

ภาคผนวกที่ 5

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

ภาคผนวกที่ 5-1
เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
ครั้งที่ 3/2565
โรงเรียนแสงหิรัญ
วันที่ตรวจวัดวันที่ 20-25 มกราคม 2566
และสถาบันการบินพลเรือน
วันที่ตรวจวัดวันที่ 24-28 มกราคม 2566



TSP High Volume Sampler Calibration

Verification Report No.
SO2200264-E001 -TSP 05

☒ PM ☐ Onsite
Site: โรงโม่แฉ่งวิทย
UTM: 47P N 1516345 E 672665
Sampler: ETSP#33
Recorder: ECRDS016187156
Date: 20 Jan 23
Technical:
Approval:
589

CONDITIONS

Barometric Press. (hPa): 1010.0
Temperature (deg C): 32.0
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0
Corrected Pressure (mm Hg): 757.6
Temperature (deg K): 305.0
Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

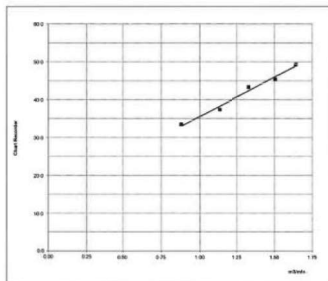
CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.12	1.634	52.0	51.32
2	9.42	1.505	48.0	47.37
3	7.33	1.330	44.0	43.42
4	5.29	1.132	38.0	37.50
5	3.12	0.874	34.0	33.55

LINEAR REGRESSION
Slope = 23.7015
Intercept = 11.9409
Corr. coeff. = 0.9929
of Observations: 5
Range of Chart at 1.1 - 1.7 m3/min: 39
52



Calibrated by:
20 January 2023

Approved by:
20 January 2023



TSP High Volume Sampler Calibration

Verification Report No.
SO2200264-E001 -TSP 06

☐ PM ☒ Onsite
Site: สถานีการันพลเรือน
UTM: 47P N 1526251 E 667883
Sampler: ETSP#42
Recorder: ECRDS016187130
Date: 20 Jan 23
Technical:
Approval:
589

CONDITIONS

Barometric Press. (hPa): 1010.0
Temperature (deg C): 32.0
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0
Corrected Pressure (mm Hg): 757.6
Temperature (deg K): 305.0
Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

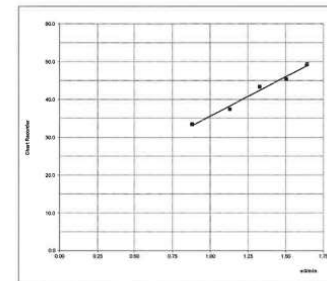
CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.22	1.712	52.0	51.32
2	9.42	1.505	48.0	47.37
3	7.33	1.330	44.0	43.42
4	5.29	1.132	38.0	37.50
5	3.26	0.893	34.0	33.55

LINEAR REGRESSION
Slope = 22.4502
Intercept = 12.7310
Corr. coeff. = 0.9926
of Observations: 5
Range of Chart at 1.1 - 1.7 m3/min: 36
51



Calibrated by:
20 January 2023

Approved by:
20 January 2023

PM10 High Volume Sampler Calibration

Verification Report No. SO2200264-E001 -PM 05

L. PM C. Onsite
Site: โรงเรียนอัสสัมชัญ
UTM : 47P N 1516345 E 672865
Sampler: EPM32
Recorder: ECRD5016187132
Date: 20 Jan 23
Technical:
Approval:

CONDITIONS

Barometric Press. (hPa): 1010.0
Temperature (deg C): 32.0
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0
Corrected Pressure (mm Hg): 757.6
Temperature (deg K): 305.0
Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.69	1.644	50.0	31.73
2	8.45	1.464	46.0	30.46
3	6.72	1.308	44.0	27.92
4	4.51	1.075	38.0	24.11
5	3.36	0.930	34.0	21.57

LINEAR REGRESSION
Slope = 14.6743
Intercept = 8.3132
Corr. coeff = 0.9912
SFR = 1.141
SSP = 39.49
of Observations: 5
Range of Chart at SFR ±10%: 38 to 41

Calibrated by :
20 January 2023
Approved by :
20 January 2023

PM10 High Volume Sampler Calibration

Verification Report No. SO2200264-E001 -PM 06

L. PM C. Onsite
Site: สถานีรถไฟฟ้ามหานคร
UTM : 47P N 1526251 E 667883
Sampler: EPM31
Recorder: ECRD5016187182
Date: 20 Jan 23
Technical:
Approval:

CONDITIONS

Barometric Press. (hPa): 1010.0
Temperature (deg C): 32.0
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0
Corrected Pressure (mm Hg): 757.6
Temperature (deg K): 305.0
Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.11	1.600	50.0	31.73
2	8.11	1.435	46.0	29.19
3	6.21	1.258	42.0	26.65
4	4.23	1.041	38.0	24.11
5	3.43	0.939	34.0	21.57

LINEAR REGRESSION
Slope = 14.6796
Intercept = 8.2367
Corr. coeff = 0.9955
SFR = 1.141
SSP = 39.37
of Observations: 5
Range of Chart at SFR ±10%: 38 to 41

Calibrated by :
20 January 2023
Approved by :
20 January 2023



Verification Test Report

Report No.:

SO2200265-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1513645 E 672865

Calibrated Date: 20 January 2023

Site : โรงเรียนแสงหิรัญ

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 2122

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No.1351075

Date of Calibration : 21 March 2022

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.66	93.62	-0.04	93.66

Calibrated By: [Signature]

Date: 20 January 2023

Approve By: [Signature]

Date: 20 January 2023

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Verification Test Report

Report No.:

SO2200265-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1526262 E 667877

Calibrated Date: 23 January 2023

Site : สถานีการันนพลเรือน

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 2205

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No.1351075

Date of Calibration : 21 March 2022

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.66	93.67	0.01	93.66

Calibrated By: [Signature]

Date: 23 January 2023

Approve By: [Signature]

Date: 23 January 2023

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

Certificate of Calibration

Calibration Certification Information						
Cal. Date:	January 18, 2023	Rootmeter S/N:	438320	Ta:	294	°K
Operator:				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	
Vstd=ΔVol/(Pa-ΔP)/Pstd(Tstd/Ta)	Va=ΔVol/(Pa-ΔP)/Pa
Qstd=Vstd/ΔTime	Qa=Va/ΔTime

For subsequent flow rate calculations:

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

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

Standard Conditions

Tstd: 298.15 °K

Pstd: 760 mm Hg

Key

ΔH: calibrator manometer reading (in H2O)

ΔP: rootmeter manometer reading (mm Hg)

Ta: actual absolute temperature (°K)

Pa: actual barometric pressure (mm Hg)

b: intercept

m: slope

RECALIBRATION

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

METTLER TOLEDO

Accuracy Calibration Certificate

Customer

Company: XXXXXXXXXX

Address: XXXXXXXXXX

City: Bangkok Contact: XXXXXXXXXX

Zip / Postal: 10160

State / Province: Bangkok

Order Number:

Weighing Device

Manufacturer:	Mettler Toledo	Instrument Type:	Weighing Instrument
Model:	XSR2050U	Asset Number:	N/A
Serial No.:	B911383567	Terminal Model:	SRAT
Building:	N/A	Terminal Serial No.:	B911383567
Floor:	3	Terminal Asset No.:	N/A
Room:	8304		

Range	Max. Capacity	Readability (d)
1	81 g	0.00001g
2	220 g	0.0001 g

Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)

METTLER TOLEDO Work Instruction: CPW002/20

This calibration certificate contains measurements for As Found calibration. No As Left calibration was performed because the device was not modified after As Found calibration. Therefore, results for As Left correspond to As Found.

The sensitivity/span of the weighing instrument was adjusted before calibration with a built-in weight.

In accordance with EURAMET cg-18 (11/2015), the test loads were selected to reflect the specific use of the weighing device or to accommodate specific calibration conditions.

As Found	Temperature		Humidity	
	Start: 22.2 °C	End: 22.6 °C	Start: 58.3 %	End: 59.7 %

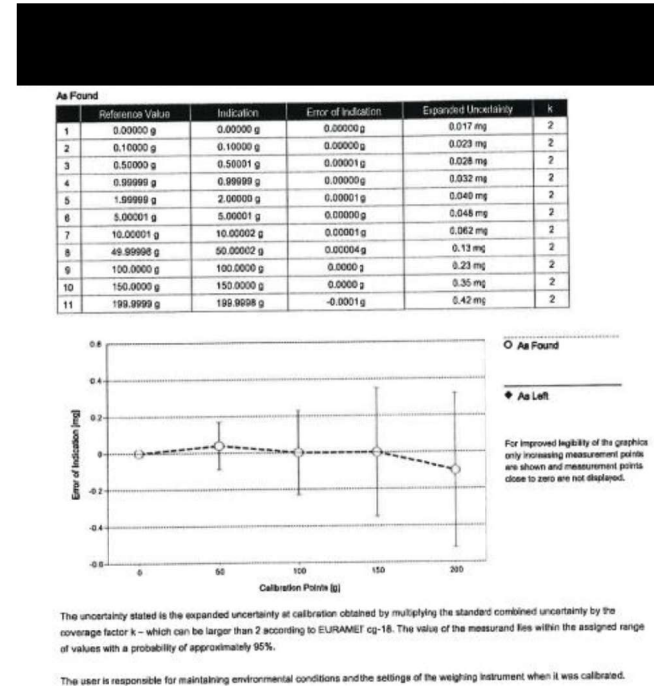
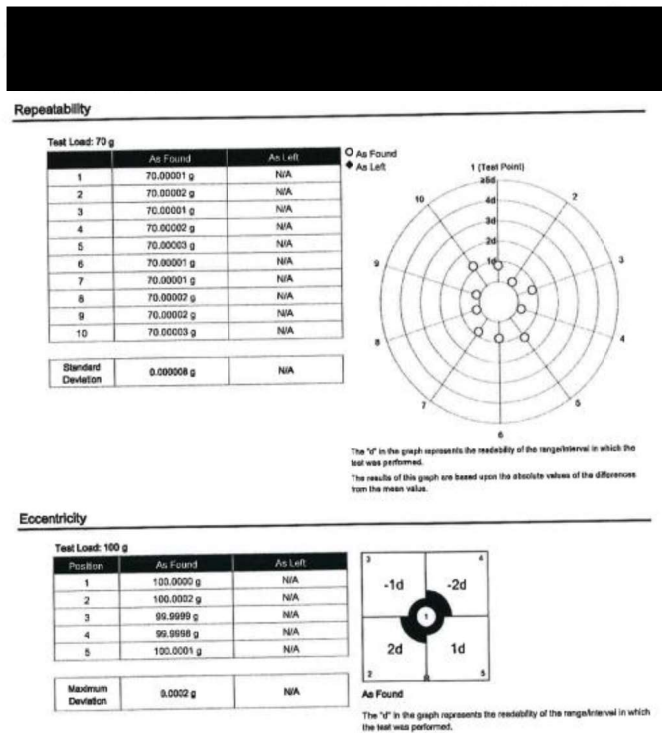
As Found Calibration Date: 02-Mar-2022

As Left Calibration Date: N/A

Issue Date: 03-Mar-2022

Calibration: XXXXXXXXXX

Approved Signatory: XXXXXXXXXX



Test Equipment

All weights used for metrological testing are traceable to national or international standards. The weights were calibrated and certified by an accredited calibration laboratory.

Weight Set 1: OIML E2

Weight Set No.:	WS22	Date of issue:	06-Jan-2022
Certificate Number:	177036	Calibration Due Date:	03-Jul-2023

Weight Set 2: OIML E2

Weight Set No.:	WS76	Date of issue:	31-Jan-2022
Certificate Number:	C205470237	Calibration Due Date:	12-Jul-2023

Thermo Hygrometer

Equipment No.:	IN199	Date of issue:	14-Jun-2021
Certificate Number:	21H1221	Calibration Due Date:	01-Jun-2022

Remarks

FACT adjustment functionality activated
Equipment condition: Good
Next calibration according to customer's procedure

End of Accredited Section

The information below and any attachments to this calibration certificate are not part of the accredited calibration.

Measurement Uncertainty of the Weighing Instrument in Use

Stated is the expanded uncertainty with $k=2$ in use. The formula shall be used for the estimation of the uncertainty under consideration of the errors of indication. The value R represents the net load indication in the unit of measure of the device.

Temperature coefficient for the evaluation of the measurement uncertainty in use: $1.5 \cdot 10^{-4} / K$

Temperature range on site for the evaluation of the measurement uncertainty in use: $3 K$

Linearization of Uncertainty Equation

Range		As Found		As Left	
	d	Min	Max		
1	0.00001 g	81 g	$U_1 = 0.018 \text{ mg} + 0.00497 \text{ mg/g} \cdot R$	N/A	N/A
2	0.0001 g	220 g	$U_2 = 0.06 \text{ mg} + 0.00492 \text{ mg/g} \cdot R$	N/A	N/A

To optimize the stability of the linearization, besides of the zero load only increasing measurement points with a test load of 5% of the measurement range or larger are taken for the calculation of the linear equation.

Absolute and Relative Measurement Uncertainty in Use for Various Net Indications (Examples)

Net indication	As Found		As Left	
0.00220 g	0.018 mg	0.81%	N/A	N/A
0.02200 g	0.018 mg	0.082%	N/A	N/A
0.22000 g	0.018 mg	0.0082%	N/A	N/A
2.20000 g	0.020 mg	0.0013%	N/A	N/A
220.0000 g	1.1 mg	0.00052%	N/A	N/A

As Found

As Left

The weighing range shown in the absolute uncertainty graph refers to the first interval range of the device.

Certificate of Calibration

Reference No. : 4182/2202-017 Certificate No. : L2203-290
Customer : [REDACTED] Page 1 of 2

Equipment : Digital Thermo-Hygrometer
Manufacturer : Testo
Model : 608-H1
Serial No. : 83353607
ID No. : -
Received Date : 7 March 2022
Calibrated Date : 9 March 2022
Issued Date : 15 March 2022

Environment	Start Calibration	Stop Calibration
Ambient Temperature (°C)	24.7	25.5
Relative Humidity (% RH)	51	52

Calibrated by : [REDACTED]

Calibration Method.
In-house method : by comparison with standard hygrometer for humidity measurement function and comparison with standard thermometer for temperature measurement function into humidity/temperature chamber

Condition of this result of calibration

- Reference standard instrument

Instrument	Model	Serial No.	Certificate No.	Due Date
1) Hygrometer	HL-NT2-D	61488576	QR21-0851	13 May 22
2) Digital Thermometer With Probe	GT11	06000089	PSL-T 0072/85	14 November 2022
- This result of calibration was found accurate as shown on date and place of calibration only
- This certificate can be traceable to International System of Unit :
 - Through Thailand Institute of Scientific And Technological Research (TISTR)
 - Through Quality Reborn Co.,Ltd.

Approved by : [REDACTED]

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

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Certificate No. : L2203-290 Page 2 of 2

Result of Calibration

Function : Humidity Measurement Reference Temperature at 25 °C

STD Reading (% RH)	UUC Reading (% RH)	UUC Error (% RH)	Measurement Uncertainty (±% RH)
50.00	49.0	-1.00	2.3

Function : Temperature Measurement

STD Reading (°C)	UUC Reading (°C)	UUC Error (°C)	Measurement Uncertainty (±°C)
25.012	25.0	-0.012	0.35

Resolution : 0.1 (°C) , 0.1 % RH
STD= Standard
UUC= Unit Under Calibration

** End of Calibration Report **

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N89E15A00V3 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: 650
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 procedure 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.

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

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	200811-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	±1.0%	Feb 02, 2025
PRM	12386	D665025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMS	124208889	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	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	±0.6%	Jun 07, 2024

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 5 N1KD579	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

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6601002

Calibrated Date: 5-Jan-23

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

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

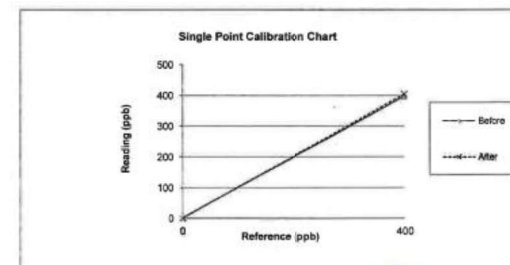
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NO Conc 44.66 PPM
ZERO AIR Generator ZAG7001 S/N: 644	SO2 Conc 45.34 PPM
	CO Conc 4500 PPM
	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.6 °C

Humidity: 70 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.5	1.5	400.0	397.0	-0.4
After	0.0	0.6	0.6	400.0	404.0	0.5



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SO2 Analyzer Verification Test Report

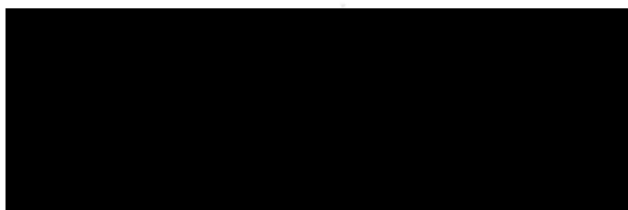
Calibration Report No.: AP-S6601002

Calibrated Date: 5-Jan-23

☒ PM ☐ Onsite

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	5-Jan-23				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
HVPS	400-900 constant	V	719	648	
DCPS	2500 (+/- 200)	mV	-	-	
CELL TEMP	50 (+/- 1)	Onesigma C	50	50	
BOX TEMP	20-40	Onesigma C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Onesigma C	8.0	8.0	
UV lamp	1000-4900	mV	4034.0	4034.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR. Light (Zero Gas)	<100	PPB	29	29	
Dark PMT	(-50) - (+200)	mV	44.7	44.7	
Dark lamp	(-50) - (+200)	mV	5.1	5.1	
SAMP PRES	20-30 constant	IN-Hg-A	28.1	27.8	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Cone	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.996	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	1.5	0.6	
Span Gas (400 PPB)	400	ppb	397.0	404.0	± 5% of Range



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6601003

Calibrated Date: 5-Jan-23

☒ PM ☐ Onsite

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

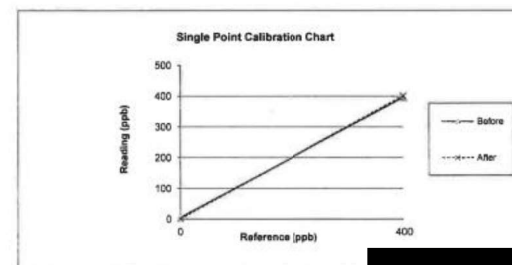
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NO Conc: 44.68 PPM
ZERO AIR Generator ZAG7001 S/N: 644	SO2 Conc: 45.34 PPM
	CO Conc: 4500 PPM
	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.5 °C

Humidity: 67 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	5.1	5.1	400.0	395.7	-0.5
After	0.0	0.9	0.9	400.0	401.0	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6601003

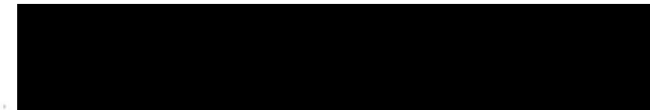
Calibrated Date: 5-Jan-23

☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	5-Jan-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	658	
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	648	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL TEMP	50 (+/- 1)	Dreagoe C	50	50	
BOX TEMP	20-40	Dreagoe C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Dreagoe C	8.0	8.0	
UV lamp	1000-4900	mV	4034.0	4034.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR Light (Zero Gas)	<100	PPB	29	29	
Dark PMT	(-50) - (+200)	mV	44.7	44.7	
Dark lamp	(-50) - (+200)	mV	5.1	5.1	
SAMP PRES	20-30 constant	IN-Hg-A	28.1	27.8	
Electric Test/OpSite Test					
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.886	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.8	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	5.1	0.9	
Span Gas (400 PPB)	400	ppb	395.7	401.0	± 5% of Range

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NOx Analyzer Verification Test Report

Calibration Report No.: SV-W6601001

Page: 1/1

Calibrated Date: 5-Jan-23

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Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer
Model: AC32e

Manufacturer: Environnement SA, France
S/N: NNOESAAC32E277

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 EBO140762

Environment: Temperature 25.6 °C

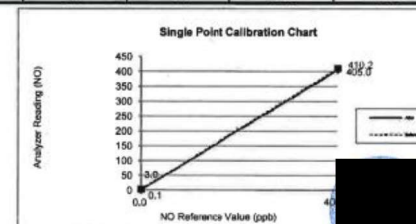
Humidity: 57 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.584	0.0	2.6	408.0	400.0	1.0
NO2	0.442	0.0	0.4	2.2	0.0	0.3
NOx	3.006	0.0	3.0	410.2	400.0	1.3

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.076	0.0	0.1	403.0	400.0	0.4
NO2	0.024	0.0	0.0	2.0	0.0	0.2
NOx	0.100	0.0	0.1	405.0	400.0	0.6



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NOx Analyzer Verification Test Report

Calibration Report No.: SV-W6601001

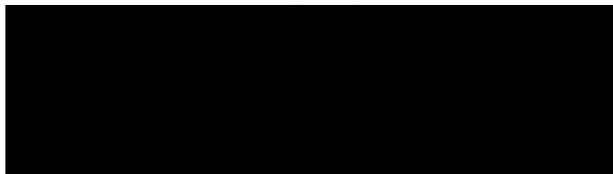
Page: 1/1

Calibrated Date: 5-Jan-23

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Analyzer Signal Values					
Date	5-Jan-23	Time	13:00		
Voltage					
+24 V (23-25)	24.0	V	+ 24V (1.5-3)	2.4	A
+12 V	12.0	V	I Peltier (0.5-1.2)	1.2	A
+5 V	5.0	V	I O3 (40-100)	90.7	mA
+4 V	4.0	V			
+3.3 V	3.3	V	PMT V (450-750)	633.0	V
Sensor					
Chamber T (39-61)	60.0	deg.C	Cham P(140-230)	199.0	hPa
Converter T (338-342)	340.0	deg.C	Sam P(850-1150)	992	hPa
Internal T (10-50)	30.5	deg.C	Flow (39-46)	40.00	Nl/h
PM T (-0.5-+0.5)	0.0	deg.C			
Calculation					
Dark PM sig(20-150)	79.66	mV			



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NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6601002

Page: 1/1

Calibrated Date: 5-Jan-23

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Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: AC32e	Manufacturer: Environnement SA, France S/N: NNOESAAC32E278
--	---

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

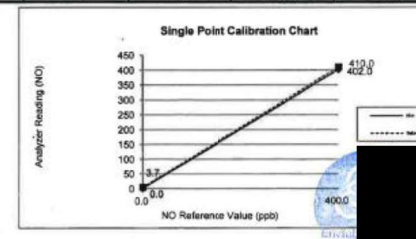
Environment: Temperature 25.7 °C Humidity 58 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.380	0.0	1.4	405.2	400.0	0.8
NO ₂	2.320	0.0	2.3	4.8	0.0	0.6
NOx	3.700	0.0	3.7	410.0	400.0	1.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.009	0.0	0.0	399.9	400.0	0.0
NO ₂	0.006	0.0	0.0	2.1	0.0	0.3
NOx	0.015	0.0	0.0	402.0	400.0	0.2



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NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6601002

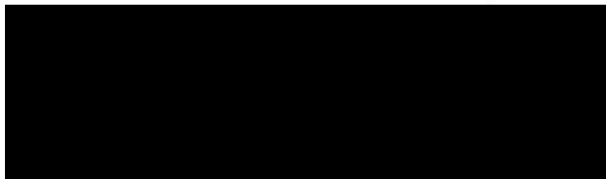
Page: 1/1

Calibrated Date: 5-Jan-23

☒ PM ☐ Onsite

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Analyzer Signal Values					
Date	5-Jan-23	Time	14:14		
Power Supplies					
Option	-13.52	mV	+5 V Sensor	4.99	V
+3.3 V	3.3	V	+24 V	23.96	V
+12 V	11.88	V	+5 V	4.99	V
+4 V	3974.3	mV	I+ 24V	2.4	A
I O3	62.74	mA			
Optical Bench					
Dark PM sig.	0.0	mV	PM NO sig.	84.28	mV
PM Nox sig.	107.0	mV	PM Ny sig.	86.71	mV
Sample					
Chamber T	60	deg.C	Internal Temp.	33.33	deg.C
Chamber P	1720.8	hPa	PM T.	1.48	deg.C
Flow	47.21	l/min	Sample Pr.	993.2	hPa



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6601002

Calibrated Date: 5-Jan-23

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Page: 1/2

Instruments Information

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

Calibration System

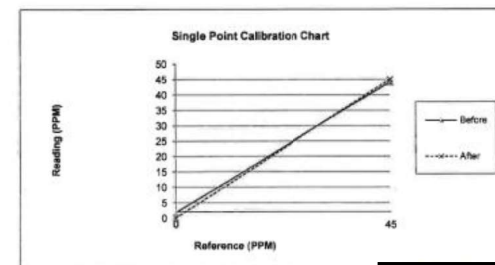
Calibrator Unit	Standard Gas
Dilutor Model ESA MGCT01	NO Conc 44.68 PPM
S/N: 792	SO2 Conc 45.34 PPM
ZERO AIR Generator ZAG7001	CO Conc 4500 PPM
S/N: 644	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.8 °C

Humidity: 69 %RH

Calibration Report

Status	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.704	1.7	45.0	44.20	-0.9
After	0.0	0.005	0.0	45.0	45.05	0.1



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CO Analyzer Verification Test Report

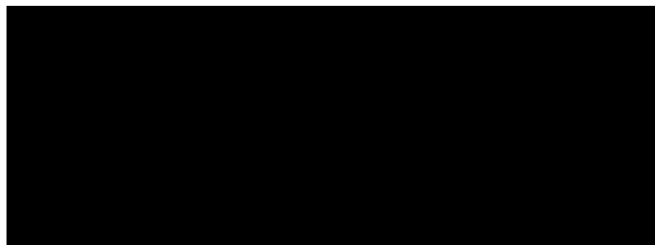
Calibration Report No.: ES-C6601002

Calibrated Date: 5-Jan-23

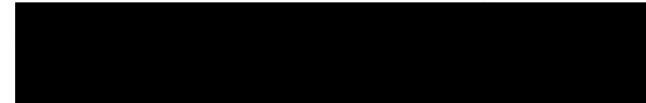
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Page:2/2

Analyzer Signal Values					
Date	5-Jan-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.	48.0	deg.C	Pbse T.	-24.2	deg.C
Measure sig.	506.4	mV	Refer Sig.	456.4	mV
Min sig.	945.0	mV	Max Sig.	2840	mV
Sample					
Inst. Ratio	1.109		Ratio	1.105	
Ref. ratio	1.109		Internal Temp.	28.9	deg.C
Source Temp.	46.0	deg.C	Gas Pressure	997	hPa
Up Pressure	947.0	hPa	Flow	59	l/h



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6601003

Calibrated Date: 5-Jan-23

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Page:1/2

Instruments Information

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

Calibration System

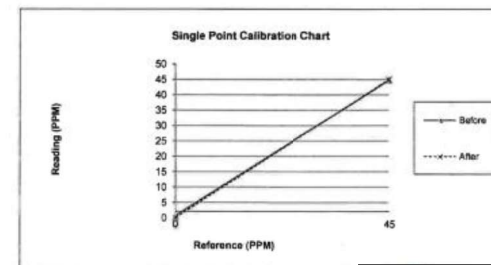
Calibrator Unit	Standard Gas
Dilutor Model ESA MGCT01	NO Conc 44.68 PPM
S/N: 792	SO2 Conc 45.34 PPM
ZERO AIR Generator ZAG7001	CO Conc 4500 PPM
S/N: 644	Expire Date: Feb 19,2024 EBO140782

Environment: Temperature 25.6 °C

Humidity: 67 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.691	0.7	45.0	44.74	-0.3
After	0.0	0.042	0.0	45.0	45.00	0.0



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CO Analyzer Verification Test Report

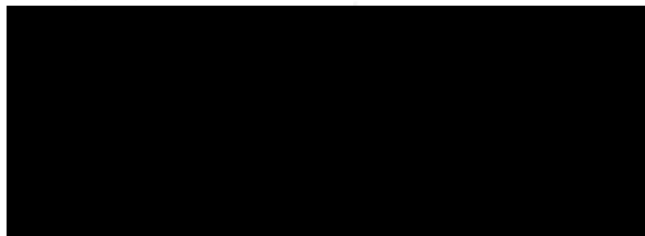
Calibration Report No.: ES-C6601003

Calibrated Date: 5-Jan-23

☒ PM ☐ Onsite

Page: 2/2

Analyzer Signal Values					
Date	5-Jan-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	Pose current	618.2	mV
Optical T _i	46.0	deg.C	Pose T _i	-24.2	deg.C
Measure sig.	508.4	mV	Refer Sig.	456.4	mV
Mn sig.	945.0	mV	Max Sig.	2840	mV
Sample					
inst. Ratio	1.109		Ratio	1.105	
Ref. ratio	1.109		Internal Temp.	28.9	deg.C
Source Temp.	46.0	deg.C	Gas Pressure	997	hPa
Up Pressure	947.0	hPa	Flow	59	l/h



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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0383

MTC No. EEL. BP. 59/0365

CALIBRATION CERTIFICATE

Submitted by

Address

Calibrated at

Instrument Calibrated :

Ambient Environment

Description : Acoustic Calibrator

Temperature : (23 ± 3) °C

Manufacturer : Bruel&Kjaer

Relative Humidity : (50 ± 15) %

Model : 4230

Ambient Pressure : (101.325 ± 1.500) kPa

Serial No. : 1351075

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

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

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

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

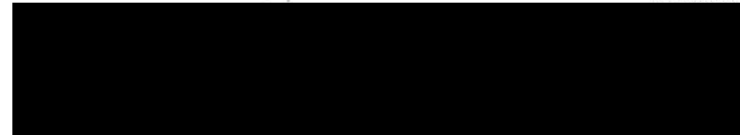
Date of Receipt : 10 Mar. 2022


Date of Calibration : 21 Mar. 2022

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.

FM.BLMTC.002 Rev.4





THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-65/0383 **MTC No.** EEL. BP. 59/0365

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

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

Acoustic Output in dB re 20 μ Pa, Corrected to Reference Conditions: 101.325 kPa, 23.0 °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	93.66	-0.34	± 0.10	± 0.40 dB


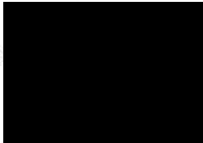
2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	997.8	-2.2	± 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	1.55	± 0.50	$\pm 3.0\%$

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

Calibrated by:  **Approved by:** 


Electrical and Electronic Standards Laboratory
Industrial Metrology and Testing Service Centre

Date of Calibration: 21 Mar. 2022
Date of Issue: 22 Mar. 2022
Ref: 2011265031501147002

End of Certificate 2 / 2

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PM/RL/MTC.002 Rev.4



Issued by: Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue: 30 June, 2022 **Certification No.** 255/22


Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิ

Manufacturer : NovaLynx

Type : Data Logger NDWD100

Serial No. : EWSNV110WS2505

Customer : 

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1003.8 hPa

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

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

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

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

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015



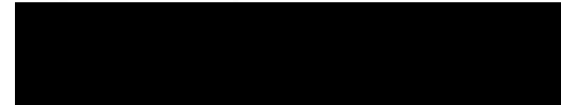
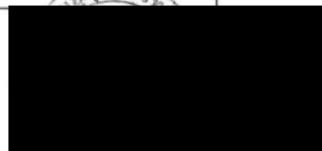
The Result of Calibration

Sensor model EWSNV110WS2505 Certification No. 255/22

30 June, 2022 Page : 2 of 6

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.4	0.62
5.00	-	-	-	4.7	0.30
7.04	-	-	-	6.9	0.14
9.02	-	-	-	8.9	0.12
11.01	-	-	-	10.9	0.11
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.1	-0.08
20.02	-	-	-	20.3	-0.28

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



The Result of Calibration

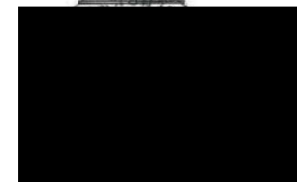
Sensor model EWSNV110WS2505

Certification No. 255/22

30 June, 2022 Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1001.48	1002.42	-0.94
1001.87	1002.92	-1.05
1002.41	1003.79	-1.38
1003.52	1004.67	-1.15
1004.06	1004.96	-0.90
1003.57	1004.38	-0.81
1003.92	1005.54	-1.62
1003.80	1005.22	-1.42
1003.76	1004.96	-1.20
1003.18	1004.67	-1.49
1003.38	1004.96	-1.58
1003.83	1005.54	-1.71
1004.26	1005.83	-1.57
1001.77	1002.92	-1.15
1001.35	1002.92	-1.57
1002.29	1003.50	-1.21
1002.77	1003.92	-1.15
1003.49	1004.50	-1.01
1004.14	1005.25	-1.11
1004.00	1004.79	-0.79

Average -1.24



The Result of Calibration

Sensor model EWSNV110WS2505 Certification No. 255/22
30 June, 2022 Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.7	45.8	-0.1
30.4	30.6	-0.2
15.6	15.7	-0.1

The Result of Calibration

Sensor model EWSNV110WS2505 Certification No. 255/22
30 June, 2022 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.20	79	6.2
64.10	60	4.1
45.20	42	3.2

Date of Issue 30 June, 2022

Certification No. 255/22

Page : 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชื่อ Davis แบบ TIPPING BUCKET
Model 7342.026 ID No.EWSNV110WS2505 ทำการสอบเทียบกับแก้วฝนแบบแก้ว
ดวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/
TIP)

วิศวกรชำนาญการ

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 30 June, 2022

Certification No. 254/22

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

Type : Data Logger NDWD100

Serial No. : EWSNV110WS2506

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1004.6 hPa

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

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

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

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

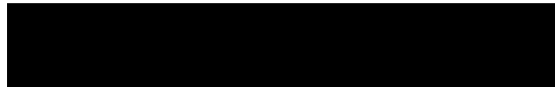
Serial Number 110730029 (sensor 120629586)

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

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

: Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015



The Result of Calibration

Sensor model EWSNV110WS2506 Certification No. 254/22

30 June, 2022

Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
	m/sec	inches H ₂ O	inches H ₂ O	m/sec	m/sec
1.00	-	-	-	0.7	0.30
3.02	-	-	-	2.8	0.22
5.00	-	-	-	4.9	0.10
7.04	-	-	-	7.1	-0.06
9.02	-	-	-	9.1	-0.08
11.01	-	-	-	10.1	0.91
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.2	-0.18

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



The Result of Calibration

Sensor model EWSNV110WS2506

Certification No. 254/22

30 June, 2022

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1001.48	1002.72	-1.24
1001.87	1003.01	-1.14
1002.41	1003.59	-1.18
1003.52	1004.76	-1.24
1004.06	1005.34	-1.28
1003.57	1004.47	-0.90
1003.92	1004.76	-0.84
1003.80	1004.47	-0.67
1003.76	1004.47	-0.71
1003.18	1003.89	-0.71
1003.38	1004.18	-0.80
1003.63	1004.47	-0.84
1004.26	1005.05	-0.79
1001.77	1002.43	-0.66
1001.35	1002.72	-1.37
1002.29	1003.30	-1.01
1002.77	1003.59	-0.82
1003.49	1004.16	-0.69
1004.14	1004.76	-0.62
1004.00	1003.30	0.70

Average -0.83



The Result of Calibration

Sensor model EWSNV110WS2506 Certification No. 254/22
30 June, 2022 Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.7	45.9	-0.2
30.4	30.6	-0.2
15.6	15.7	-0.1

The Result of Calibration

Sensor model EWSNV110WS2506 Certification No. 254/22
30 June, 2022 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.20	81	4.2
64.10	62	2.1
45.20	44	1.2

Date of Issue 30 June,2022

Certification No. 254/22

Page : 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝุ่น ชื่อ Davis แบบ TIPPING BUCKET
Model 7342.026 ID No.EWSNV110WS2506 ทำการสอบเทียบกับแก้วฝุ่นแบบแก้ว
ควง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/
TIP)

วิศวกรชำนาญการ

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
โรงเรียนแสงหิรัญและสถาบันการbinพลเรือน
ครั้งที่ 4/2565
ตรวจวัดวันที่ 21-26 เมษายน 2566

eVL

TSP High Volume Sampler Calibration

Verification Report No. SO2300073-E001 - TSP 01

☐ PM ☒ Onsite
Site: โรงเรียนสวนกุหลาบวิทยาลัย
UTM : 47P N 1518343 E 672863
Sampler: ETSP#15
Recorder: ECRDCPR4169240
Date: 21 Apr 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

Plate or Test #	H ₂ O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.73	1.633	56.0	53.80
2	10.36	1.536	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

LINEAR REGRESSION

Slope = 30.2583
Intercept = 3.8117
Corr. coeff. = 0.9979
of Observations: 5
Range of Chart: 39
at 1.1 - 1.7 m3/min: 57

Calibrated by: [Redacted]
21 April 2023

Approved by: [Redacted]
21 April 2023

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Environmental responsibility with accuracy measurement.

eVL

TSP High Volume Sampler Calibration

Verification Report No. SO2300073-E001 - TSP 02

☐ PM ☒ Onsite
Site: กรุงเทพมหานคร
UTM : 47P N 1526245 E 667874
Sampler: ETSP#16
Recorder: ECRANG15315224
Date: 21 Apr 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

Plate or Test #	H ₂ O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.22	1.667	52.0	49.96
2	9.14	1.444	46.0	44.20
3	7.47	1.307	40.0	38.43
4	4.77	1.048	32.0	30.74
5	2.98	0.832	26.0	24.98

LINEAR REGRESSION

Slope = 30.5848
Intercept = -0.9695
Corr. coeff. = 0.9980
of Observations: 5
Range of Chart: 35
at 1.1 - 1.7 m3/min: 53

Calibrated by: [Redacted]
21 April 2023

Approved by: [Redacted]
21 April 2023

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PM10 High Volume Sampler Calibration

Verification Report No. SO2300073-ED01 -PM 01

L: PM E: Onsite
Site: กรุงเทพมหานคร
UTM: 47P N 1516343 E 672863
Sampler: EPMW39
Recorder: ECRDS01618124
Date: 21 Apr 23
Technical:
Approval:

CONDITIONS

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

CALIBRATION ORIFICE

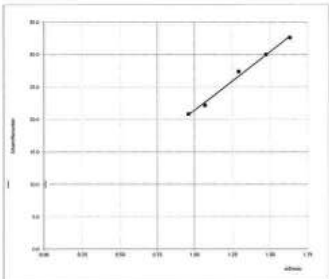
Brand: Tisch Environmental, Inc Slope: 1.27576
Model: TE-5025A Intercept: -0.02337
Serial#: 759 Date Certified: 18 Jan 23

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.00	1.634	50.0	32.59
2	8.11	1.473	46.0	29.98
3	6.21	1.291	42.0	27.37
4	4.23	1.069	34.0	22.16
5	3.43	0.964	32.0	20.86

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

Calibrated by:
21 April 2023
Approved by:
21 April 2023



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Environmental responsibility with accuracy measurement
16-0001-01 Rev.02/2016/01

PM10 High Volume Sampler Calibration

Verification Report No. SO2300073-ED01 -PM 02

L: PM E: Onsite
Site: กรุงเทพมหานคร
UTM: 47P N 1526245 E 667874
Sampler: EPMW22
Recorder: ECRDS01618125
Date: 21 Apr 23
Technical:
Approval:

CONDITIONS

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

CALIBRATION ORIFICE

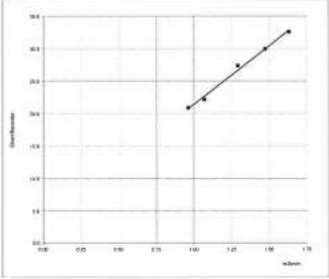
Brand: Tisch Environmental, Inc Slope: 1.27576
Model: TE-5025A Intercept: -0.02337
Serial#: 759 Date Certified: 18 Jan 23

CALIBRATIONS


Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	11.73	1.779	56.0	36.72
2	10.36	1.674	52.0	34.10
3	7.33	1.410	44.0	28.85
4	4.82	1.147	38.0	24.92
5	2.99	0.907	30.0	19.67

LINEAR REGRESSION
Slope = 18.9635
Intercept = 2.6326
Corr. coeff = 0.9979
SFR = 1.216
SSP = 39.23
of Observations: 5
Range of Chart at SFR ±10%: 37/42

Calibrated by:
21 April 2023
Approved by:
21 April 2023



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16-0001-01 Rev.02/2016/01



Verification Test Report

Report No.:
 SO2300073-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47° N 1516343 E 672863

Calibrated Date: 21 April 2023
Site : โรงเรียนแสงหิรัญ
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 0033

Environment: Temperature 25 °C Humidity 72 %RH

Reference Standard: Acoustic Calibrator Class 1 Model CB011,CESVA
 Serial No.T252953
 Date of Calibration : 02 December 2022

Result of Test


Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.92	93.57	-0.35	93.92

Calibrated By:
Date: 21 April 2023

Approve By:
Date: 21 April 2023

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ประกาศใช้ 01/02/2566
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Environmental Report



Verification Test Report

Report No.:
 SO2300073-E001 -SLM 02

☒ PM ☐ Onsite UTM : 47° N 1526246 E 667884

Calibrated Date: 21 April 2023
Site : การบินพลเรือน
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1973

Environment: Temperature 25 °C Humidity 72 %RH

Reference Standard: Acoustic Calibrator Class 1 Model CB011,CESVA
 Serial No.T252953
 Date of Calibration : 02 December 2022

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.92	93.70	-0.22	93.92

Calibrated By:
Date: 21 April 2023

Approve By:
Date: 21 April 2023

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www.evltesting.com
Environmental Report

**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: [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	
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
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 : SECURA125-1S

Serial No. : 0034606552 ID No. : ELABBALANCEN05

Capacity : 120 g Resolution : 0.0001 g

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

Ambient Temperature : (21.7 to 22.0) °C

Relative Humidity : (47.0 to 47.1) %

Air Pressure : (1015.0 to 1016.0) mbar

Date of Received : 01 March 2023

Date of Calibration : 01 March 2023

Date of Issue : 04 March 2023

Calibrated by : [REDACTED]

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

Edition 7 - November 2022

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

Standard Weights

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

The Uncertainties are for a confidence probability of approximately 95%

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CAL-P0031-03

Certificate of Calibration

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

Result of Calibration : [REDACTED]

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty ± (g)
0.1	0.0000	0.00003
0.5	0.0000	0.00004
1	0.0000	0.00005
2	0.0000	0.00009
5	0.0000	0.00010
10	0.0000	0.00002
20	0.0000	0.00010
50	0.0000	0.00012
100	0.0000	0.00020
120	-0.0001	0.00038

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

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%

Eccentric error

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

g

Repeatability

Load test	100 g
Sidev.	0.00004

g

- o O o -

CAL-P001T-03

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. : PONPES852094 ID No. : ELABTMHTC10003

Environment : Ambient Temperature : $(23 \pm 2) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$

Date of Received : 08 March 2023

Date of Calibration : 09 March 2023

Date of Issue : 09 March 2023

Calibrated by : [REDACTED]

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-00021/06	11 Jul 2023	Success Gateway Co., Ltd., Accredited by TISI Calibration No.0268

The Uncertainties are for a confidence probability of approximately 95%

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CAL-P001T-03

Certificate of Calibration

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

UUC Condition As-Received : Good

Result of Calibration : XXXXXXXXXX

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%

- o O o -

CERTIFICATE OF ANALYSIS
Grade of Product: EPA Protocol

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

Expiration Date: Feb 19, 2024

Certification performed in accordance with EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012) document EPA 820-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

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	KAL003190	49.87 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022
NTRM	08012341	KAL004718	4887 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 5 N1KD679	NDIR	Jan 27, 2021
Nicolet iS60 FTIR AJP2010246 NO	FTIR	Feb 11, 2021
Nicolet iS60 FTIR AJP2010245 NO2	FTIR	Jan 21, 2021
Nicolet iS60 FTIR AJP2010245 SO2	FTIR	Jan 21, 2021



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6604007

Calibrated Date: 1-Apr-23

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

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

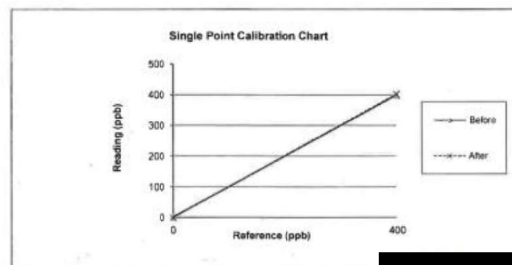
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 762 ZERO AIR Generator: ZAG7001 S/N: 644	NO Conc: 44.88 PPM SO2 Conc: 45.34 PPM CO Conc: 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 26.4 °C

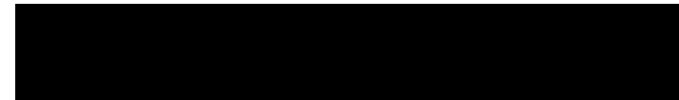
Humidity: 49 %RH

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	398.9	-0.1
After	0.0	0.1	0.1	400.0	402.0	0.2



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6604007

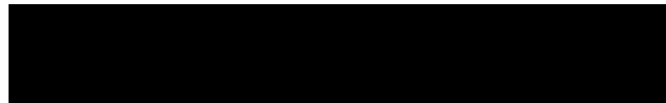
Calibrated Date: 1-Apr-23

☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-23				
Time	13:45				
Range	50 - 20000	PPB	500.0	505.0	
Stability (Zero Gas)	< 0.2	PPB	0.2	0.1	
Sample Flow	650 (+/- 50)	cc/min	592.0	591.0	
PMT Detector	0 - 10000	mV	255.6	61.0	
Norm PMT Detector	0 - 5000	mV	59.7	65.2	
H/PS	400-800 constant	V	607.0	607.0	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL TEMP	50 (+/- 1)	Degree C	50.0	50.0	
BOX TEMP	20-40	Degree C	34.0	34.1	
PMT TEMP	7 (+/- 1)	Degree C	8.0	8.9	
UV lamp	1000-4900	mV	1981.0	1981.0	
Lamp Ratio	30-120	%	82.6	82.6	
STR. Light (Zero Gas)	<100	PPB	61.5	61.7	
Dark PMT	(-50) - (+200)	mV	3.8	3.6	
Dark lamp	(-50) - (+200)	mV	56.5	57.0	
SAMP PRES	20-30 constant	IN-Hg-A	29.3	29.3	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	1682.0	2044.0	
SO2 Conc	1000 (+/- 250)	PPB	841.0	1022.0	
SO2 Slope	1 (+/- 0.3)	-	1.224	1.104	
SO2 Offset	< 250	mV	24.6	8.0	
Stability at Zero	< 0.2	PPB	0.2	0.2	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.2	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	0.9	0.1	
Span Gas (400 PPB)	400	ppb	398.9	402.0	± 5% of Range

This report



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6604005
Calibrated Date: 1-Apr-23

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API S/N: ESOAI100A01175
--	---

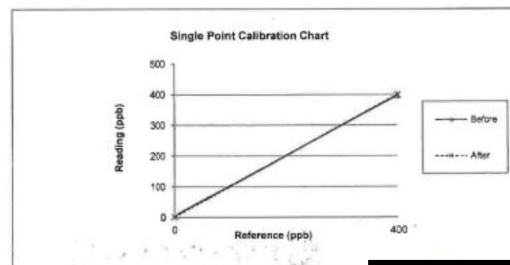
Calibration System

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

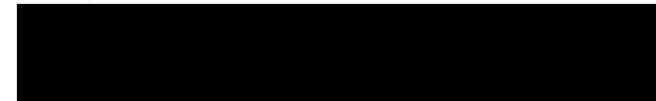
Environment: Temperature 26.4 °C Humidity 50 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	5.2	5.2	400.0	397.0	-0.4
After	0.0	0.7	0.7	400.0	400.1	0.0



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6604005
Calibrated Date: 1-Apr-23

☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-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	
H/PS	400-900 constant	V	719	644	
DCPS	2500 (+/- 200)	mV	-	-	
PCELL TEMP	50 (+/- 1)	Draeger C	50	50	
COX TEMP	20-40	Draeger C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Draeger 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	29.1	27.8	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	5.2	0.7	
Span Gas (400 PPB)	400	ppb	397.0	400.1	± 5% of Range

Fig 1



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6804002

Page:1/1

Calibrated Date: 1-Apr-23

☒ PM ☐ Onsite

Instruments Information

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

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 41.58 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19,2024 EB0140762

Environment: Temperature 26.5 °C

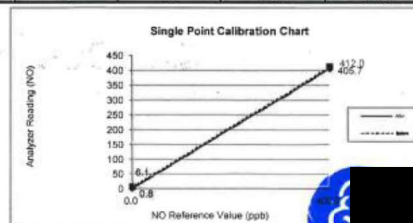
Humidity: 50 %RH

Calibration Check (Before adjust)

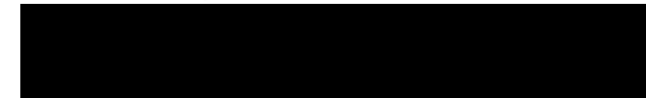
GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	4.0	0.0	4.0	410.5	400.0	1.3
NO ₂	2.1	0.0	2.1	1.5	0.0	0.2
NOx	6.1	0.0	6.1	412.0	400.0	1.5

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.3	0.0	0.3	403.0	400.0	0.4
NO ₂	0.5	0.0	0.5	2.7	0.0	0.3
NOx	0.8	0.0	0.8	405.7	400.0	0.7



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6804002

Page:1/1

Calibrated Date: 1-Apr-23

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Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-23				
Time	13:20				
Range	0.00 - 500.00 PPM	PPM	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPM	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	474.0	441.0	
Ozone Flow	60-90	cc/min	76.0	76.0	
PMT Detector	0-5000	mV	24.5	62.2	
AZERO	-20-150	mV	8.6	67.5	
HVPS	400-900 constant	V	839.0	836.0	
DCPS	2500 +/- 200	mV	-	-	
CELL TEMP	50 +/- 1	Deegree C	50.0	50.0	
BOX TEMP	20-35	Deegree C	34.5	30.5	
PMT TEMP	7 +/- 1	Deegree C	7.0	7.1	
ZIS TEMP	50 +/- 4	Deegree C	-	-	
MOLY Temp	315 +/- 5	Deegree C	315.0	314.4	
RGEL PRES	4-10 constant	IN-Hg-A	4.20	7.90	
DAMP 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	6.95	
NOx Offset	-10 to + 150	mV	-5.00	-1.50	

Span and Cal Values

Zero Value	NO	0	ppb	4.0	0.3
	NOx	9	ppb	6.1	0.8
Span Value	NO	400	ppb	410.5	403.0
	NOx	400	ppb	412.0	405.7

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6604003

Page: 1/1

Calibrated Date: 1-Apr-23

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

Environment: Temperature 26.5 °C

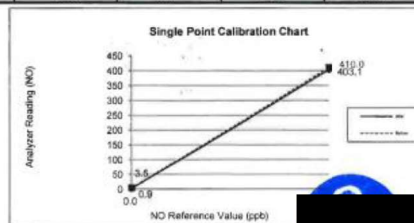
Humidity 50 %RH

Calibration Check (Before adjust)

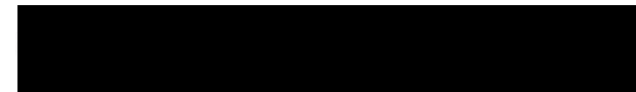
GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.1	0.0	3.1	408.0	400.0	1.0
NO ₂	0.4	0.0	0.4	2.0	0.0	0.2
NOx	3.5	0.0	3.5	410.0	400.0	1.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.5	0.0	0.5	401.2	400.0	0.1
NO ₂	0.4	0.0	0.4	1.9	0.0	0.2
NOx	0.9	0.0	0.9	403.1	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6604003

Page: 1/1

Calibrated Date: 1-Apr-23

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Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-23				
Time	13:30:50 AM				
Range	0.00 - 500.00 PPM	PPM	500	500	
Stability (Zero Gas)	< 0.2	PPM	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	505	460	
Ozone Flow	60-80	cc/min	79	72	
PMT Detector	0-5000	mV	26.2	29.3	
AZERO	20-150	mV	56.0	55.0	
HVPS	400-900 constant	V	755	755	
DCPS	2500 +/- 200	mV	-	-	
WCELL TEMP	50 +/- 1	Temperature C	50	50	
BOX TEMP	20-35	Temperature C	30.2	32.0	
PMT TEMP	7 +/- 1	Temperature C	7.2	7.2	
ZS TEMP	50 +/- 4	Temperature C	-	-	
MOLY Temp	315 +/- 5	Temperature C	315.0	315.0	
WCELL PRES	4-10 constant	Pressure kPa-A	4	5	
SAMP PRES	20-30 constant	Pressure kPa-A	29	29	
NO Slope	1 +/- 0.3		0.990	1.118	
NOx Slope	1 +/- 0.3		0.911	1.046	
NO Offset	-10 to +150	mV	12.9	2.2	
NOx Offset	-10 to +150	mV	-2.4	9.1	
Span and Cal Values					
Zero Value	NO	0	ppb	3.1	0.5
	NOx	0	ppb	3.5	0.9
Span Value	NO	400	ppb	408.0	401.2
	NOx	400	ppb	410.0	403.1

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6604002

Calibrated Date: 1-Apr-23

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Instruments Information

Page:1/2

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

Calibration System

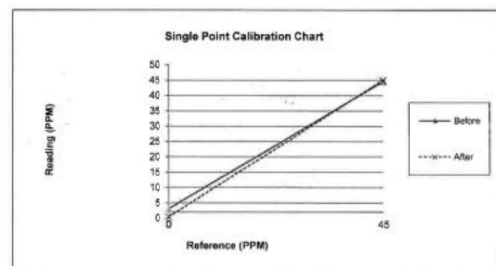
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19,2024 EB0140762

Environment: Temperature 24.4 °C

Humidity 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	3.010	3.0	45.0	44.54	-0.5
After	0.0	0.386	0.4	45.0	45.00	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6604002

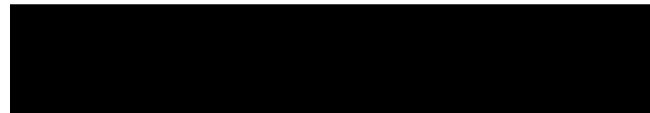
Calibrated Date: 1-Apr-23

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Analyzer Signal Values					
Date	1-Apr-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	Pbase current	618.2	mV
Optical T.	46.0	deg.C	Phsa 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

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6604003

Calibrated Date: 1-Apr-23

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Instruments Information

Page:1/2

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

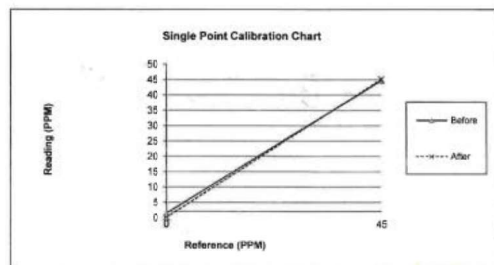
Calibration System

Calibrator Unit	Standard Gas
Dilutor Model: ESA MGC101 S/N: 792 ZERO AIR Generator: ZAG7001 S/N: 644	NO Conc: 41.56 PPM SO2 Conc: 45.34 PPM CO Conc: 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.4 °C Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.437	1.4	45.0	44.70	-0.3
After	0.0	0.060	0.1	45.0	45.08	0.1



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6604003

Calibrated Date: 1-Apr-23

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Page:2/2

Analyzer Signal Values					
Date	1-Apr-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.	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

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

CALIBRATION CERTIFICATE

Submitted by : 
Address : 
Calibrated at : 

Instrument Calibrated :	Ambient Environment
Description : Sound Level Calibrator	Temperature : $(23 \pm 3) ^\circ\text{C}$
Manufacturer : Bruel & Kjaer	Relative Humidity : $(50 \pm 15) \%$
Model : 4230	Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$
Serial No. : 1351075	

Standards used :

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

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


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

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

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



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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

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

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

Acoustic Output in dB re 20 μ Pa, Corrected to Reference Conditions : 101.325 kPa, 23.0 $^\circ$ C and 50 %RH

1. Sound Pressure Level

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

2. Frequency


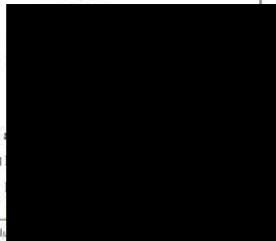
Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	999.0	-1.0	± 1.5	$\pm 1.0\%$

3. Total distortion

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

Note :

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

Calibrated by :  **Approved by :** 

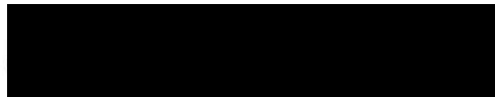
Date of Calibration : 16 Mar. 2023
Date of Issue : 17 Mar. 2023

Electrical
Industrial

End of Certificate

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FM.BLMTC.002 Rev.4

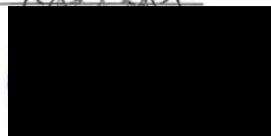


Issued by : Calibration & Test Section : Meteorological Instruments Bureau
Date of Issue : 2 September, 2022 Certification No. 316/22
Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา
Manufacturer : DYACON
Type : Data Logger CM-1
Serial No. : 130129 ID No. : NWSDCMS1200129
Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1010.3 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 120629596)
JAPAN QUALITY ASSURANCE ORGANIZATION : Standard Velocity at 0 - 20 m/sec
STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8369/94
: Thermoschneider No.918902
STANDARD BAROMETER : Digital Barometer Vaisala PTB220 No. 1923015

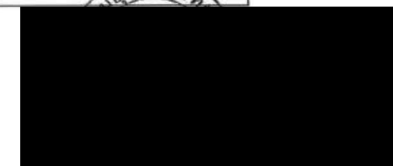


The Result of Calibration

Sensor model NWSDCMS1200129 Certification No. 316/22
2 September, 2022 Serial No. 1198 Page : 2 of 6

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacuum inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	2.9	0.12
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.9	0.14
9.02	-	-	-	8.9	0.12
11.01	-	-	-	11.0	0.01
13.01	-	-	-	12.9	0.11
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.1	-0.08

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



The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6235

Certification No. 316/22

2 September, 2022

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1010.31	1010.10	0.21
1010.60	1010.20	0.40
1010.38	1010.00	0.38
1010.23	1009.70	0.53
1009.93	1009.50	0.43
1009.66	1009.20	0.46
1009.41	1009.00	0.41
1009.13	1008.80	0.33
1008.96	1008.60	0.36
1008.58	1008.20	0.38
1008.25	1007.90	0.35
1007.57	1007.30	0.27
1007.27	1007.00	0.27
1007.04	1006.70	0.34
1006.63	1006.30	0.33
1010.02	1009.80	0.22
1008.77	1008.50	0.27
1008.67	1008.40	0.27
1007.63	1007.40	0.23
1007.40	1007.10	0.30

Average



The Result of Calibration

Sensor Temperature Model TPH-1 C

Certification No. 316/22

2 September, 2022

Serial No. 6235

Page : 4 of 6

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

The Result of Calibration

Sensor Humidity Model TPH-1 C Certification No. 316/22
2 September, 2022 Serial No. 6235 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.6	87.4	-1.8
60.4	61.2	-0.8
42.3	42.7	-0.4

Date of Issue 2 September, 2022

Certification No. 316/22

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ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชื่อ Davis แบบ TIPPING BUCKET
Model 7342.026 ID No.NWSDCMS1200129 ทำการสอบเทียบกับแก้วฝนแบบแก้ว
ดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/
TIP)

วิศวกรชำนาญการ



Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 21 February, 2023

Certification No. 064/23

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130148 ID No. : EWSDCMS1200148

Customer :



Calibration Condition : Temperature 25.1 °C Barometric Pressure 1010.1 hPa

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

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

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

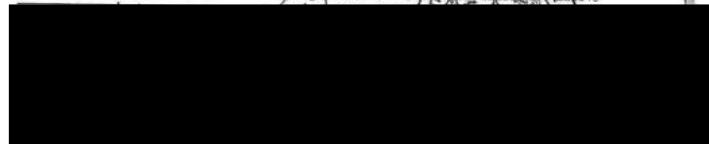
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)

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

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

: Thermoschneider No.918902

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No.1220015



The Result of Calibration

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

21 February, 2023

Serial No. 1222

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Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.9	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.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRECTION	TESTED WIND DIRECTION
0	0
90	90
180	180
270	



The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6273

Certification No. 064/23

21 February, 2023

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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
1012.48	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

0.45

The Result of Calibration

Sensor Temperature Model TPH-1 C

Certification No. 064/23

21 February, 2023

Serial No. 6273

Page : 4 of 6

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

Date of Issue 21 February, 2023

Certification No. 064/23

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ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ Davis แบบ TIPPING BUCKET
Model 7342.026 ID No.EWSDCMS1200148 ที่การสอบเทียบกับแก้วฝนแบบแก้วดวง
GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No 71082
และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 มม./TIP)

วิศวกรชำนาญการ