Offset	0.05 +/- 0.2		0.031	0.029	
Zero Gas	0	PPM	0.4	0.3	
Span Gas	45	PPM	44.9	45.0	± 5% of Range


this report




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

### CALIBRATION CERTIFICATE

Submitted by 

Address 

Calibrated at 

**Instrument Calibrated :**

Description : Sound Level Calibrator

Manufacturer : Bruel & Kjaer

Model : 4230

Serial No. : 1351075

**Ambient Environment**

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

**Standards used :**

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.

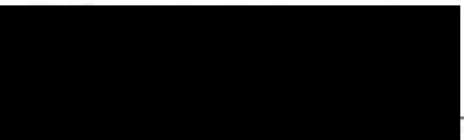
Date of Receipt : 14 Mar. 2023

Date of Calibration : 16 Mar. 2023



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 TSTR.



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 Bruel&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 Bruel&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 Bruel&Kjaer 4180	1.05	± 0.50	±3.0%

Date of Issue : 17 Mar. 2023

Ref : 2011266031401056001

End of Certificate



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Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 21 February, 2023

Certification No. 068/23

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2501

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1011.6 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

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

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

### The Result of Calibration

Sensor model EWSNV110WS2501

Certification No. 068/23

21 February, 2023

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	"	"	"	0.3	0.70
3.02	"	"	"	2.5	0.52
5.00	"	"	"	4.9	0.10
7.04	"	"	"	6.9	0.14
9.02	"	"	"	8.9	0.12
11.01	"	"	"	10.8	0.21
13.01	"	"	"	12.8	0.21
15.01	"	"	"	14.8	0.21
17.02	"	"	"	17.1	-0.08
20.02	"	"	"	21.0	-0.98

Wind Aloft Plotting Board.

US.DEPARTMENT OF COMMERCE WEATHER BUREAU

WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180

### The Result of Calibration

Sensor model EWSNV110WS2501

Certification No. 068/23

21 February, 2023

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1015.44	1015.32	0.12
1012.89	1013.30	-0.41
1012.80	1012.71	-0.11
1012.46	1012.41	0.05
1011.79	1011.81	-0.02
1011.30	1011.21	0.09
1009.87	1009.71	0.16
1009.66	1008.42	0.24
1009.40	1009.12	0.28
1008.71	1008.52	0.19
1009.00	1008.82	0.18
1009.28	1009.12	0.16
1009.94	1009.71	0.23
1010.66	1010.61	0.05
1011.21	1011.21	0.00
1013.01	1013.60	-0.59
1013.40	1013.90	-0.50
1012.91	1013.30	-0.39
1012.44	1012.70	-0.26
1008.09	1007.92	0.17

### The Result of Calibration

Sensor model

EWSNV110WS2501

Certification No. 068/23

21 February, 2023

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.1	44.8	0.3
30.2	30.1	0.1
15.6	15.5	0.1





**THAI METEOROLOGICAL DEPARTMENT**

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

**The Result of Calibration**

Sensor model EWSNV110WS2501 Certification No. 068/23

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Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
88.5	85.3	3.2
61.4	58.5	2.9
41.2	39.4	1.8



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**ใบรับรอง**

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน อีห้อ Davis แบบ TIPPING BUCKET  
ID No. E [REDACTED] ทำการสอบเทียบกับแก้วฝนแบบแก้วดวง GAUGE  
DIAMETER 8.0 INCHES , NEGRETTI & ZAMMARELLI  
สามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของ [REDACTED]

## Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 21 February, 2023

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Object : เครื่องมือตรวจวัดอุณหภูมิตัว

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130148 ID No. : EWSDCMS1200148

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 1010.1 hPa

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

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

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

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

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

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

## The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 064/23

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Serial No. 1222

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Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425		TESTED ANEMOMETER		
	Pressure Inches H2O	Vacuum Inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.9	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	-	-	-	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	
270	

### The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6273

Certification No. 064/23

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Standard Barometer Pressure	Tested Barometer Pressure	Correction
1015.44	1015.9	-0.46
1012.89	1013.3	-0.41
1012.60	1013.0	-0.40
1012.46	1012.9	-0.44
1011.79	1012.2	-0.41
1011.30	1011.8	-0.50
1009.87	1010.3	-0.43
1009.66	1010.1	-0.44
1009.40	1009.9	-0.50
1008.71	1009.2	-0.49
1009.00	1009.4	-0.40
1009.28	1009.7	-0.42
1009.94	1010.3	-0.36
1010.66	1011.1	-0.44
1011.21	1011.6	-0.39
1013.01	1013.4	-0.39
1013.40	1013.7	-0.30
1012.91	1013.2	-0.29
1012.44	1012.8	-0.36
1008.09	1008.5	-0.41

Average

### The Result of Calibration

Sensor Temperature Model TPH-1 C

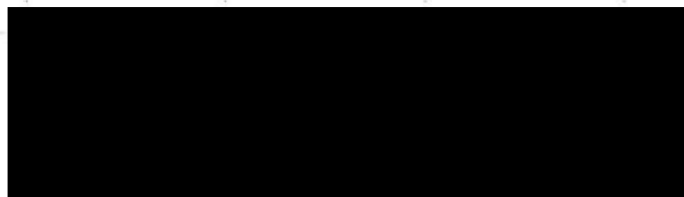
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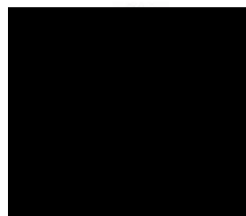
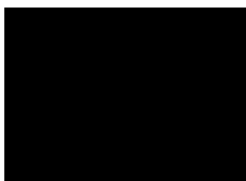
Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.1	45.0	0.1
30.2	30.1	0.1
15.6	15.6	0.0



### The Result of Calibration

Sensor Humidity Model TPH-1 C      Certification No. 064/23  
21 February, 2023      Serial No. 6273      Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
88.5	82.2	6.3
61.4	57.4	4.0
41.2	38.6	2.6



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### ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ Davis แบบ TIPPING BUCKET  
Model 7342.026 ID No.EWSCMS1200148 ทำการสอบเทียบกับแก้วฝนแบบแก้วดวง  
GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No 71082  
และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของ

