

ภาคผนวกที่ 4-3
เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
ครั้งที่ 3/2564
สถานีโรงเรียนกรุงเทพคริสเตียนวิทยาลัย
สถานีโรงพยาบาลเซนต์หลุยส์
วันที่ตรวจวัดวันที่ 19-23 กุมภาพันธ์ 2565

TSP High Volume Sampler Calibration

Verification Report No.
 SO2200012-E001 -TSP_01

☐ PM ☒ Onsite

Site: กรุงเทพมหานคร

UTM: 47P N 1517397 E 664628

Sampler: ETSP#42

Recorder: ECRANG15315242

Date: 19 Feb 22

Technical: [Redacted]

Approval: [Redacted]

CONDITIONS

Barometric Press. (hPa): 1009.0	Corrected Pressure (mm Hg): 756.8
Temperature (deg C): 34.0	Temperature (deg K): 307.0
Average Press. (hPa): 1013.0	Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc	Qstd Slope: 1.63957
Model: TE-5026A	Qstd Intercept: -0.01202
Serial#: 1328	Date Certified: 19 Jan 22

Plate or Test #	H ₂ O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.24	2.018	56.0	55.06
2	9.22	1.828	54.0	53.09
3	7.54	1.654	50.0	49.16
4	4.87	1.331	44.0	43.26
5	2.97	1.041	36.0	35.39

LINEAR REGRESSION

Slope = 20.2713

Intercept = 15.2803

Corr. coeff = 0.9923

of Observations: 5

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

Calibrated by: [Redacted]

19 February 2022

Approved by: [Redacted]

19 February 2022

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PL-INT-22 Rev. 01/01/2020

TSP High Volume Sampler Calibration

Verification Report No.
 SO2200012-E001 -TSP_02

☐ PM ☒ Onsite

Site: กรุงเทพมหานคร

UTM: 47P N1517256 E 664814

Sampler: ETSP#44

Recorder: ECRANG15315224

Date: 19 Feb 22

Technical: [Redacted]

Approval: [Redacted]

CONDITIONS

Barometric Press. (hPa): 1009.0	Corrected Pressure (mm Hg): 756.8
Temperature (deg C): 34.0	Temperature (deg K): 307.0
Average Press. (hPa): 1013.0	Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc	Qstd Slope: 1.63957
Model: TE-5026A	Qstd Intercept: -0.01202
Serial#: 1328	Date Certified: 19 Jan 22

Plate or Test #	H ₂ O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.96	1.993	56.0	55.06
2	9.23	1.829	54.0	53.09
3	7.52	1.652	50.0	49.16
4	4.87	1.331	42.0	41.29
5	3.25	1.088	36.0	35.39

LINEAR REGRESSION

Slope = 22.3989

Intercept = 11.4426

Corr. coeff = 0.9960

of Observations: 5

Range of Chart at 1.1 - 1.7 m3/min: 37

Calibrated by: [Redacted]

19 February 2022

Approved by: [Redacted]



19 February 2022

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PL-INT-22 Rev. 01/01/2020

PM10 High Volume Sampler Calibration

Verification Report No.
SO2200012-E001-PM 01

L. PM ☒ Onsite
Site: โรงพยาบาลศิริราช
UTM : 47P N 1517397 E 664528
Sampler: EPMK29
Recorder: ECRDS01618156
Date: 19 Feb 22
Technical: 
Approval: 

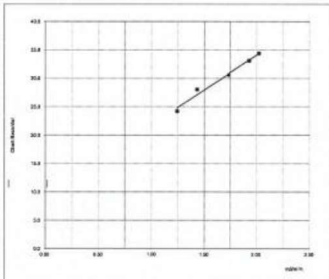
CONDITIONS


Barometric Press. (hPa): 1009.0 Corrected Pressure (mm Hg): 756.8
Temperature (deg C): 34.0 Temperature (deg K): 307.0
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 OFFICE

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

CALIBRATIONS					LINEAR REGRESSION
Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	
1	10.56	2.023	54.0	34.39	Slope = 12.2571 Intercept = 9.5699 Corr. coeff = 0.9903 SFR = 1.149 SSP = 37.15 # of Observations: 5 Range of Chart at SFR ±10%: 36 / 39
2	9.62	1.931	52.0	33.12	
3	7.72	1.731	48.0	30.57	
4	5.26	1.430	44.0	28.02	
5	3.97	1.243	38.0	24.20	



Calibrated by: 
19 February 2022



Approved by: 
19 February 2022

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16.0007123 Rev.001/2021

PM10 High Volume Sampler Calibration

Verification Report No.
SO2200012-E001-PM 02

L. PM ☒ Onsite
Site: โรงพยาบาลศิริราช
UTM : 47P N1517256 E 664914
Sampler: EPMK33
Recorder: ECRDS01618124
Date: 19 Feb 22
Technical: 
Approval: 

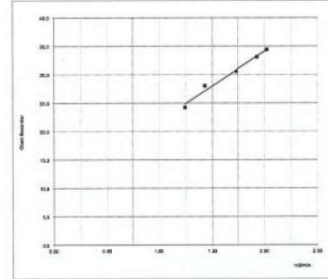
CONDITIONS

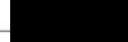
Barometric Press. (hPa): 1009.0 Corrected Pressure (mm Hg): 756.8
Temperature (deg C): 34.0 Temperature (deg K): 307.0
Average Press. (hPa): 1013.0 Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0 Average Temp. (deg K): 303.0

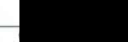
CALIBRATION OFFICE

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

CALIBRATIONS					LINEAR REGRESSION
Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	
1	10.22	1.991	54.0	34.39	Slope = 12.4907 Intercept = 9.1483 Corr. coeff = 0.9941 SFR = 1.149 SSP = 36.91 # of Observations: 5 Range of Chart at SFR ±10%: 35 / 38
2	9.12	1.881	50.0	31.85	
3	7.22	1.674	48.0	30.57	
4	4.42	1.312	40.0	25.48	
5	3.14	1.107	36.0	22.93	



Calibrated by: 
19 February 2022

Approved by: 
19 February 2022

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16.0007123 Rev.001/2021

Verification Test Report

Report No.:
SO2200012-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1517244 E 664920

Calibrated Date: 19 February 2022
Site : โรงเรียนเซนต์หลุยส์
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 2198

Environment: Temperature 28 °C Humidity 61 %RH

Reference Standard: Acoustic Calibrator Model 106
Serial No. 87098
Date of Calibration : Mar.12, 2021

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
94.13	93.80	-0.33	94.13

Calibrated By:
Date: 19 February 2022

Approve By:
Date: 19 February 2022

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Verification Test Report

Report No.:
SO2200012-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1517413 E 664530

Calibrated Date: 19 February 2022
Site : โรงเรียนกรุงเทพคริสเตียน
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1974

Environment: Temperature 28 °C Humidity 61 %RH

Reference Standard: Acoustic Calibrator Model 106
Serial No. 87098
Date of Calibration : Mar.12, 2021

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
94.13	93.70	-0.43	94.13

Calibrated By:
Date: 19 February 2022

Approve By:
Date: 19 February 2022

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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 800R-12/831, 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 medium. 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	44.68 PPM	G1	+/- 1.4% NIST Traceable	02/12/2021, 02/19/2021
NITRIC OXIDE	45.00 PPM	44.62 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	D565025	9.91 PPM AIR/NITROGEN DIOXIDE	2.3%	Feb 28, 2020
GMIS	124206889	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	+/- 0.6%	Jun 07, 2024

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1K0579	NDR	Jan 27, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Jan 21, 2021
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Jan 21, 2021

Triad Data Available Upon Request

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502006

Page:1/1

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Instruments Information

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

Calibrator Unit	Standard Gas
Dilutor Model ESA 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 25.4 °C

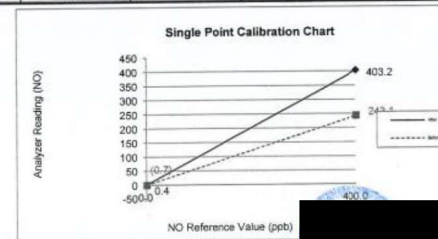
Humidity 52 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	7.7	0.0	7.7	259.0	400.0	-21.4
NO ₂	-8.4	0.0	-8.4	-15.9	0.0	-3.0
NOx	-0.7	0.0	-0.7	243.1	400.0	-24.4

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.1	0.0	0.1	396.4	400.0	-0.5
NO ₂	0.3	0.0	0.3	6.8	0.0	0.9
NOx	0.4	0.0	0.4	403.2	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502006

Page:1/1

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-22				
Time	13:20				
Range	0.00 - 500.00 PPB	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	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	400-800 constant	V	839.0	836.0	
DCPS	2500 +/- 200	mV	-	-	
RCCELL TEMP	50 +/- 1	Dreogee C	50.0	50.0	
BOX TEMP	20-35	Dreogee C	34.5	30.5	
PMT TEMP	7 +/- 1	Dreogee C	7.0	7.1	
IZS TEMP	50 +/- 4	Dreogee C	-	-	
MOLY Temp	315 +/- 5	Dreogee C	315.0	314.4	
RCEL PRES	4-10 constant	IN-Hg-A	4.20	7.90	
SAMP PRES	20-30 constant	IN-Hg-A	29.9	28.8	
NO Slope	1 +/- 0.3		1.256	1.032	
Nox Slope	1 +/- 0.3		1.232	1.048	
NO Offset	-10 to + 150	mV	4.50	6.90	
NOx Offset	-10 to + 150	mV	-5.00	-1.50	
Span and Cal Values					
Zero Value	NO	0	ppb	7.7	0.1
	NOx	0	ppb	-0.7	0.4
Span Value	NO	400	ppb	259.0	396.4
	NOx	400	ppb	243.1	403.2

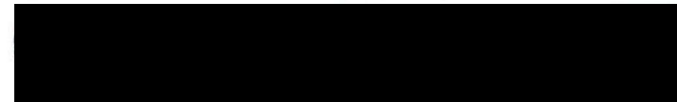
Calibrate By: _____

Date: 1-Feb-22

Approve By: _____

Date: 1-Feb-22

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502005

Page:1/1

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Instruments Information

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

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

Environment: Temperature 25.6 °C

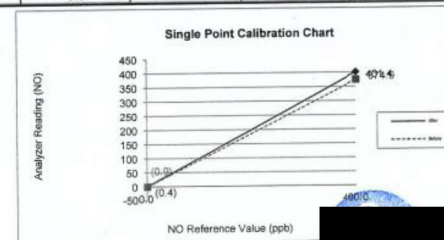
Humidity: 55 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.2	0.0	0.2	381.3	400.0	-2.4
NO ₂	-1.1	0.0	-1.1	-6.4	0.0	-0.8
NOx	-0.9	0.0	-0.9	374.9	400.0	-3.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-0.4	0.0	-0.4	398.9	400.0	-0.1
NO ₂	0.0	0.0	0.0	2.5	0.0	0.3
NOx	-0.4	0.0	-0.4	401.4	400.0	0.2



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502005

Page:1/1

Calibrated Date: 1-Feb-22

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-22				
Time	10:15				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	500 +/- 50	cc/min	482	486	
Ozone Flow	80-90	cc/min	80	80	
PMT Detector	0-5000	mV	33.2	25.1	
AZERO	-20-150	mV	23.4	23.0	
HVPS	400-900 constant	V	733	733	
DCPS	2500 +/- 200	mV	-	-	
RCCELL TEMP	50 +/- 1	Degree C	48.9	50.0	
BOX TEMP	20-35	Degree C	34.2	33.5	
PMT TEMP	7 +/- 1	Degree C	7.0	7.0	
IZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	314.9	314.9	
RCCL PRES	4-10 constant	IN-Hg-A	4.5	4.5	
SAMP PRES	20-30 constant	IN-Hg-A	29.5	23.0	
NO Slope	1 +/- 0.3		0.850	1.095	
NOx Slope	1 +/- 0.3		0.973	0.977	
NO Offset	-10 to + 150	mV	7.1	4.1	
NOx Offset	-10 to + 150	mV	-5.9	15.3	
Span and Cal Values					
Zero Value	NO	0	ppb	0.2	-0.4
	NOx	0	ppb	-0.9	-0.4
Span Value	NO	400	ppb	381.3	398.9
	NOx	400	ppb	374.9	401.4

Calibrate By: _____

Date: 1-Feb-22

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502005

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

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Instruments Information

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

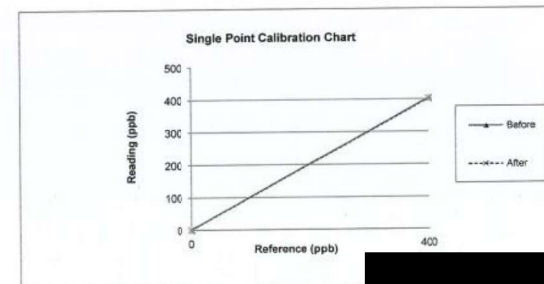
Calibrator Unit	Standard Gas
Dilutor Model ESA MGCT01 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19,2024 EB0140762

Environment: Temperature 25.5 °C

Humidity: 60 %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	404.3	0.5
After	0.0	0.4	0.4	400.0	402.0	0.2



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502005
Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-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	32.6	
HVPS	400-900 constant	V	719	648	
DCPS	2500 (+/- 200)	mV	-	-	
CELL TEMP	50 (+/- 1)	Degree C	50	50	
BOX TEMP	20-40	Degree C	34.1	32.7	
PMT TEMP	7 (+/-1)	Degree C	8.0	8.0	
UV lamp	1000-4900	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 Volta	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	1.5	0.4	
Span Gas (400 PPB)	400	ppb	404.3	402.0	± 5% of Range

Calibrate By: _____

Date: 1-Feb-22

Approve By: _____

Date: 1-Feb-22

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502006
Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100E	Manufacturer API S/N: ESQAI100E01218
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Calibration System

Calibrator Unit Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	Standard Gas NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762
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Environment: Temperature 25.4 °C Humidity: 59 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.8	0.8	400.0	395.5	-0.6
After	0.0	0.2	0.2	400.0	403.0	0.4

Single Point Calibration Chart

Calibrate By: _____

Date: 1-Feb-22

Approve By: _____

Date: 1-Feb-22

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502006

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-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	32.6	
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)	0	ppb	0.8	0.2	
Span Gas (400 PPB)	400	ppb	395.5	403.0	± 5% of Range

Calibrate By: _____

Date: 1-Feb-22

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6502006

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

Analyzer Type: CO Analyzer
Model: CO12E

Manufacturer Environnement SA, France
S/N: ECOESACO12E205

Calibration System

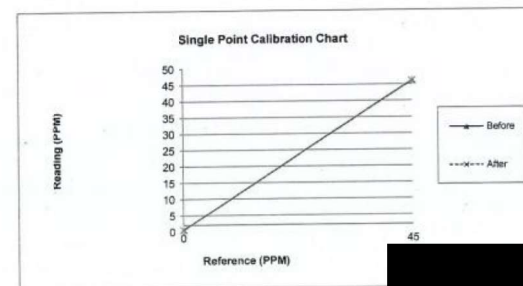
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NO Conc 44.68 PPM
ZERO AIR Generator ZAG7001 S/N: 644	SO2 Conc 45.34 PPM
	CO Conc 4500 PPM
	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.0 °C

Humidity: 61 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.500	0.5	45.0	46.17	1.3
After	0.0	0.500	0.5	45.0	46.08	1.2



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6502006

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 2/2

Analyzer Signal Values					
Date	1-Feb-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

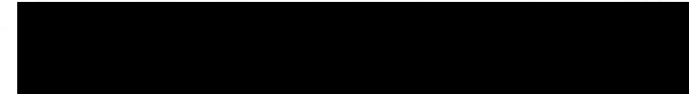
Calibrate By :

Date: 1-Feb-22

Approve By :

Date: 1-Feb-22

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6502005

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

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

Calibration System

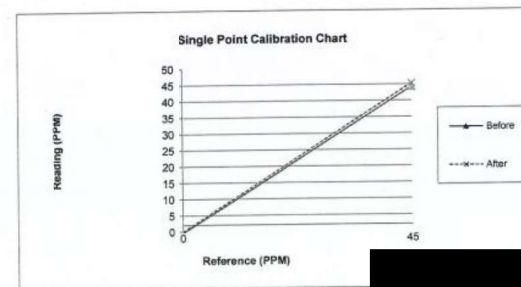
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 24.9 °C

Humidity: 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	-0.480	-0.5	45.0	44.21	-0.9
After	0.0	-0.020	0.0	45.0	45.32	0.4



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6502005
Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 2/2

Analyzer Signal Values					
Date	1-Feb-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	50	l/h

Calibrate By : _____

Date: 1-Feb-22

Approve By : _____

Date: 1-Feb-22

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

Certificate of Calibration

Calibration Certification Information					
Cal. Date: January 19, 2022	Rootsmeter S/N: 438320	Ta: 294	*K		
Operator: Jim Tisch		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)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (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= $Vstd/\Delta Time$	Qa= $Va/\Delta Time$
For subsequent flow rate calculations:	
Qstd= $1/m \left(\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)} \right) - b$	Qa= $1/m \left(\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)} \right) - b$

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

Key

ΔH: calibrator manometer reading (in H2O)

ΔP: rootsmeter manometer reading (mm Hg)

Ta: actual absolute temperature (°K)

Pa: actual barometric pressure (mm Hg)

b: intercept

m: slope

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

Certificate of Calibration

Certificate No. : 65-200022-1 Page : 1 of 2

Submitted by : [REDACTED]

Equipment : Electronic Balance
 Manufacturer : Sartorius Model : SECURA224-1S
 Serial No. : 0034803270 ID No. : ELABBALANCEN04
 Capacity : 220 g Resolution : 0.0001 g

Environment : On site calibration was carried out at the Balance Room, Envilab Co., Ltd.
 Ambient Temperature : (23.7 to 23.8) °C
 Relative Humidity : (57.1 to 58.0) %
 Air Pressure : 1012.0 mbar

Date of Received : 02 February 2022
 Date of Calibration : 02 February 2022
 Date of Issue : 09 February 2022
 Calibrated by : [REDACTED]

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 14
 Edition 5, July 2015

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

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02213103	18 Nov 2022	National Institute of Metrology (Thailand), (NIMT)

Approved by : [REDACTED]
 Laboratory Manager

The Uncertainties are for [REDACTED]
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CAL-F0031-03

Certificate of Calibration

Certificate No. : 65-200022-1 Page : 2 of 2

Result of Calibration : Without Adjustment
 UUC Condition As-Received : Good
 Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty ± (g)
0.01	0.0001	0.00011
0.1	0.0001	0.00011
1	0.0000	0.00011
2	0.0001	0.00011
5	0.0000	0.00012
10	0.0001	0.00012
20	-0.0001	0.00013
50	0.0000	0.00014
100	-0.0002	0.00020
200	-0.0004	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 $k = 2.11$,
 providing a level of confidence of approximately 95%

Eccentric error Load test : 50 g

A	B	C	D	E
-0.0001	-0.0002	-0.0002	-0.0001	0.0000

Repeatability Load test : 200 g
 Sidev. : 0.00005 g

CAL-F0031-03



Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 10 August, 2021

Certification No. 377/21

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2509

Customer :



Calibration Condition : Temperature 25.1 °C Barometric Pressure 1007.3 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

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

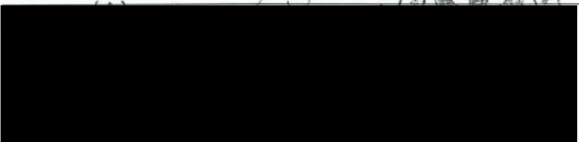
Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

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

: Thermoschneider No.9183

STANDARD BAROMETER : Digital Barometer Vaisala PTB320 No.120015



The Result of Calibration

Sensor model

EWSNV110WS2509

Certification No. 377/21

10 August, 2021

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Pressure	Velocity	Correction
m/sec	inches	inches	hPa	m/sec	m/sec
1.00	-	-	-	6.9	0.10
3.02	-	-	-	3.1	-0.08
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.0	0.04
9.02	-	-	-	8.7	0.32
11.01	-	-	-	10.7	0.31
13.01	-	-	-	12.7	0.31
15.01	-	-	-	14.9	0.11
17.02	-	-	-	17.0	0.02
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 EWSNV110WS2509

Certification No. 377/21

10 August, 2021

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1009.87	1009.99	-0.12
1009.53	1009.72	-0.19
1007.23	1007.59	-0.36
1007.00	1007.33	-0.33
1006.68	1007.06	-0.38
1006.46	1006.79	-0.33
1006.27	1006.53	-0.26
1006.44	1006.79	-0.35
1006.78	1006.79	-0.01
1007.64	1007.86	-0.22
1008.23	1008.39	-0.16
1007.79	1008.13	-0.34
1008.96	1009.19	-0.23
1007.85	1008.13	-0.28
1008.02	1008.39	-0.37
1008.30	1008.66	-0.36
1008.77	1008.92	-0.15
1009.28	1009.46	-0.18
1009.65	1009.72	-0.07
1009.75	1009.99	-0.24

Average

กช.ย.ม.ว.

The Result of Calibration

Sensor model EWSNV110WS2509

Certification No. 377/21

10 August, 2021

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.2	45.0	0.2
31.3	31.0	0.3
15.8	15.7	0.1

Mechanical Engineer

The Result of Calibration		
Sensor model EWSNV110WS2509 Certification No. 377/21		
10 August, 2021 Page : 5 of 6		
Standard Humidity % R.H.	Relative Humidity Sensor Reading Reading % R.H.	Correction % R.H.
85.2	78.0	7.2
61.4	56.4	5.0
41.5	38.8	2.7

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชื่อ Davis แบบ TIPPING BUCKET Model 7342.026 ID No.EWSNV110WS2509 ทำการสอบเทียบกับแก้วฝนแบบแก้ว ควง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm(0.01 in) P)

วิศวกรชำนาญการ

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau
Date of Issue : 10 August, 2021 Certification No. 378/21
Page : 1 of 6

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

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1006.3 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
: Ultrasonic Anemometer Model DA-650-3TV (sensor TR-90AH)
Serial Number 110730029 (sensor 120629586)
JAPAN QUALITY ASSURANCE ORGANIZATION
STANDARD THERMOMETER : Theodor Friedrich : Dry No.8390/94 Wet No. 8389/94
: Thermoschneider No.918802
STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 Non-Vacuum 0015



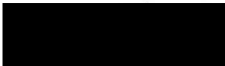
The Result of Calibration


Sensor model EWSNV110WS2510 Certification No. 378/21
10 August, 2021 Page : 2 of 6

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches	Vacuum inches	Pressure hPa	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.9	0.12
5.00	-	-	-	5.0	0.00
7.04	-	-	-	7.1	-0.06
9.02	-	-	-	9.0	0.02
11.01	-	-	-	11.1	-0.09
13.01	-	-	-	13.1	-0.09
15.01	-	-	-	15.1	-0.09
17.02	-	-	-	17.2	-0.18
20.02	-	-	-	20.5	-0.48

Wind Aloft Plotting Board.
US.DEPARTMENT OF COMMERCE WEATHER BUREAU

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


Mechanical Engineer



The Result of Calibration

Sensor model EWSNV110WS2510

Certification No. 378/21

10 August, 2021

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1009.87	1010.09	-0.22
1009.53	1009.82	-0.29
1007.23	1007.70	-0.47
1007.00	1007.43	-0.43
1006.68	1007.16	-0.48
1006.46	1006.90	-0.44
1006.27	1006.63	-0.36
1006.44	1006.90	-0.46
1006.78	1007.16	-0.38
1007.64	1008.23	-0.59
1008.23	1008.76	-0.53
1007.79	1008.23	-0.44
1008.96	1009.56	-0.60
1007.85	1008.23	-0.38
1008.02	1008.49	-0.47
1008.30	1008.76	-0.46
1008.77	1008.29	0.48
1009.28	1009.82	-0.54
1009.65	1010.09	-0.44
1009.75	1010.36	-0.61

Average

Mechanical Engineer

The Result of Calibration

Sensor model EWSNV110WS2510

Certification No. 378/21

10 August, 2021

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.2	45.4	-0.2
31.3	31.3	0.0
15.8	15.9	-0.1

Mechanical Engineer

The Result of Calibration		
Sensor model EWSNV110WS2510 Certification No. 378/21		
10 August, 2021 Page : 5 of 6		
Standard Humidity % R.H.	Relative Humidity Sensor Reading Reading % R.H. Correction % R.H.	
85.2	81.6	3.6
61.4	59.2	2.2
41.5	40.1	1.4

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีฮ้อ Davis แบบ TIPPING BUCKET Model 7342.026 ID No.EWSNV110WS2510 ทำการสอบเทียบกับแก้วฝนแบบแก้ว ตวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องวัดฝน (NIP)

วิศวกรชำนาญการ

Mechanical Engineer

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-64/0406 MTC No. EEL. BP. 68/0364

CALIBRATION CERTIFICATE

Submitted by : [REDACTED]
Address : [REDACTED]
Calibrated at : [REDACTED]

Instrument Calibrated :
Description : Acoustic Calibrator
Manufacturer : Pulsar
Model : 106
Serial No. : 87098

Ambient Environment
Temperature : (23 ± 3) °C
Relative Humidity : (50 ± 15) %
Ambient Pressure : (101.325 ± 1.500) kPa

Standards used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier 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 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 : 10 Mar. 2021
Date of Calibration : 12 Mar. 2021

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. 21-64/0406 MTC No. EEL. BP. 68/0364

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 2
1/2 inch Brüel&Kjaer 4180	94.13	0.13	± 0.10	± 0.75 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Brüel&Kjaer 4180	1000.3	0.3	± 1.5	± 2.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 2
1/2 inch Brüel&Kjaer 4180	0.72	± 0.50	± 4.0%

Note :

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

Calibrated by : [REDACTED]

Date of Calibration : 12 Mar. 2021
Date of Issue : 16 Mar. 2021

Ref : 2011264031001119001 2 / 2

End of Certificate

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

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

สถานีโรงพยาบาลเซนต์หลุยส์

สถานีโรงเรียนกรุงเทพคริสเตียนวิทยาลัย

ครั้งที่ 4/2564

วันที่ตรวจวัดวันที่ 25-30 เมษายน 2565

TSP High Volume Sampler Calibration

Verification Report No.
SO-2200070-E001 -TSP 01

☐ FM ☒ Onsite
Site: กรุงเทพมหานคร
UTM: 47P N 1517383 E 664631
Sampler: TSP#23
Recorder: EVFCDIGITAL023
Date: 25 Apr 22
Technical:
Approval:

CONDITIONS

Barometric Press. (hPa): 1009.0 Corrected Pressure (mm Hg): 756.8
Temperature (deg C): 33.7 Temperature (deg K): 306.7
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

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.48	1.950	52.0	51.15
2	9.12	1.819	48.0	47.21
3	7.35	1.634	46.0	45.25
4	4.55	1.287	40.0	39.35
5	3.26	1.091	36.0	35.41

LINEAR REGRESSION
Slope = 17.3485
Intercept = 16.6794
Corr. coeff = 0.9947
of Observations: 5
Range of Chart at 1.1 - 1.7 m3/min: 48

Calibrated by:
25 April 2022

Approved by:
25 April 2022

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15-0007123 Rev.02/20/2020

TSP High Volume Sampler Calibration

Verification Report No.
SO-2200070-E001 -TSP 02

☐ FM ☒ Onsite
Site: กรุงเทพมหานคร
UTM: 47P N 1517261 E 664905
Sampler: ETSP#19
Recorder: EVFCDIGITAL019
Date: 25 Apr 22
Technical:
Approval:

CONDITIONS

Barometric Press. (hPa): 1009.0 Corrected Pressure (mm Hg): 756.8
Temperature (deg C): 33.7 Temperature (deg K): 306.7
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

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.46	1.948	52.0	51.15
2	9.45	1.852	50.0	49.18
3	7.31	1.629	46.0	45.25
4	4.62	1.283	40.0	39.35
5	3.26	1.091	36.0	35.41

LINEAR REGRESSION
Slope = 18.0358
Intercept = 15.9242
Corr. coeff = 0.9996
of Observations: 5
Range of Chart at 1.1 - 1.7 m3/min: 47

Calibrated by:
25 April 2022

Approved by:
25 April 2022

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15-0007123 Rev.02/20/2020

PM10 High Volume Sampler Calibration

Verification Report No. SO-2200070-E001-PM 01

L. PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM: 47P N 1517393 E 664631
 Sampler: PM10023
 Recorder: EVFCDIGITAL019

Date: 25 Apr 22
 Technical: XXXXXXXXXX
 Approver: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1009.0

Corrected Pressure (mm Hg): 756.8

Temperature (deg C): 33.7

Temperature (deg K): 306.7

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

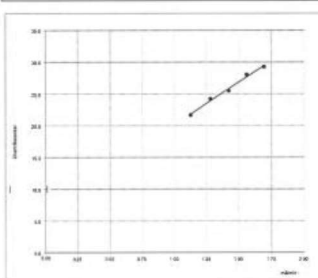
Brand: Tisch Environmental, Inc
Model: TE-5028A
Serial#: 1328

Slope: 1.02967
 Intercept: -0.00753
 Date Certified: 19 Jan 22

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	7.40	1.694	46.0	29.28
2	6.28	1.581	44.0	28.01
3	5.22	1.434	40.0	25.46
4	4.22	1.281	38.0	24.19
5	3.25	1.125	34.0	21.64

LINEAR REGRESSION
 Slope = 13.4810
 Intercept = 6.6144
 Corr. coeff = 0.9948
 SFR = 1.148
 SSP = 34.71
 # of Observations: 5
 Range of Chart at SFR ±10%: 33



Calibrated by: XXXXXXXXXX
 25 April 2022

 Approved by: XXXXXXXXXX
 25 April 2022

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PM10 High Volume Sampler Calibration

Verification Report No. SO-2200070-E001-PM 02

L. PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM: 47P N 1517261 E 664905
 Sampler: PM1006S
 Recorder: EVFCDIGITAL005

Date: 25 Apr 22
 Technical: XXXXXXXXXX
 Approver: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1008.4

Corrected Pressure (mm Hg): 756.4

Temperature (deg C): 33.7

Temperature (deg K): 306.7

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

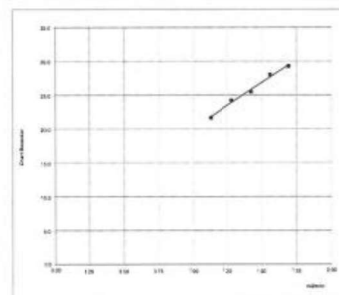
Brand: Tisch Environmental, Inc
Model: TE-5028A
Serial#: 1328

Slope: 1.02967
 Intercept: -0.00753
 Date Certified: 19 Jan 22

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	7.22	1.674	46.0	29.29
2	6.85	1.631	44.0	28.02
3	5.32	1.438	40.0	25.47
4	4.76	1.361	38.0	24.20
5	3.86	1.228	36.0	22.92

LINEAR REGRESSION
 Slope = 14.0117
 Intercept = 5.4424
 Corr. coeff = 0.9922
 SFR = 1.149
 SSP = 33.83
 # of Observations: 5
 Range of Chart at SFR ±10%: 32



Calibrated by: XXXXXXXXXX
 25 April 2022

 Approved by: XXXXXXXXXX
 25 April 2022

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Verification Test Report

Report No.:
SO2200070-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1517400 E 664651

Calibrated Date: 25 April 2022
Site : โรงพยาบาลพระคริสเตียน
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1799

Environment: Temperature 30 °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	94.00	0.34	93.66

Calibrated By:
Date: 25 April 2022

Approve By:
Date: 25 April 2022

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Verification Test Report

Report No.:
SO2200070-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1517253 E 664610

Calibrated Date: 25 April 2022
Site : โรงพยาบาลเซนต์หลุยส์
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1968

Environment: Temperature 30 °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	93.90	0.24	93.66

Calibrated By:
Date: 25 April 2022

Approve By:
Date: 25 April 2022

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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	Tx:	294	°K
Operator:	Jim Tisch	Px:	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 (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)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (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	1.1505	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 (in H2O)
ΔP:	rootsmeter manometer reading (mm Hg)
Ta:	actual absolute temperature (°K)
Pa:	actual barometric pressure (mm Hg)
b:	intercept
m:	slope

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

Certificate of Calibration

Certificate No. : 65-200022-1

Page : 1 of 2

Submitted by : [REDACTED]

Equipment : Electronic Balance
 Manufacturer : Sartorius Model : SECURA224-1S
 Serial No. : 0034803270 ID No. : ELABBALANCEN04
 Capacity : 220 g Resolution : 0.0001 g

Environment : On site calibration was carried out at the Balance Room, Envilab Co., Ltd.
 Ambient Temperature : (23.7 to 23.8) °C
 Relative Humidity : (57.1 to 58.0) %
 Air Pressure : 1012.0 mbar

Date of Received : 02 February 2022
 Date of Calibration : 02 February 2022
 Date of Issue : 09 February 2022

Calibrated by : [REDACTED]

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref: LAB 14 Edition 5, July 2015

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

Standard Weights	ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02213103	18 Nov 2022	National Institute of Metrology (Thailand), (NIMT)	

Approved by : [REDACTED]

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 65-200022-1 Page : 1 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of Indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty ± (g)
0.01	0.0001	0.00011
0.1	0.0001	0.00011
1	0.0000	0.00011
2	0.0001	0.00011
5	0.0000	0.00012
10	0.0001	0.00012
20	-0.0001	0.00013
50	0.0000	0.00014
100	-0.0002	0.00029
200	-0.0004	0.00034

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 $k = 2.11$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 50 g	A	B	C	D	E
	-0.0001	-0.0002	-0.0002	-0.0001	0.0000

Repeatability

Load test : 200 g	Sidev. : 0.00005 g

(CAL-P001)-03

Certificate of Calibration

Certificate No. SG-H-00003/45
Issue By Humidity Laboratory Page : 1 of 4

Customer : [REDACTED]

Address : [REDACTED]

Description : HygroPalm Calibrator

Manufacturer : Rotronic

Model : HP23-A

Serial No. : 61496805

ID No. : 400034

Location : -

Received Date : January 5, 2022

Measurement Date : January 6, 2022

Issued Date : January 7, 2022

Checked By Approved By


[REDACTED] [REDACTED]

Supervisor Calibration Manager

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

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SGF-0001-REV. 02/08-02-99



Certificate of Calibration

Certificate No.
SG-H-00003/65

Issue By
Humidity Laboratory

Page : 2 of 4

Environment	Temperature (23 °C ± 2 °C)	Humidity (50 %RH ± 15 %RH)																																																																																				
Measurement Method This instrument was calibrated by in house method CP-H-001 comparison with two temperature two pressure standard humidity generator																																																																																						
Uncertainty of Measurement The uncertainty state is the expanded uncertainty obtained by multiplying the standard Uncertainty by the coverage factor k=2. It has been determined in accordance with M3003 "The Expression of Uncertainty and Confidence in Measurement". The value of the measured lies within the assigned range of values with a Probability of 95 %																																																																																						
Traceability This certification is traceable to the International System of Units (SI Units)																																																																																						
Standard Used <table border="1" style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th>Item</th> <th>Description</th> <th>Model</th> <th>Serial No.</th> <th>Traceable through</th> <th>Certificate No.</th> <th>Due Date</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Humidity Generator</td> <td>23005T-4T</td> <td>14081021</td> <td>Success</td> <td>SG-T-01408/64</td> <td>4-Oct-22</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> <td>Success</td> <td>SG-P-00518/64</td> <td>5-Oct-22</td> </tr> <tr><td> </td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td> </td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td> </td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td> </td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td> </td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td> </td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td> </td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td> </td><td></td><td></td><td></td><td></td><td></td><td></td></tr> <tr><td> </td><td></td><td></td><td></td><td></td><td></td><td></td></tr> </tbody> </table>			Item	Description	Model	Serial No.	Traceable through	Certificate No.	Due Date	1	Humidity Generator	23005T-4T	14081021	Success	SG-T-01408/64	4-Oct-22					Success	SG-P-00518/64	5-Oct-22																																																															
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				Success	SG-P-00518/64	5-Oct-22																																																																																

Success : Success Gateway Co., Ltd.

SGP-0021-REV. 02/08-02-59

Report of Calibration

Certificate No.
SG-H-00003/65

Page : 3 of 4

Channel : 1

Measurement Results : As-Found

Function : Humidity measurement

Reference Temperature @ 25.0 °C

This instrument was connected with Humidity sensor model HC2A-S S/N. 20136114 ID No. 400035

Standard Reading (%RH)	UUC Reading (%RH)	Correction (%RH)	Uncertainty (± %RH)
28.04	27.87	0.17	0.40
50.04	49.57	0.47	0.67
70.03	69.53	0.50	0.93
90.01	89.76	0.25	1.2

UUC : Unit Under Calibration

Measurement Results : As-Found

Function : Temperature measurement

Reference Humidity @ 50.0 %RH

Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
10.01	10.01	0.00	0.19
19.96	19.96	0.00	0.19
29.94	29.93	0.01	0.19
40.04	40.00	0.04	0.19

UUC : Unit Under Calibration

SGP-0021-REV. 02/08-02-59

Report of Calibration

Certificate No.
SG-H-00003/65

Page : 4 of 4

Channel : 2

Measurement Results : As-Found

Function : Humidity measurement

Reference Temperature @ 25.0 °C

This instrument was connected with Humidity sensor model HC2A-S S/N. 20136032 ID No. 400036

Standard Reading (%RH)	UUC Reading (%RH)	Correction (%RH)	Uncertainty (± %RH)
28.04	28.05	-0.01	0.40
50.04	49.87	0.17	0.67
70.03	69.73	0.30	0.93
90.01	89.69	0.32	1.2

UUC : Unit Under Calibration

Measurement Results : As-Found

Function : Temperature measurement

Reference Humidity @ 50.0 %RH

Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
10.01	10.00	0.01	0.19
19.96	19.98	-0.02	0.19
29.94	29.94	0.00	0.19
40.04	40.02	0.02	0.19

UUC : Unit Under Calibration

----- End of Certificate of Calibration -----

SGF-0023-REV. 02/08-02/09

CALIBRATION CERTIFICATE

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

Submitted by : [REDACTED]

Address : [REDACTED]

Calibrated at : [REDACTED]

Instrument Calibrated :

Description : Acoustic Calibrator

Manufacturer : Bruel&Kjaer

Model : 4230

Serial No. : 1351075

Ambient Environment

Temperature : (23 ± 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

Standards used :

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

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level 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

/ 2

The results relate only to the items tested/calibrated or value assigned.
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FABL.MTC.002 Rev.4

รายงานการติดตามตรวจสอบคุณภาพสิ่งแวดล้อมประจำปี 2564
โครงการระบบขนส่งมวลชนกรุงเทพมหานคร (ครั้งที่ 2)

บริษัท ระบบขนส่งมวลชนกรุงเทพ จำกัด (มหาชน)

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 : [Redacted] Approved by : [Redacted]

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.

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 800R-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	$\pm 1.4\%$ NIST Traceable	02/12/2021, 02/19/2021
NITRIC OXIDE	45.00 PPM	44.82 PPM	G1	$\pm 1.4\%$ NIST Traceable	02/12/2021, 02/19/2021
SULFUR DIOXIDE	45.00 PPM	45.34 PPM	G1	$\pm 1.1\%$ NIST Traceable	02/12/2021, 02/19/2021
CARBON MONOXIDE	4500 PPM	4500 PPM	G1	$\pm 1.0\%$ NIST Traceable	02/19/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	200611-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	$\pm 1.0\%$	Feb 02, 2025
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 26, 2020
GMIS	124204889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141769	KAL003190	49.87 PPM SULFUR DIOXIDE/NITROGEN	$\pm 1.0\%$	Jun 26, 2022
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	$\pm 0.6\%$	Jun 07, 2024

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Jan 27, 2021
Nicolet iS50 FTIR AJP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AJP2010245 NO2	FTIR	Jan 21, 2021
Nicolet iS50 FTIR AJP2010245 SO2	FTIR	Jan 21, 2021

Triad Data Available Upon Request

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504007

Calibrated Date: 1-Apr-22

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

Analyzer Type: SO2 Analyzer Model: T100	Manufacturer API S/N: ESOAIT10002033
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Calibration System

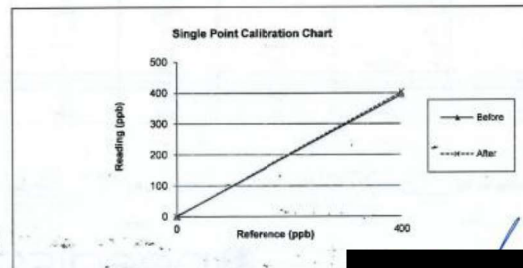
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NO Conc: 44.68 PPM
ZERO AIR Generator ZAG7001 S/N: 644	SO2 Conc: 45.34 PPM
	CO Conc: 4500 PPM
	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 24.5 °C

Humidity: 48 %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	395.0	-0.5
After	0.0	0.2	0.2	400.0	403.0	0.4



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504007

Calibrated Date: 1-Apr-22

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Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-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	32.6	
RVPS	400-900 constant	V	719	648	
DCPS	2500 (+/- 250)	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 constant	IN-Hg-A	28.1	27.8	
Electric Test/Optic Test					
PMT Volta	2000 (+/- 100)	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	0.8	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	0.9	0.2	
Span Gas (400 PPB)	400	ppb	395.0	403.0	± 5% of Range

Calibrate By: [Signature]

Approve By: [Signature]

Date: 1-Apr-22

Date: 1-Apr-22

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504006

Calibrated Date: 1-Apr-22

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Instruments Information

Page: 1/2

Analyzer Type: SO2 Analyzer Model: 100E	Manufacturer API S/N: ESOAH100E01218
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Calibration System

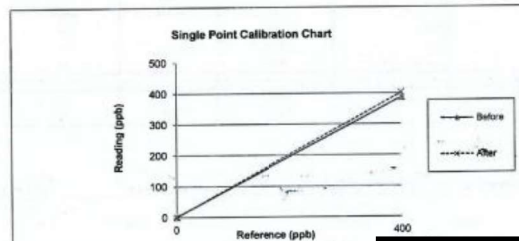
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc: 44.68 PPM SO2 Conc: 45.34 PPM CO Conc: 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 26.8 °C

Humidity: 47 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.3	1.3	400.0	387.2	-1.6
After	0.0	0.6	0.6	400.0	401.6	0.2



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504006

Calibrated Date: 1-Apr-22

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Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-22				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	950 (+/- 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 (+/- 250)	mV	-	-	
CELL TEMP	50 (+/- 1)	Degrees C	50	50	
BOX TEMP	20-40	Degrees C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Degrees 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	PPE	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	26.1	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	1.3	0.6	
Span Gas (400 PPB)	400	ppb	387.2	401.6	± 5% of Range

Calibrate By: [Redacted]

Approve By: [Redacted]

Date: 1-Apr-22

Date: 1-Apr-22

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504002

Page: 1/1

Calibrated Date: 1-Apr-22

☒ PM ☐ Onsite

Instruments Information

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

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc: 44.68 PPM SO2 Conc: 45.34 PPM CO Conc: 4500 PPM Expire Date: Feb 19, 2024 E80140762

Environment: Temperature 27.0 °C

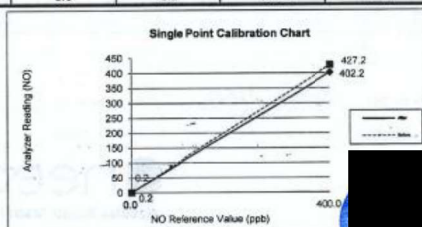
Humidity: 47 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-1.2	0.0	-1.2	421.9	400.0	2.7
NO ₂	1.4	0.0	1.4	5.3	0.0	0.6
NOx	0.2	0.0	0.2	427.2	400.0	3.3

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.2	0.0	0.2	398.3	400.0	-0.2
NO ₂	0.0	0.0	0.0	3.9	0.0	0.5
NOx	0.2	0.0	0.2	402.2	400.0	0.3



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504002

Page: 1/1

Calibrated Date: 1-Apr-22

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Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-22				
Time	10:15				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	500±1.50	cc/min	482	488	
Ozone Flow	80.80	cc/min	80	80	
PMT Detector	0-50000	mV	33.2	25.1	
AZERO	-20-150	mV	23.4	23.0	
WVPS	400-800 constant	V	733	733	
DCPS	2500 ±1.200	mV	-	-	
RCCL TEMP	50±1	Degree C	48.9	50.0	
BOX TEMP	20-35	Degree C	34.2	33.5	
PMT TEMP	7 ±1	Degree C	7.0	7.0	
IZS TEMP	50±1.4	Degree C	-	-	
MOLY Temp	315 ±1.5	Degree C	314.9	314.9	
RCCL PRES	4-10 constant	IN-Hg-A	4.5	4.5	
SAMP PRES	20-30 constant	IN-Hg-A	29.5	23.0	
NO Slope	1 ±1.0.3		0.890	1.095	
NOx Slope	1 ±1.0.3		0.973	0.977	
NO Offset	-10 to +150	mV	7.1	4.1	
NOx Offset	-10 to +150	mV	-5.9	15.3	
Span and Cal Values					
Zero Value	NO	0	ppb	-1.2	0.2
	NOx	0	ppb	0.2	0.2
Span Value	NO	400	ppb	421.8	398.3
	NOx	400	ppb	427.2	402.2

Calibrate By: [Redacted]

Approve By: [Redacted]

Date: 1-Apr-22

Date: 1-Apr-22

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504001

Page: 1/1

Calibrated Date: 1-Apr-22

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Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20002470
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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 EB140762

Environment: Temperature 27.8 °C

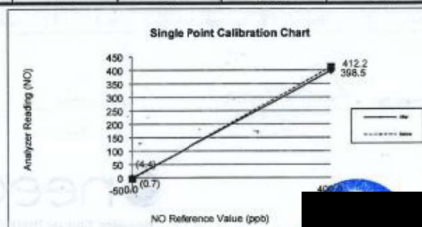
Humidity: 50 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-4.9	0.0	-4.9	405.5	400.0	0.7
NO ₂	0.5	0.0	0.5	6.7	0.0	0.8
NOx	-4.4	0.0	-4.4	412.2	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	0.0	0.0	0.0	398.8	400.0	-0.2
NO ₂	-0.7	0.0	-0.7	-0.3	0.0	0.0
NOx	-0.7	0.0	-0.7	398.5	400.0	-0.2



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504001

Page: 2/2

Calibrated Date: 1-Apr-22

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Test Function Value	Normal range	Unit	Before	After	Note
Date	1-Apr-22				
Time	16:10				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	± 0.2	PPB	0.5	0.2	
Sample Flow	500±10	cc/min	511	532	
Ozone Flow	80-90	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 ±100	mV	-	-	
NO ₂ TEMP	50±1	Dreagee C	50	50	
NO ₂ TEMP	25-35	Dreagee C	33.7	32.9	
PMT TEMP	7 ±1	Dreagee C	7.1	7.1	
NO ₂ TEMP	50±1	Dreagee C	-	-	
MOLY Temp	315 ±1	Dreagee C	314.4	315.0	
NO ₂ 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	-4.9	0.0
	NOx	0	ppb	-4.4	-0.7
Span Value	NO	400	ppb	405.5	398.8
	NOx	400	ppb	412.2	398.5

Calibrate By: [Signature]

Approve By: [Signature]

Date: 1-Apr-22

Date: 1-Apr-22

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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6504002

Calibrated Date: 1-Apr-22

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Instruments Information

Page: 1/2

Analyzer Type: CO Analyzer Model: T300	Manufacturer API S/N: ECOAIT3000099
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Calibration System

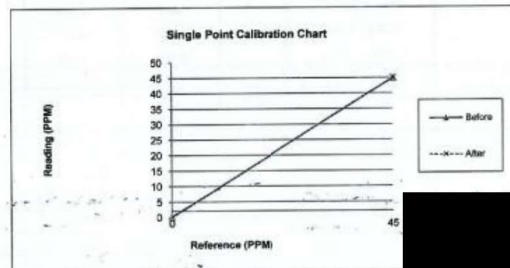
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 27.7 °C

Humidity 51 %RH

Calibration Report

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



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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6504002

Calibrated Date: 1-Apr-22

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Page: 2/2

Detail	Range	Unit	Before	After	Note
Date	1-Apr-22				
Time	14:57				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.22	0	
CO Measure	2500 - 4800 MV,	mV	3793.2	3836.5	
CO Reference	2500 - 4800 MV,	mV	3143.6	3179.5	
MR Ratio	1.2 +/- 0.5		1.215	1.215	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	28.6	28.6	
Sample Flow	720 - 880 cc/min	cc/min	859	859	
Sample Temp	44 - 52 deg.C	deg.C	47.8	46.7	
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	32	34.9	
PHT drive	250 - 4750 mv,	mV	3015	3018.6	
Slope	0.800 - 1.200		0.867	0.875	
Offset	0.05 +/- 0.2		0.006	0.005	
Gas Test Response					
Zero Gas	0	PPM	0.4	0.0	
Span Gas	45	PPM	45.8	45.0	± 5% of Range

Calibrate By: [Signature]

Approve By: [Signature]

Date: 1-Apr-22

Date: 1-Apr-22

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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6504001

Calibrated Date: 1-Apr-22

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Instruments Information

Page: 1/2

Analyzer Type: CO Analyzer Model: T300	Manufacturer API S/N: ECOAIT30000088
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Calibration System

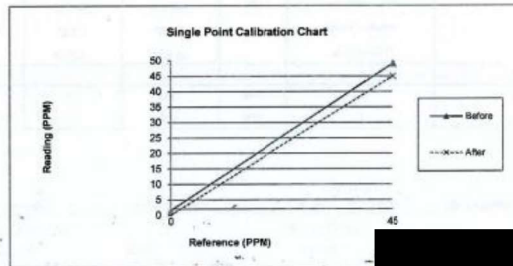
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO ₂ Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 27.5 °C

Humidity 53 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.5	1.5	45.0	49.1	4.4
After	0.0	0.0	0.0	45.0	45.0	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: TD-C6504001

Calibrated Date: 1-Apr-22

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Detail	Range	Unit	Before	After	Note
Date	1-Apr-22				
Time	10:51				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.04	0.2	
CO Measure	2500 - 4800 MV	mV	4465.6	4431.3	
CO Reference	2500 - 4800 MV	mV	3768.5	3730.2	
MR Ratio	1.2 +/- 0.5		1.19	1.20	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	28.7	28.6	
Sample Flow	720 - 880 ccl/min	ccl/min	904	898	
Sample Temp	44 - 52 deg.C	deg.C	48.5	43.3	
Bench Temp	47 - 49 deg.C	deg.C	48	48	
Wheel Temp	66 - 70 deg.C	deg.C	68	68	
Box Temp	27 - 50 deg.C	deg.C	33.3	34.8	
PHI drive	250 - 4750 mv.	mV	2912.3	2913.5	
Slope	0.800 - 1.200		1.197	1.138	
Offset	0.05 +/- 0.2		-0.015	-0.016	
Gas Test Response					
Zero Gas	0	PPM	0.4	0.0	
Span Gas	45	PPM	44.8	45.0	± 5% of Range

Calibrate By :

Approve By :

Date:

1-Apr-22

Date:

1-Apr-22

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