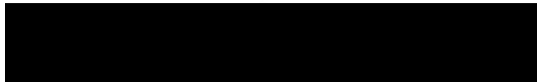


ภาคผนวกที่ 5

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

ภาคผนวกที่ 5-1

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
โรงเรียนแสงหิรัญและสถาบันการbinพลเรือน
ครั้งที่ 1/2565
วันที่ตรวจวัดวันที่ 4-9 สิงหาคม 2565



TSP High Volume Sampler Calibration

Verification Report No.
SO2200118-E001 -TSP 01

☐ PM ☒ Onsite
Site: โรงเรียนแสงอรุณ
UTM : 47P N 1516338 E 672861
Sampler: ETSP#34
Recorder: ECRANG016339508
Date: 4 Aug 22
Technical:
Approval:

CONDITIONS

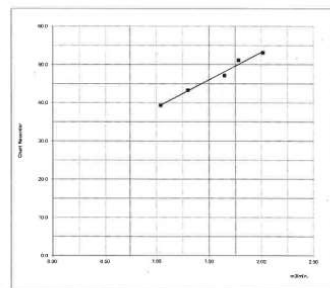
Barometric Press. (hPa): 1006.2
Temperature (deg C): 33.2
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0
Corrected Pressure (mm Hg): 754.7
Temperature (deg K): 306.2
Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc
Model: TE-5028A
Serial#: 1328
Gold Slope: 1.63957
Gold Intercept: -0.01202
Date Certified: 19 Jan 22

CALIBRATIONS

Plate or Test #	H2O (in)	Gold (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	11.22	2.016	54.0	53.09	Slope = 14.3952
2	8.76	1.782	52.0	51.12	Intercept = 24.3581
3	7.53	1.653	48.0	47.19	Corr. coeff. = 0.9910
4	4.65	1.300	44.0	43.26	
5	2.98	1.042	40.0	39.32	
# of Observations:					5
Range of Chart at 1.1 - 1.7 m3/min					41 49

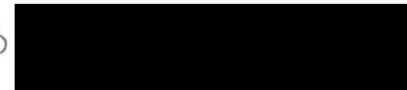


Calibrated by :
4 August 2022

Approved by :
4 August 2022

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01-0001-01 Rev.001/0001



PM10 High Volume Sampler Calibration

Verification Report No.
SO2200118-E001 -PM 01

☒ PM ☐ Onsite
Site: โรงเรียนแสงอรุณ
UTM : 47P N 1516338 E 672861
Sampler: EPM10#37
Recorder: ECRANG000053215
Date: 4 Aug 22
Technical:
Approval:

CONDITIONS

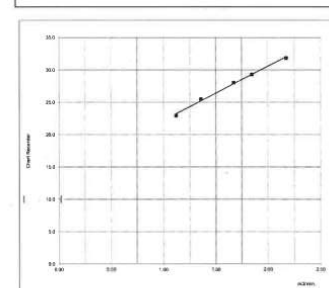
Barometric Press. (hPa): 1006.2
Temperature (deg C): 33.2
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0
Corrected Pressure (mm Hg): 754.7
Temperature (deg K): 306.2
Corrected Avg Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc
Model: TE-5028A
Serial#: 1328
Slope: 1.02667
Intercept: -0.00753
Date Certified: 19 Jan 22

CALIBRATIONS

Plate or Test #	H2O (in)	Gold (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	12.22	2.176	50.0	31.85	Slope = 8.3144
2	8.81	1.849	46.0	29.30	Intercept = 13.9143
3	7.24	1.677	44.0	28.03	Corr. coeff. = 0.9978
4	4.75	1.359	40.0	25.48	SFR = 1.150
5	3.21	1.119	36.0	22.93	SSP = 36.85
# of Observations:					5
Range of Chart at SFR ±10%					36 38



Calibrated by :
4 August 2022

Approved by :
4 August 2022

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01-0001-01 Rev.001/0001

evl

TSP High Volume Sampler Calibration

Verification Report No. SO2200118-E001 -TSP_02

☐ PM ☒ Onsite
Site: สถานีการันพลเรือน
UTM : 47P N 1526244 E 667885
Sampler: ETSP#41
Recorder: ECRANG15315224
Date: 4 Aug 22
Technical Approval: [Signature]

CONDITIONS

Barometric Press. (hPa): 1006.2 Corrected Pressure (mm Hg): 754.7
Temperature (deg C): 33.2 Temperature (deg K): 306.2
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 OFFICE

Brand: Tisch Environmental, Inc Qstd Slope: 1.63957
Model: TE-5028A Qstd Intercept: -0.01202
Serial#: 1326 Date Certified: 19 Jan 22

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.68	2.057	52.0	51.12
2	9.66	1.871	48.0	47.19
3	6.41	1.525	44.0	43.26
4	3.81	1.178	40.0	39.32
5	2.39	0.934	36.0	35.39

LINEAR REGRESSION
Slope = 13.2628
Intercept = 23.1895
Corr. coeff = 0.9954
of Observations: 5
Range of Chart at 1.1 - 1.7 m3/min: 39
46

Calibrated by: [Signature]
4 August 2022

Approved by: [Signature]
4 August 2022

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TE-5028-01 Rev. 01/2019

evl

PM10 High Volume Sampler Calibration

Verification Report No. SO2200118-E001 -PM_02

☐ PM ☒ Onsite
Site: สถานีการันพลเรือน
UTM : 47P N 1526244 E 667885
Sampler: EPMT0814
Recorder: ECRDS01618124
Date: 4 Aug 22
Technical Approval: [Signature]

CONDITIONS

Barometric Press. (hPa): 1006.3 Corrected Pressure (mm Hg): 754.8
Temperature (deg C): 33.1 Temperature (deg K): 306.1
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 OFFICE

Brand: Tisch Environmental, Inc Slope: 1.02667
Model: TE-5028A Intercept: -0.00753
Serial#: 1326 Date Certified: 19 Jan 22

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	11.82	2.140	54.0	34.39
2	8.57	1.823	50.0	31.84
3	6.22	1.554	46.0	29.29
4	4.61	1.339	42.0	26.75
5	2.93	1.069	38.0	24.20

LINEAR REGRESSION
Slope = 9.6626
Intercept = 13.9775
Corr. coeff = 0.9980
SFR = 1.149
SSP = 39.39
of Observations: 5
Range of Chart at SFR ±10%: 38
40

Calibrated by: [Signature]
4 August 2022

Approved by: [Signature]
4 August 2022

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TE-5028-01 Rev. 01/2019



Verification Test Report

Report No.:

SO22000118-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1526260 E 667887

Calibrated Date: 4 August 2022

Site : สถานีการันพลเรือน

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1900

Environment: Temperature 33.3 °C Humidity 60 %RH

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

Serial No.1351075

Date of Calibration : March.21, 2022

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.66	93.80	0.14	93.66

Calibrated By:

Date: 4 August 2022

Approve By:

Date: 4 August 2022

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Verification Test Report

Report No.:

SO22000118-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1516331 E 672889

Calibrated Date: 4 August 2022

Site : โรงเรียนแสงหิรัญ

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1897

Environment: Temperature 33.3 °C Humidity 60 %RH

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

Serial No.1351075

Date of Calibration : March.21, 2022

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.66	93.60	-0.06	93.66

Calibrated By:

Date: 4 August 2022

Approve By:

Date: 4 August 2022

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**RECALIBRATION
DUE DATE:**
January 19, 2023

Certificate of Calibration

Calibration Certification Information						
Cal. Date: January 19, 2022	Rootsmer S/N: 438320	Ta: 294	"K			
Operator: [REDACTED]		Pa: 749.05	mm Hg			
Calibration Model #: TE-5028A	Calibrator S/N: 1328					

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3190	3.7	1.50
2	3	4	1	1.0220	6.2	2.50
3	5	6	1	0.9290	7.5	3.00
4	7	8	1	0.8590	8.7	3.50
5	9	10	1	0.6530	14.8	6.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \times \frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9941	0.7536	1.2241	0.9951	0.7544	0.7673
0.9907	0.9694	1.5803	0.9917	0.9704	0.9906
0.9890	1.0646	1.7312	0.9900	1.0656	1.0851
0.9874	1.1495	1.8699	0.9884	1.1506	1.1721
0.9793	1.4996	2.4483	0.9802	1.5011	1.5346
QSTD	m= 1.63957		QA	m= 1.02667	
	b= -0.01202			b= -0.00753	
	r= 0.99999			r= 0.99999	

Calculations	
Vstd= $\Delta Vol / ((Pa - \Delta P) / Pstd) (Tstd / Ta)$	Va= $\Delta Vol / ((Pa - \Delta P) / Pa)$
Qstd= $Vstd / \Delta Time$	Qa= $Va / \Delta Time$

For subsequent flow rate calculations:

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

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.	

METTLER TOLEDO

Accuracy Calibration Certificate

Customer

Company: [REDACTED]
 Address: [REDACTED]
 City: Bangkok Contact: [REDACTED]
 Zip / Postal: 10160
 State / Province: Bangkok
 Order Number: [REDACTED]

Weighing Device

Manufacturer: Mettler Toledo	Instrument Type: Weighing Instrument
Model: XSR205DU	Asset Number: N/A
Serial No.: B911363567	Terminal Model: SRAT
Building: N/A	Terminal Serial No.: B911363567
Floor: 3	Terminal Asset No.: N/A
Room: B304	

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

Procedure

Calibration Guideline: EURAMET cg-18 v. 4.0 (11/2015)
 METTLER TOLEDO Work Instruction: CPW00220

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

Calibrator: [REDACTED]

Approved Signatory: [REDACTED]

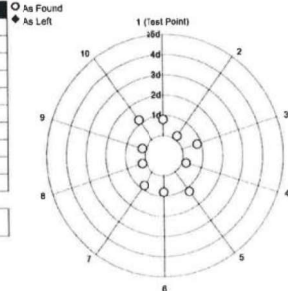
Software Version: 1.23.0.260
 Report Version: 2.16.12
 Form Number: F1030

Repeatability

Test Load: 70 g

	As Found	As Left
1	70.00001 g	N/A
2	70.00002 g	N/A
3	70.00001 g	N/A
4	70.00002 g	N/A
5	70.00003 g	N/A
6	70.00001 g	N/A
7	70.00001 g	N/A
8	70.00002 g	N/A
9	70.00002 g	N/A
10	70.00003 g	N/A

Standard Deviation	0.00008 g	N/A
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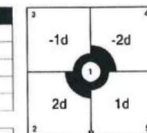
The "d" in the graph represents the readability of the range interval in which the test was performed.
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	100.0000 g	N/A
2	100.0002 g	N/A
3	99.9999 g	N/A
4	99.9998 g	N/A
5	100.0001 g	N/A

Maximum Deviation	0.0002 g	N/A
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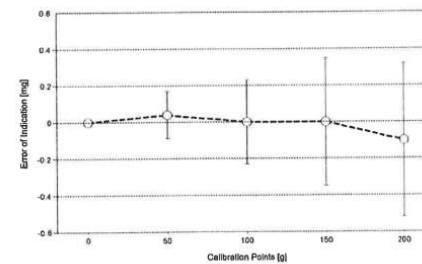


As Found
The "d" in the graph represents the readability of the range interval in which the test was performed.

Error of Indication

As Found

	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.00000 g	0.00000 g	0.00000 g	0.017 mg	2
2	0.10000 g	0.10000 g	0.00000 g	0.023 mg	2
3	0.50000 g	0.50001 g	0.00001 g	0.028 mg	2
4	0.99999 g	0.99999 g	0.00000 g	0.032 mg	2
5	1.99999 g	2.00000 g	0.00001 g	0.040 mg	2
6	5.00001 g	5.00001 g	0.00000 g	0.046 mg	2
7	10.00001 g	10.00002 g	0.00001 g	0.062 mg	2
8	49.99998 g	50.00002 g	0.00004 g	0.13 mg	2
9	100.0000 g	100.0000 g	0.0000 g	0.23 mg	2
10	150.0000 g	150.0000 g	0.0000 g	0.35 mg	2
11	199.9999 g	199.9998 g	-0.0001 g	0.42 mg	2



As Found
As Left
For improved legibility of the graphics only increasing measurement points are shown and measurement points close to zero are not displayed.

The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k - which can be larger than 2 according to EURAMET cg-18. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

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: 05-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.: IK193 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: $1.5 \cdot 10^{-6} / K$

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

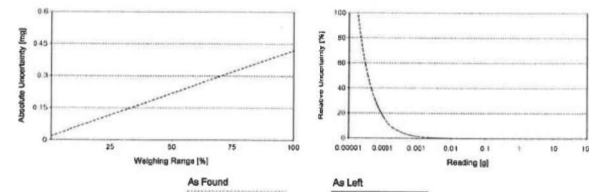
Uncertainty of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.0001 g	81 g	$U_1 = 0.016 \text{ mg} + 0.00497 \text{ mg/g} \cdot R$	N/A
2	0.0001 g	220 g	$U_2 = 0.06 \text{ mg} + 0.00492 \text{ mg/g} \cdot R$	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 (Example)

Net Indication	As Found		As Left	
0.00220 g	0.018 mg	0.82%	N/A	N/A
0.02200 g	0.018 mg	0.082%	N/A	N/A
0.22000 g	0.019 mg	0.0087%	N/A	N/A
2.20000 g	0.029 mg	0.0013%	N/A	N/A
220.0000 g	1.1 mg	0.00052%	N/A	N/A



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 : 808-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	61468578	QR21-0851	13 May 22
2) Digital Thermometer With Probe	GT11	08000089	PSL-T 0072/65	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 [REDACTED]

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

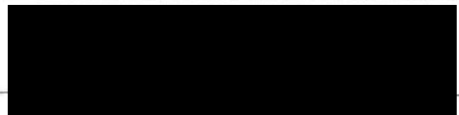
STD Reading (% RH)	UUC Reading (% RH)	UUC Error (% RH)	Measurement Uncertainty (±% RH)
50.00	49.0	-1.00	2.3

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

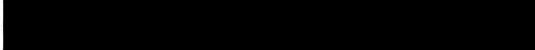
** End of Calibration Report **





Request No. 11-65/0383 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 : 	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&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 Brüel&Kjaer 4180 S/N 2889871.

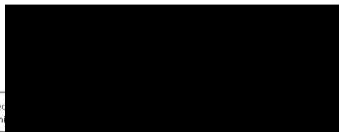
Calibration Procedure: CP-102-04 based on IEC 60942:2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

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



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



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 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&Kjaer 4180	93.66	-0.34	± 0.10	± 0.40 dB

2. Frequency


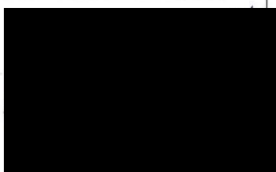
Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	997.8	-2.2	± 1.5	± 1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Brüel&Kjaer 4180	1.55	± 0.50	± 3.0%

Note :

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

Calibrated by :  Approved by : 

Electrical and Electronic Standards Laboratory

Date of Calibration : 21 Mar. 2022 Industrial Metrology and Testing Service Centre

Date of Issue : 22 Mar. 2022 Ref : 2011265031501147002

End of Certificate 2 / 2

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N99E15A00V3
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-12/531, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

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

CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	200811-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	+/-1.0%
PRM	12386	D686025	3.91 PPM AIR/NITROGEN DIOXIDE	2.0%
GMS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%
NTRM	0141709	KAL003190	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/-1.0%
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	+/-1.5%

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 8 N1K0579	NDIR	Jan 27, 2021
Nicolet IS50 FTIR AUP210245 NO	FTIR	Feb 11, 2021
Nicolet IS50 FTIR AUP210245 NO2	FTIR	Jan 21, 2021
Nicolet IS50 FTIR AUP210245 SO2	FTIR	Jan 21, 2021

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6508006

Page:1/1

Calibrated Date: 2-Aug-22

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200E	Manufacturer API S/N: ENOAI200E01526
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NO Conc 44.88 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 26.8 °C

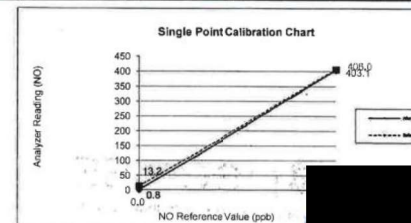
Humidity: 53 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	10.5	0.0	10.5	380.2	400.0	-2.5
NO ₂	2.7	0.0	2.7	25.8	0.0	3.3
NOx	13.2	0.0	13.2	406.0	400.0	0.7

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.5	0.0	0.5	399.0	400.0	-0.1
NO ₂	0.3	0.0	0.3	4.1	0.0	0.5
NOx	0.8	0.0	0.8	403.1	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6508006
Calibrated Date: 2-Aug-22

Page:1/1

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Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	2-Aug-22				
Time	15:30				
Range	0.00 - 500.00 PPS	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.8	0.2	
Sample Flow	500 +/- 50	cc/min	470.0	476.0	
Ozone Flow	80-90	cc/min	90.0	76.0	
PMT Detector	0-5000	mV	24.8	19.6	
AZERO	-20-150	mV	11.7	7.3	
HVPS	400-900 constant	V	768.0	714.0	
DCPS	2500 +/- 200	mV	-	-	
RCCELL TEMP	50 +/- 1	Degree C	50.3	50.3	
BOX TEMP	20-35	Degree C	28.0	27.5	
PMT TEMP	7 +/- 1	Degree C	7.7	7.8	
IZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	313.1	315.0	
RCEL PRES	4-10 constant	IN-Hg-A	7.30	7.30	
SAMP PRES	20-30 constant	IN-Hg-A	31.4	31.3	
NO Slope	1 +/- 0.3		0.647	0.963	
Nox Slope	1 +/- 0.3		0.652	0.940	
NO Offset	-10 to + 150	mV	17.40	6.60	
NOx Offset	-10 to + 150	mV	24.10	12.70	
Span and Cal Values					
Zero Value	NO	0	ppb	10.5	0.5
	NOx	0	ppb	13.2	0.8
Span Value	NO	400	ppb	380.2	399.0
	NOx	400	ppb	406.0	403.1

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6508006
Calibrated Date: 2-Aug-22

Page:1/1

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer
Model: 200A

Manufacturer API
S/N: ENOAI200E01170

Calibration System

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

Environment: Temperature: 26.9 °C

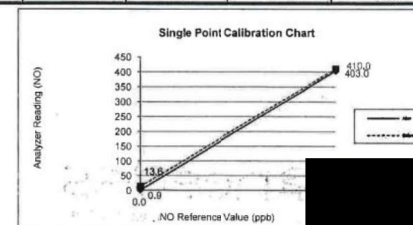
Humidity: 54 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	11.2	0.0	11.2	389.1	400.0	-1.4
NO ₂	2.4	0.0	2.4	20.9	0.0	2.6
NOx	13.6	0.0	13.6	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	399.1	400.0	-0.1
NO ₂	0.4	0.0	0.4	3.9	0.0	0.5
NOx	0.9	0.0	0.9	403.0	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6508008

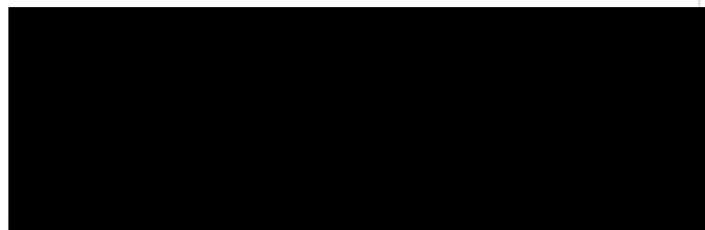
Page: 1/1

Calibrated Date: 2-Aug-22

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Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	2-Aug-22				
Time	10:10				
Range	0.00 - 500.00 PPS	PPS	500	500	
Stability (Zero Gas)	< 0.2	PPS	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	511	532	
Ozone Flow	60-90	cc/min	80	80	
PMT Detector	0-5000	mV	27.4	16.4	
AZERO	20-150	mV	54.2	54.2	
HVPS	400-900 constant	V	819	819	
DCPS	2500 +/- 200	mV	-	-	
RECELL TEMP	50 +/- 1	Degree C	50	50	
BOX TEMP	20-35	Degree C	33.7	32.9	
PMT TEMP	7 +/- 1	Degree C	7.1	7.1	
IS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	314.4	315.0	
RECEL PRES	4-10 constant	IN-Hg-A	10	10	
SAMP PRES	20-30 constant	IN-Hg-A	29.0	29.4	
NO Slope	1 +/- 0.3		0.820	0.801	
Nox Slope	1 +/- 0.3		0.848	0.813	
NO Offset	-10 to + 150	mV	10.2	15.3	
NOx Offset	-10 to + 150	mV	-2.0	-3.4	
Span and Cal Values					
Zero Value	NO	0	ppb	11.2	0.5
	NOx	0	ppb	13.6	0.9
Span Value	NO	400	ppb	389.1	399.1
	NOx	400	ppb	410.0	403.0



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6508004

Calibrated Date: 2-Aug-22

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Page: 1/2

Instruments Information

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

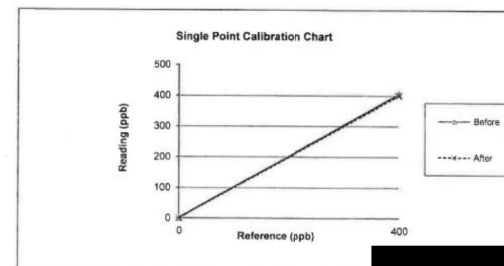
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 26.8 °C

Humidity: 54 %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	405.0	0.6
After	0.0	0.4	0.4	400.0	400.2	0.0



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6508004

Calibrated Date: 2-Aug-22

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Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	2-Aug-22				
Time	15:20				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	850 (+/- 50)	cc/min	637	620	
PMT Detector	0 - 5000	mV	24.2	24.2	
Norm PMT Detector	0 - 5000	mV	19.3	40.5	
FVPS	400-900 constant	V	632	630	
DCPS	2500 (+/- 200)	mV	-	-	
ROCELL TEMP	50 (+/- 1)	Dreagee C	50	50	
BOX TEMP	20-40	Dreagee C	35.4	36.0	
PMT TEMP	7 (+/- 1)	Dreagee C	8.5	8.0	
UV lamp	1000-4900	mV	2900	2900	
Lamp Ratio	30-120	%	82.9	82.9	
STR, Light (Zero Gas)	<100	PPB	25.4	25.4	
Dark PMT	(-50) - (+200)	mV	12.5	12.5	
Dark lamp	(-50) - (+200)	mV	1.5	1.5	
SAMP PRES	20-30 constant	IN-Hg-A	27.8	28.3	
Electric Test/Optic Test					
PMT Volta	2000 (+/- 500)	mV	2010	2022	
SO2 Conc	1000 (+/- 250)	PPB	1005	1011	
SO2 Slope	1 (+/- 0.3)	-	1.040	0.824	
SO2 Offset	< 250	mV	51.9	145.5	
Stability at Zero	< 0.2	PPB	0.2	0.6	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	0.9	0.4	
Span Gas (400 PPB)	400	ppb	405.0	400.2	± 5% of Range

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6508003

Calibrated Date: 2-Aug-22

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Instruments Information

Page:1/2

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

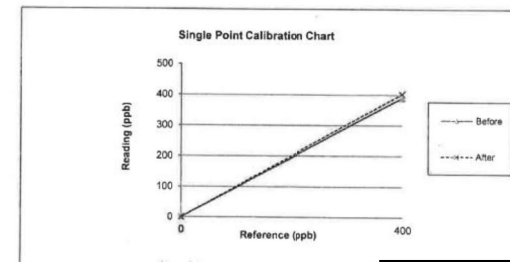
Calibrator Unit	Standard Gas
Dilutor Model ESA MGCT01 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 26.9 °C

Humidity: 54 %RH

Calibration Report

Status	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.7	0.7	400.0	389.4	-1.3
After	0.0	0.3	0.3	400.0	402.1	0.3



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6508003

Calibrated Date: 2-Aug-22

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Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	2-Aug-22				
Time	13:45				
Range	50 - 20000	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.2	0.1	
Sample Flow	850 (+/- 50)	cc/min	992.0	991.0	
PMT Detector	0 - 5000	mV	255.6	61.0	
Norm PMT Detector	0 - 5000	mV	59.7	65.2	
FVPS	400-900 constant	V	607.0	607.0	
DCPS	2500 (+/- 200)	mV	-	-	
RECELL TEMP	50 (+/- 1)	Dreogee C	50.0	50.0	
BOX TEMP	20-40	Dreogee C	34.0	34.1	
PMT TEMP	7 (+/-1)	Dreogee C	8.0	8.0	
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	24.8	8.0	
Stability at Zero	< 0.2	PPB	0.2	0.2	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.2	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	0.7	0.3	
Span Gas (400 PPB)	400	ppb	389.4	402.1	± 5% of Range

CO Analyzer Verification Test Report

Calibration Report No.: AP-C6508002

Calibrated Date: 2-Aug-22

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Page:1/2

Instruments Information

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

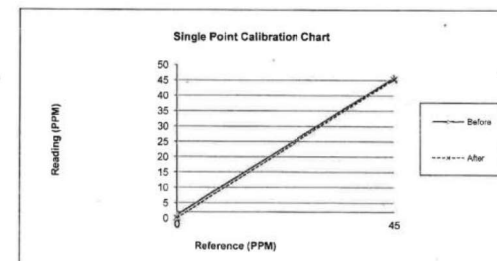
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 26.5 °C

Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.0	1.0	45.0	45.7	0.8
After	0.0	0.0	0.0	45.0	45.2	0.2



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CO Analyzer Verification Test Report

Calibration Report No.: AP-C6508002

Calibrated Date: 2-Aug-22

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Page: 2/2

Detail	Range	Unit	Before	After	Note
Date	2-Aug-22				
Time	6:06				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.01	0.06	
CO Measure	2500 - 4800 MV.	mV	3426.3	3401.3	
CO Reference	2500 - 4800 MV.	mV	2850.7	2832.1	
MR Ratio	1.2 +/- 0.5		1.21	1.21	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	28.5	28.4	
Sample Flow	720 - 880 cc/min	cc/min	790	783	
Sample Temp	44 - 52 deg.C	deg.C	48.2	48.2	
Bench Temp	47 - 49 deg.C	deg.C	48	48	
Wheel Temp	66 - 70 deg.C	deg.C	68	68	
Box Temp	27 - 50 deg.C	deg.C	35.2	35.4	
PHT drive	250 - 4750 mv.	mV	3114.8	3106.5	
Slope	0.803 - 1.200		0.972	0.981	
Offset	0.05 +/- 0.2		0.01	0.009	
Gas Test Response					
Zero Gas	0	PPM	0.5	0.0	
Span Gas	45	PPM	45.9	45.0	± 5% of Range

CO Analyzer Verification Test Report

Calibration Report No.: AP-C6508001

Calibrated Date: 2-Aug-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

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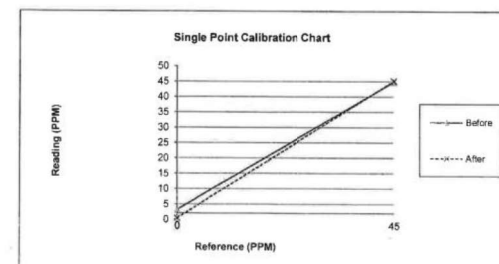
Calibration System

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

Environment: Temperature 26.2 °C Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	3.2	3.2	45.0	44.8	-0.2
After	0.0	0.4	0.4	45.0	45.1	0.1



CO Analyzer Verification Test Report

Calibration Report No.: AP-C6508001

Calibrated Date: 2-Aug-22

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Page: 2/2

Detail	Range	Unit	Before	After	Note
Date	2-Aug-22				
Time	15:40:00 AM				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.12PPB)	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	
Gas Test Response					
Zero Gas	0	PPM	3.2	0.4	
Span Gas	45	PPM	44.8	45.1	± 5% of Range

Calibration Certificate

Issued by : Calibration & Test Section ; Meteorological Instruments Bureau

Date of issue : 11 February, 2022

Certification No. 049/22

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิ

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130149 ID No. : NWSDCMS1200149

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.1 hPa

NATIONAL STANDARD WIND TUNNEL : Micromanometer Theodor Friedrichs FC014 Serial.9310119

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

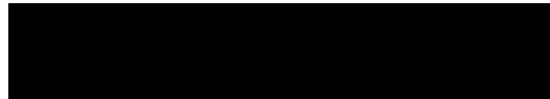
N.I.S.T. Test Reference Number 7317/241460

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

Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

STANDARD THERMOMETER : Theodor Friedrichs : Dry No.8390/04 Wet No. 8389/04



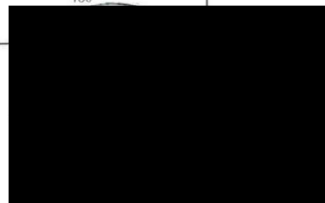
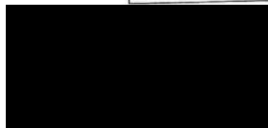
The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 049/22

11 February, 2022 Serial No. 1223 Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
Ultrasonic Anemometer					
m/sec	inches H ₂ O	inches H ₂ O	m/sec	m/sec	m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	2.9	0.12
5.00	-	-	-	4.9	0.10
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.0	0.02
11.01	-	-	-	11.0	0.01
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.1	-0.08

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



The Result of Calibration

Sensor Pressure Model TPH-1 D

Serial No. 6381

Certification No. 049/22

11 February, 2022

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1007.91	1008.10	-0.19
1008.08	1008.40	-0.32
1008.38	1008.70	-0.34
1008.72	1009.00	-0.28
1009.35	1009.70	-0.35
1010.01	1010.30	-0.29
1010.23	1010.50	-0.27
1009.30	1009.50	-0.20
1009.68	1009.90	-0.22
1009.84	1010.10	-0.26
1010.54	1010.80	-0.26
1010.71	1010.90	-0.19
1010.93	1011.10	-0.17
1009.58	1009.80	-0.22
1010.70	1011.00	-0.30
1011.09	1011.30	-0.21
1010.08	1010.40	-0.32
1008.86	1009.10	-0.24
1008.97	1009.20	-0.23
1009.08	1009.30	-0.22



The Result of Calibration

Sensor Temperature Model TPH-1 D Certification No. 049/22
11 February, 2022 Serial No. 6381 Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.1	45.2	-0.1
31.2	31.4	-0.2
16.4	16.5	-0.1

The Result of Calibration

Sensor Humidity Model TPH-1 D Certification No. 049/22
11 February, 2022 Serial No. 6381 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.6	80.3	5.3
61.4	57.4	4.0
40.6	37.8	2.8

Date of Issue 11 February, 2022

Certification No. 049/22

Page : 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ Davis แบบ TIPPING BUCKET
Model 7342.026 ID No. NWSDCMS1200149 ทำการสอบเทียบกับแก้วฝนแบบแก้ว
ดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียด
(TIP)

ถึง

วิศวกรชำนาญการ



Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 11 February, 2022

Certification No. 048/22

Page : 1 of 6

Object : เครื่องมือตรวจวัดจุลอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger MS-100

Serial No. : 130152 ID No. : NWSDCMS1200152

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.6 hPa

NATIONAL STANDARD WIND TUNNEL : Micromanometer Theodor Friedrichs FC014 Serial 9310119

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

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

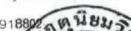
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)

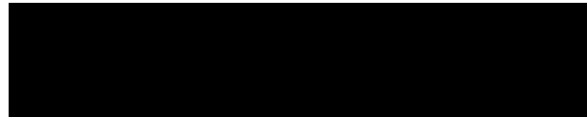
Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

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

: Thermoschneider No.918802





The Result of Calibration

Sensor Wind Speed & Wind Direction Model WSD-1 F Certification No. 048/22

11 February, 2022

Serial No. 1226

Page : 2 of 6

Standard Ultrasonic Anemometer	HIOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
	m/sec	inches H2O	inches H2O	m/sec	m/sec
1.00	-	-	-	0.6	0.40
3.02	-	-	-	2.6	0.42
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.1	-0.08
11.01	-	-	-	11.0	0.01
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.1	-0.08

Wind Aloft Plotting Board.

U.S. DEPARTMENT OF COMMERCE WEATHER BUREAU

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



The Result of Calibration

Sensor Pressure Model TPH-1 C

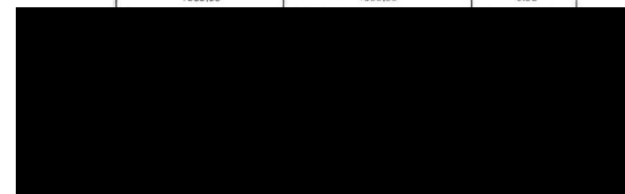
Serial No. 6277

Certification No. 048/22

11 February, 2022

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1007.91	1008.30	-0.39
1008.08	1008.40	-0.32
1008.36	1008.70	-0.34
1008.72	1009.00	-0.28
1009.35	1009.70	-0.35
1010.01	1010.30	-0.29
1010.23	1010.50	-0.27
1009.30	1009.50	-0.20
1009.68	1009.80	-0.12
1009.84	1010.00	-0.16
1010.54	1010.70	0.16
1010.71	1010.80	-0.09
1010.93	1011.00	-0.07
1009.58	1009.90	-0.32
1010.70	1011.00	-0.30
1011.09	1011.40	0.31
1010.08	1010.40	-0.32
1008.86	1009.10	-0.24
1008.97	1009.20	0.23
1009.08	1009.30	0.22



The Result of Calibration

Sensor Temperature Model TPH-1 C Certification No. 048/22
11 February, 2022 Serial No. 6277 Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.1	45.4	-0.3
31.2	31.4	-0.2
16.4	16.5	-0.1

The Result of Calibration

Sensor Humidity Model TPH-1 C Certification No. 048/22
11 February, 2022 Serial No. 6277 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.6	82.2	3.4
61.4	58.3	3.1
40.6	38.0	2.6

Date of Issue 11 February, 2022

Certification No. 048/22

Page : 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีห้อ Davis แบบ TIPPING BUCKET
Model 7342.026 ID No.NWSDCMS1200152 ทำการสอบเทียบกับแก้วฝนแบบแก้ว
ดวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm./
TIP)

วิศวกรชำนาญการ

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
โรงเรียนแสงหิรัญและสถาบันการbinพลเรือน
ครั้งที่ 2/2565
ตรวจวัดวันที่ 18-23 ตุลาคม 2565

TSP High Volume Sampler Calibration

Verification Report No.
SO2200174-E001 -TSP 01

☐ PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM : 47P N 1516338 E 672861
 Sampler: ETS#42
 Recorder: ECRANG01639908

Date: 18 Oct 22
 Technical: XXXXXXXXXX
 Approver: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1006.2	Corrected Pressure (mm Hg): 754.7
Temperature (deg C): 33.2	Temperature (deg K): 306.2
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: 1.63957
Model: TE-5028A	Qstd Intercept: -0.01202
Serial#: 1328	Date Certified: 19 Jan 22

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.22	2.016	54.0	53.09
2	8.76	1.762	52.0	51.12
3	7.53	1.653	48.0	47.19
4	4.65	1.300	44.0	43.26
5	2.98	1.042	40.0	39.32

LINEAR REGRESSION

Slope = 14.3952
Intercept = 24.3581
Corr. coeff = 0.9910

of Observations: 5

Range of Chart	41
at 1.1 - 1.7 m3/min	49

Calibrated by : XXXXXXXXXX

Approved by : XXXXXXXXXX

TSP High Volume Sampler Calibration

Verification Report No.
SO2200174-E001 -TSP 02

☐ PM ☒ Onsite
 Site: สถานีบางเขน
 UTM : 47P N 1526244 E 667835
 Sampler: ETS#31
 Recorder: ECRANG15315224

Date: 18 Oct 22
 Technical: XXXXXXXXXX
 Approver: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1006.2	Corrected Pressure (mm Hg): 754.7
Temperature (deg C): 33.2	Temperature (deg K): 306.2
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: 1.63957
Model: TE-5028A	Qstd Intercept: -0.01202
Serial#: 1328	Date Certified: 19 Jan 22

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.68	2.057	52.0	51.12
2	9.66	1.871	48.0	47.19
3	6.41	1.525	44.0	43.26
4	3.81	1.178	40.0	39.32
5	2.39	0.934	36.0	35.39

LINEAR REGRESSION

Slope = 13.2628
Intercept = 23.1895
Corr. coeff = 0.9954

of Observations: 5

Range of Chart	39
at 1.1 - 1.7 m3/min	46

Calibrated by : XXXXXXXXXX

Approved by : XXXXXXXXXX

PM10 High Volume Sampler Calibration

Verification Report No.
SO2200174-E001 -PM 01

L PM ☒ Onsite
 Site: โรงโม่หินแสงหิน
 UTM : 47P N 1516338 E 672861
 Sampler: EPM10#43
 Recorder: ECRANG000053215

Date: 18 Oct 22
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1006.2

Corrected Pressure (mm Hg): 754.7

Temperature (deg C): 33.2

Temperature (deg K): 306.2

Average Press. (hPa): 1013.0

Corrected Avg Press. (mm Hg): 759.8

Average Temp. (deg C): 30.0

Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Slope: 1.02667

Model: TE-5028A

Intercept: -0.00753

Serial#: 1328

Date Certified: 19 Jan 22

CALIBRATIONS				
Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	12.22	2.176	50.0	31.85
2	8.81	1.849	46.0	29.30
3	7.24	1.677	44.0	28.03
4	4.75	1.359	40.0	25.48
5	3.21	1.119	36.0	22.93

LINEAR REGRESSION

 Slope = 8.3144
 Intercept = 13.9143
 Corr. coeff = 0.9978
 SFR = 1.150
 SSP = 36.85
 # of Observations: 5
 Range of Chart at SFR ±10%: 36 / 38

Calibrated by: XXXXXXXXXX

 Approved by: XXXXXXXXXX

PM10 High Volume Sampler Calibration

Verification Report No.
SO2200174-E001 -PM 02

L PM ☒ Onsite
 Site: สถานีการันพลเรือน
 UTM : 47P N 1526244 E 667885
 Sampler: EPM10#33
 Recorder: ECRD501618124

Date: 18 Oct 22
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1006.3

Corrected Pressure (mm Hg): 754.8

Temperature (deg C): 33.1

Temperature (deg K): 306.1

Average Press. (hPa): 1013.0

Corrected Avg Press. (mm Hg): 759.8

Average Temp. (deg C): 30.0

Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Slope: 1.02667

Model: TE-5028A

Intercept: -0.00753

Serial#: 1328

Date Certified: 19 Jan 22

CALIBRATIONS				
Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	11.82	2.140	54.0	34.39
2	8.57	1.823	50.0	31.84
3	6.22	1.554	46.0	29.29
4	4.61	1.339	42.0	26.75
5	2.93	1.069	38.0	24.20

LINEAR REGRESSION

 Slope = 9.6626
 Intercept = 13.9775
 Corr. coeff = 0.9980
 SFR = 1.149
 SSP = 39.39
 # of Observations: 5
 Range of Chart at SFR ±10%: 38 / 40

Calibrated by: XXXXXXXXXX

 Approved by: XXXXXXXXXX

Verification Test Report

Report No.:

SO22000174-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1516338 E 672861

Calibrated Date: 18 October 2022

Site : โรงเรียนแสงทิตย

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1897

Environment: Temperature 33.3 °C Humidity 60 %RH

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

Serial No.1351075

Date of Calibration : March.21, 2022

Result of Test			
Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.66	93.60	-0.06	93.66

Calibrated By:

Date:

Approve By:

Date:

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Verification Test Report

Report No.:

SO22000174-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1526260 E 667887

Calibrated Date: 18 October 2022

Site : สถาบันการปิ่นพลเรือน

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1865

Environment: Temperature 33.3 °C Humidity 60 %RH

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

Serial No.1351075

Date of Calibration : March.21, 2022

Result of Test			
Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.66	93.80	0.14	93.66

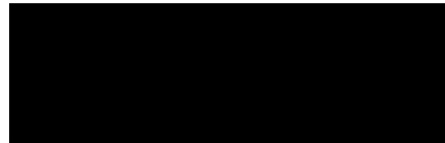
Calibrated By:

Date:

Approve By:

Date:

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RECALIBRATION
DUE DATE:
January 19, 2023

Certificate of Calibration

Calibration Certification Information				
Cal. Date:	January 19, 2022	Rootmeter S/N:	438320	Ta: 294 °K
Operator:		Pa:	749.05	mm Hg
Calibration Model #:	TE-S028A	Calibrator S/N:	1328	

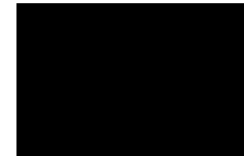
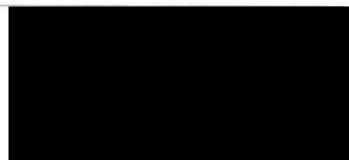
Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (ln H2O)
1	1	2	1	1.3190	3.7	1.50
2	3	4	1	1.0220	6.2	2.50
3	5	6	1	0.9290	7.5	3.00
4	7	8	1	0.8590	8.7	3.50
5	9	10	1	0.6530	14.8	6.00

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)
0.9941	0.7536	1.2241	0.9951	0.7544	0.7673
0.9907	0.9694	1.5803	0.9917	0.9704	0.9906
0.9890	1.0646	1.7312	0.9900	1.0656	1.0851
0.9874	1.1495	1.8699	0.9884	1.1506	1.1721
0.9793	1.4996	2.4483	0.9802	1.5011	1.5346
QSTD		m= 1.63957	QA		m= 1.02667
		b= -0.01202			b= -0.00753
		r= 0.99999			r= 0.99999

Calculations			
Vstd=	$\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$	Va=	$\Delta Vol((Pa-\Delta P)/Pa)$
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 (ln 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.	



Accuracy Calibration Certificate

Customer

Company: [REDACTED]

Address: [REDACTED]

City: Bangkok

Zip / Postal: 10180

State / Province: Bangkok

Order Number: [REDACTED]

Weighing Device

Manufacturer: Mettler Toledo

Model: XSR205DU

Serial No.: B911363567

Building: N/A

Floor: 3

Room: B304

Instrument Type: Weighing Instrument

Asset Number: N/A

Terminal Model: SRAT

Terminal Serial No.: B911363567

Terminal Asset No.: N/A

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

Procedure

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

METTTLER 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.

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

As Found Calibration Date: 32-Mar-2022

As Left Calibration Date: N/A

Issue Date: 33-Mar-2022

Calibrator: [REDACTED]

Approved Signatory: [REDACTED]



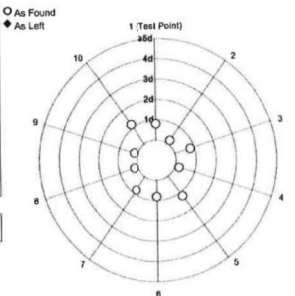
Measurement Results

Repeatability

Test Load: 73 g

	As Found	As Left
1	70.00001 g	N/A
2	70.00002 g	N/A
3	70.00001 g	N/A
4	70.00002 g	N/A
5	70.00003 g	N/A
6	70.00001 g	N/A
7	70.00001 g	N/A
8	70.00002 g	N/A
9	70.00002 g	N/A
10	70.00003 g	N/A

Standard Deviation	0.000008 g	N/A
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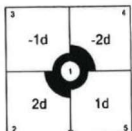
The "d" in the graph represents the readability of the range/interval in which the test was performed.
The results of this graph are based upon the absolute values of the differences from the mean value.

Eccentricity

Test Load: 100 g

Position	As Found	As Left
1	100.0000 g	N/A
2	100.0002 g	N/A
3	99.9999 g	N/A
4	99.9998 g	N/A
5	100.0001 g	N/A

Maximum Deviation	0.0002 g	N/A
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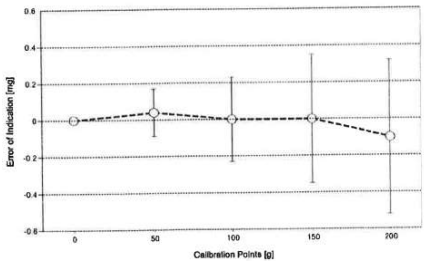


The "d" in the graph represents the readability of the range/interval in which the test was performed.

Error of Indication

As Found

k	Reference Value	Indication	Error of Indication	Expanded Uncertainty	k
1	0.00000 g	0.00000 g	0.00000 g	0.017 mg	2
2	0.10000 g	0.10000 g	0.00000 g	0.023 mg	2
3	0.50000 g	0.50001 g	0.00001 g	0.028 mg	2
4	0.99999 g	0.99999 g	0.00000 g	0.032 mg	2
5	1.99999 g	2.00000 g	0.00001 g	0.040 mg	2
6	5.00001 g	5.00001 g	0.00000 g	0.046 mg	2
7	10.00001 g	10.00002 g	0.00001 g	0.062 mg	2
8	49.99998 g	50.00002 g	0.00004 g	0.13 mg	2
9	100.0000 g	100.0000 g	0.0000 g	0.23 mg	2
10	150.0000 g	150.0000 g	0.0000 g	0.35 mg	2
11	199.9999 g	199.9998 g	-0.0001 g	0.42 mg	2



For improved legibility of the graphics only increasing measurement points are shown and measurement points close to zero are not displayed.

The uncertainty stated is the expanded uncertainty at calibration obtained by multiplying the standard combined uncertainty by the coverage factor k - which can be larger than 2 according to EURAMET cg-16. The value of the measurand lies within the assigned range of values with a probability of approximately 95%.

The user is responsible for maintaining environmental conditions and the settings of the weighing instrument when it was calibrated.

Calibration Certificate ID
TH2068-088-030222-ACC-TH

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.: JN193 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.

Calibration Certificate ID
TH2068-088-030222-ACC-TH

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

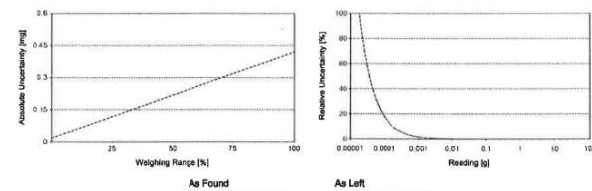
Linearization of Uncertainty Equation

	Range		As Found	As Left
	d	Max		
1	0.00001 g	81 g	$u_1 = 0.018 \text{ mg} + 0.00497 \text{ mg/g} \cdot R$	N/A
2	0.0001 g	220 g	$u_2 = 0.06 \text{ mg} + 0.00492 \text{ mg/g} \cdot R$	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	0.82%	N/A	N/A
0.02200 g	0.018 mg	0.082%	N/A	N/A
0.22000 g	0.018 mg	0.0087%	N/A	N/A
2.20000 g	0.028 mg	0.0013%	N/A	N/A
220.0000 g	1.1 mg	0.00052%	N/A	N/A



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

Customer : [REDACTED]

Equipment : Digital Thermo-Hygrometer

Manufacturer : Testo

Model : 608-H1

Serial No. : 63353607

ID No. : -

Received Date : 7 March 2022

Calibrated Date : 9 March 2022

Issued Date : 15 March 2022

Certificate No. : L2203-290

Page 1 of 2

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

Calibrated by : Mr. Nattawut Reangdech

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	61468578	QR21-0851	13 May 22
2) Digital Thermometer With Probe	GT11	06000089	PSL-T 0072/65	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.

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: E04N199E15A00V3 Reference Number: 160-402021734-1
Cylinder Number: EB0140762 Cylinder Volume: 144.4 Cubic Feet
Laboratory: 124 - Plumsteadville - PA Cylinder Pressure: 2015 PSIG
PGVP Number: A12021 Valve Outlet: 660
Gas Code: CO,NO,NOX,SO2,BALN Certification Date: Feb 19, 2021

Expiration Date: Feb 19, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 800/R-12/031, using the assay procedures listed. Analytical Methodology does not require correction for analytical interference. This cylinder has a total analytical uncertainty as stated below with a confidence level of 95%. There are no significant impurities which affect the use of this calibration mixture. All concentrations are on a mole/mole basis unless otherwise noted.

Do Not Use This Cylinder below 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	12386	D665025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMS	124206888	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.57 PPM SULFUR DIOXIDE/NITROGEN	+/-1.0%	Jun 20, 2022
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	+/-0.5%	Jun 07, 2024

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 NTKD579	NDIR	Jan 27, 2021
Nicolet iS60 FTIR AUP2016245 NO	FTIR	Feb 11, 2021
Nicolet iS60 FTIR AUP2016245 NO2	FTIR	Jan 21, 2021
Nicolet iS60 FTIR AUP2016245 SO2	FTIR	Jan 21, 2021

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.4 Kg

Net Weight: 4.5 Kg

PO# 5221000405

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6510005

Calibrated Date: 1-Oct-22

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: ECOESACO12E201
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Calibration System

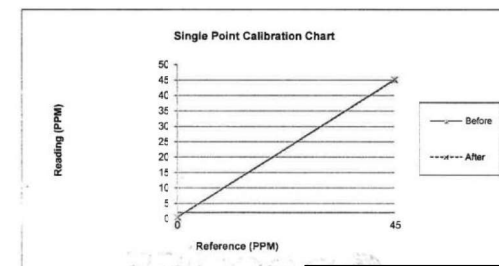
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NO Conc 44.68 PPM
ZERO AIR Generator ZAG7001 S/N: 644	SO2 Conc 45.34 PPM
	CO Conc 4500 PPM
	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature: 24.6 °C

Humidity: 75 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.562	0.6	45.0	45.23	0.3
After	0.0	0.467	0.5	45.0	45.08	0.1



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6510005

Calibrated Date: 1-Oct-22

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Page: 2/2

Analyzer Signal Values					
Date	1-Oct-22	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

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6510006

Calibrated Date: 1-Oct-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

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

Calibration System

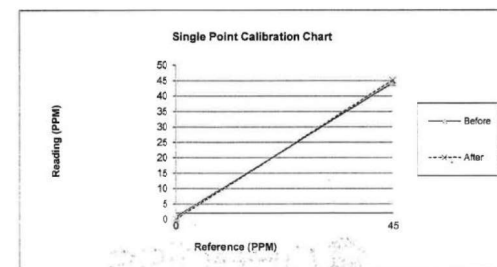
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101	NO Conc 44.68 PPM
S/N: 792	SO2 Conc 45.34 PPM
ZERO AIR Generator ZAG7001	CO Conc 4500 PPM
S/N: 644	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 24.6 °C

Humidity: 74 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.815	0.8	45.0	44.25	-0.8
After	0.0	0.060	0.1	45.0	45.10	0.1



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6510006

Calibrated Date: 1-Oct-22

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Page: 2/2

Analyzer Signal Values					
Date	1-Oct-22	Time	10:08:00		
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

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6510006

Calibrated Date: 1-Oct-22

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Page: 1/2

Instruments Information

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

Calibrator Unit	Standard Gas	
Dilutor Model ESA MGC131 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

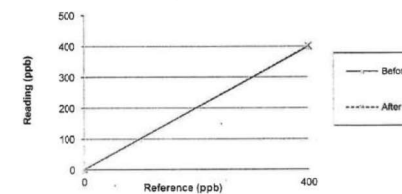
Environment: Temperature 24.5 °C

Humidity: 65 %RH

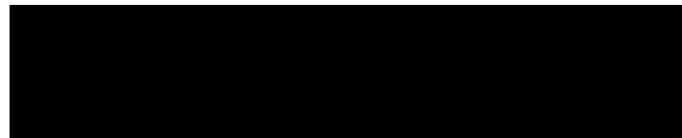
Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.9	0.9	400.0	399.3	-0.1
After	0.0	0.2	0.2	400.0	401.4	0.2

Single Point Calibration Chart



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SO2 Analyzer Verification Test Report

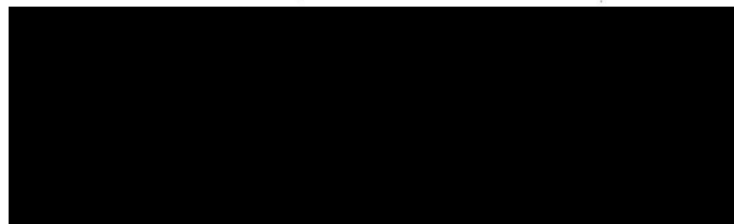
Calibration Report No.: AP-S6510006

Calibrated Date: 1-Oct-22

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Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-22				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
HVPS	400-900 constant	V	719	648	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL TEMP	50 (+/- 1)	Dreagee C	50	50	
BOX TEMP	20-40	Dreagee C	34.1	32.7	
PMT TEMP	7 (+/-1)	Dreagee C	8.0	8.0	
UV lamp	1000-4900	mV	4034.0	4034.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR Light (Zero Gas)	<100	PPB	29	29	
Dark PMT	(-50) - (+200)	mV	44.7	44.7	
Dark lamp	(-50) - (+200)	mV	5.1	5.1	
SAMP PRES	20-30 constant	IN-Hg-A	28.1	27.8	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	-	ppb	0.9	0.2	
Span Gas (400 PPB)	400	ppb	399.3	401.4	± 5% of Range



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6510007

Calibrated Date: 1-Oct-22

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Page: 1/2

Instruments Information

Analyzer Type: SO2 Analyzer Model: T100	Manufacturer API S/N: ESCAIT10002032
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Calibration System

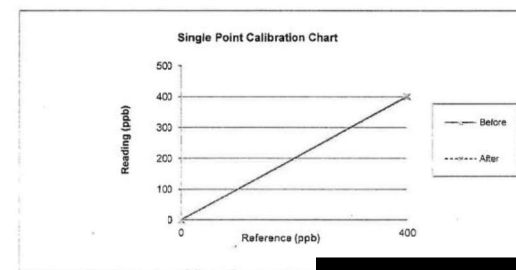
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC131 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.88 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.5 °C

Humidity: 65 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.4	0.4	400.0	401.1	0.1
After	0.0	0.1	0.1	400.0	400.0	0.0



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S8510007

Calibrated Date: 1-Oct-22

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Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-22				
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	-	-	
RCCELL 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	1000-4900	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 contant	IN-Hg-A	28.1	27.8	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Gas Test Response					
Zero Gas (0.30 PPB)	0	ppb	0.4	0.1	
Span Gas (400 PPB)	400	ppb	401.1	400.0	± 5% of Range

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6510005

Page: 1/1

Calibrated Date: 1-Oct-22

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Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer
Model: 200A

Manufacturer API
S/N: NNOAI200A02608

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 24.5 °C

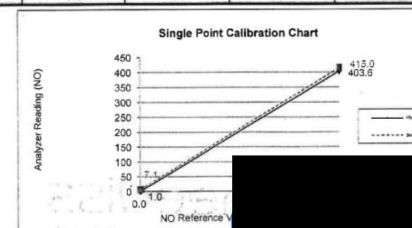
Humidity 67 %RH

Calibration Check (Before adjust)

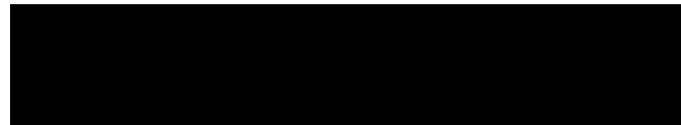
GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.9	0.0	3.9	412.0	400.0	1.5
NO ₂	3.2	0.0	3.2	3.0	0.0	0.4
NOx	7.1	0.0	7.1	415.0	400.0	1.8

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.6	0.0	0.6	400.5	400.0	0.1
NO ₂	0.4	0.0	0.4	3.1	0.0	0.4
NOx	1.0	0.0	1.0	403.6	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6510005

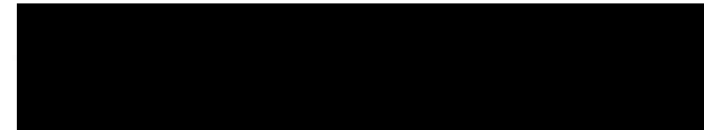
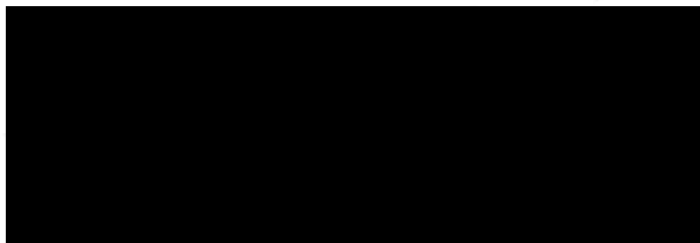
Page:1/1

Calibrated Date: 1-Oct-22

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Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-22				
Time	15:30				
Range	0.00 - 500.00 PPB	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.8	0.2	
Sample Flow	500 +/- 50	cc/min	470.0	476.0	
Ozone Flow	60-90	cc/min	80.0	76.0	
PMT Detector	0-5000	mV	24.8	19.8	
AZERO	-20-150	mV	11.7	7.3	
IVPS	400-900 constant	V	766.0	714.0	
DCPS	2500 +/- 200	mV	-	-	
CELL TEMP	50 +/- 1	Degree C	50.3	50.3	
BOX TEMP	20-35	Degree C	28.0	27.5	
PMT TEMP	7 +/- 1	Degree C	7.7	7.8	
ZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	313.1	315.0	
RCCL PRES	4-10 constant	IN-Hg-A	7.30	7.30	
SAMP PRES	20-30 constant	IN-Hg-A	31.4	31.3	
NO Slope	1 +/- 0.3		0.847	0.963	
Nox Slope	1 +/- 0.3		0.652	0.940	
NO Offset	-10 to + 150	mV	17.40	6.60	
NOx Offset	-10 to + 150	mV	24.10	12.70	
Span and Cal Values					
Zero Value	NO	0	ppb	3.9	0.6
	NOx	0	ppb	7.1	1.0
Span Value	NO	400	ppb	412.0	400.5
	NOx	400	ppb	415.0	403.6



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6510006

Page:1/1

Calibrated Date: 1-Oct-22

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENOAI200A01679
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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 24.5 °C

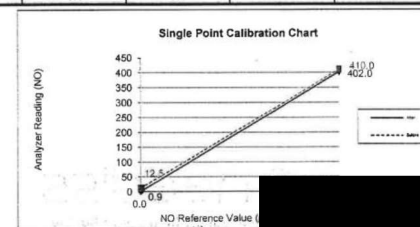
Humidity: 67 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	10.3	0.0	10.3	398.1	400.0	-0.2
NO ₂	2.2	0.0	2.2	11.9	0.0	1.5
NOx	12.5	0.0	12.5	410.0	400.0	1.2

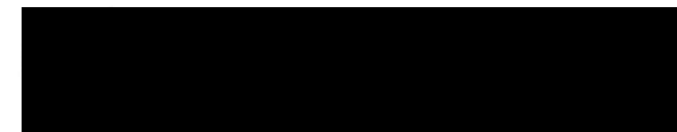
Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.6	0.0	0.6	400.0	400.0	0.0
NO ₂	0.3	0.0	0.3	2.0	0.0	0.2
NOx	0.9	0.0	0.9	402.0	400.0	0.2



This report shall not be relied upon without the written approval of the calibration engineer.





NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6510006

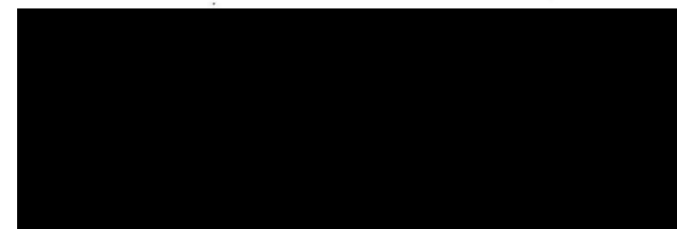
Page:1/1

Calibrated Date: 1-Oct-22

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Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-22				
Time	10:10				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	500±50	cc/min	482	494	
Ozone Flow	80-80	cc/min	74	77	
PMT Detector	0-5000	mV	51	26	
AZERO	-20-150	mV	53.3	33.3	
HVPS	400-900 constant	V	821	821	
DCPS	2500 ± 200	mV	2556	2556	
RECELL TEMP	50±1	Dreagee C	50	50	
BOX TEMP	20-35	Dreagee C	30.2	32.8	
PMT TEMP	7 ±1	Dreagee C	7.5	7.5	
ZS TEMP	50±1.4	Dreagee C	-	-	
MOLY Temp	315 ±1.5	Dreagee C	315.0	314.5	
RECEL PRES	4-10 contant	IN-Hg A	8.8	8.8	
SAMP PRES	20-30 contant	IN-Hg-A	30.2	31.8	
NO Slope	1 ± 0.3		0.820	0.822	
NOx Slope	1 ± 0.3		0.854	0.856	
NO Offset	-10 to + 150	mV	17.8	17.8	
NOx Offset	-10 to + 150	mV	5.0	5.0	
Span and Cal Values					
Zero Value	NO	0	ppb	10.3	0.6
	NOx	0	ppb	12.5	0.9
Span Value	NO	400	ppb	398.1	400.0
	NOx	400	ppb	410.0	402.0



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





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 I
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 I
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 I
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

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.

Issued by : Calibration & Test Section : Meteorological Instruments Bureau


Date of Issue 1 September, 2022 **Certification No.** 312/22
Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSN110WS2510

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 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.916800

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. 11220015



The Result of Calibration

Sensor model EWSNV110WS2510 Certification No. 312/22

1 September, 2022

Page : 2 of 6

Standard Ultrasonic Anemometer	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.4	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	180
270	270

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

The Result of Calibration

Sensor model EWSNV110WS2510 Certification No. 312/22
1 September, 2022 Page : 4 of 6

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

Page : 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีห้อ Davis แบบ TIPPING BUCKET
Model 7342.026 ID No.EWSNV110WS2510 ที่การสอบเทียบกับแก้วฝนแบบแก้ว
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 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 :

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)

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

STANDARD THERMOMETER : Theodor Friedrich : Dry No.839094 Wet No. 8389/94

: Thermoschneider No.918302

STANDARD BAROMETER : Digital Barometer Vaisala Type PTE220 No. V1220015

The Result of Calibration

Sensor model EWSNV110WS2511 Certification No. 315/22

2 September, 2022 Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Velocity	Velocity	Correction
	m/sec	inches H2O	inches H2O	m/sec	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	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
1010.38	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

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 เครื่องวัดฝุ่น ชื่อ Davis แบบ TIPPING BUCKET
Model 7342.026 ID No.EWSNV110WS2511 ทำการสอบเทียบกับแก้วฝุ่นแบบแก้ว
ดวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/
TIP)

วิศวกรชำนาญการ