

ภาคผนวกที่ 4-2

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
สถานีรถไฟฟ้าชองนนทบุรี (อาคารโดมอันทาวเวอร์)
และสถานีรถไฟฟ้าศาลาแดง (สถานีอาคารหอแว่น)
ครั้งที่ 3/2564
วันที่ตรวจวัด วันที่ 19-24 กุมภาพันธ์ 2565

Verification Test Report

Report No.: SO2200013-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1517757 E 665377

Calibrated Date: 19 February 2022
Site : BTS ปลงนทรี
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1973

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	94.10	-0.03	94.13

Calibrated By:
Date: 19 February 2022

Approve By:
Date: 19 February 2022

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Verification Test Report

Report No.: SO2200013-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1518198 E 665848

Calibrated Date: 19 February 2022
Site : BTS ศาลาแดง
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1968

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	93.90	-0.23	94.13

Calibrated By:
Date: 19 February 2022

Approve By:
Date: 19 February 2022

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TSP High Volume Sampler Calibration

Verification Report No.
SO2200013-E001 -TSP 02

☐ PM ☒ Onsite
 Site: BTS ชลบุรี
 UTM : 47P N1517767 E 665344
 Sampler: ETSP#38
 Recorder: ECRANG15315224

Date: 19 Feb 22
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

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-5028A	Qstd Intercept: -0.01202
Serial#: 1328	Date Certified: 19 Jan 22

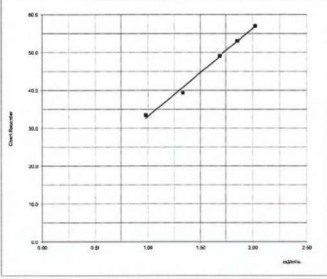
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.28	2.021	54.0	53.09
2	9.23	1.829	52.0	51.12
3	7.25	1.622	48.0	47.19
4	4.87	1.331	40.0	39.33
5	3.45	1.121	36.0	35.39

LINEAR REGRESSION

Slope = 20.7185
Intercept = 12.3905
Corr. coeff = 0.9914

of Observations: 5

Range of Chart at 1.1 - 1.7 m3/min	36
	48



Calibrated by: XXXXXXXXXX
19 February 2022

Approved by: XXXXXXXXXX
19 February 2022

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H-4017-20 Rev 02/20/2013

TSP High Volume Sampler Calibration

Verification Report No.
SO2200013-E001 -TSP 01

☐ PM ☒ Onsite
 Site: BTS ศาลาแดง
 UTM : 47P N 1518202 E 665866
 Sampler: ETSP#37
 Recorder: ECRANG15315246

Date: 19 Feb 22
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

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-5028A	Qstd Intercept: -0.01202
Serial#: 1328	Date Certified: 19 Jan 22

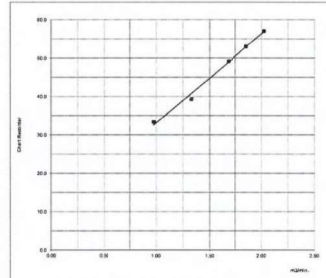
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.28	2.021	58.0	57.02
2	9.51	1.857	54.0	53.09
3	7.79	1.681	50.0	49.16
4	4.87	1.331	40.0	39.33
5	2.63	0.980	34.0	33.43

LINEAR REGRESSION

Slope = 23.2602
Intercept = 9.7972
Corr. coeff = 0.9963

of Observations: 5

Range of Chart at 1.1 - 1.7 m3/min	36
	50



Calibrated by: XXXXXXXXXX
19 February 2022

Approved by: XXXXXXXXXX
19 February 2022

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H-4017-20 Rev 02/20/2013

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

ผ4-39

[Redacted]

PM10 High Volume Sampler Calibration

Verification Report No.
SO2200013-E001-PM 02

L. PM <input checked="" type="checkbox"/> Onsite Site: BTS สถานีรถไฟ UTM : 47P N1517767 E 665344 Sampler: EPM#37 Recorder: ECRDS01618124	Date: 19 Feb 22 Technical: [Redacted] Approver: [Redacted]
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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 CRIFICE			
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	10.56	2.023	52.0	33.12
2	9.12	1.881	50.0	31.85
3	7.22	1.674	48.0	29.30
4	4.32	1.297	40.0	25.48
5	3.14	1.107	36.0	22.93

LINEAR REGRESSION	
Slope = 11.0549	Intercept = 10.8862
Corr. coeff = 0.9989	SFR = 1.149
SSP = 37.04	# of Observations: 5
Range of Chart at SFR ±10%:	36

Calibrated by: [Redacted]
 19 February 2022

 Approved by: [Redacted]
 19 February 2022

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[Redacted]

PM10 High Volume Sampler Calibration

Verification Report No.
SO2200013-E001-PM 01

L. PM <input checked="" type="checkbox"/> Onsite Site: BTS ศาลาแดง UTM : 47P N 1518202 E 665366 Sampler: EPM#32 Recorder: ECRDS01618152	Date: 19 Feb 22 Technical: [Redacted] Approver: [Redacted]
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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 CRIFICE			
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	10.56	2.023	54.0	34.39
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

LINEAR REGRESSION	
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

Calibrated by: [Redacted]
 19 February 2022

 Approved by: [Redacted]
 19 February 2022

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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 800R-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	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	200611-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	+/-1.0%	Feb 02, 2025
PRM	12389	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.9%	Feb 20, 2020
GMS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.87 PPM SULFUR DIOXIDE/NITROGEN	+/-1.0%	Jun 28, 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 GMS used in the assay and not part of the analysis.

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multi-point Calibration
SIEMENS ULTRAMAT 8 NTKD579	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

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.4 Kg
Net Weight: 4.5 Kg
PO# 5221000405

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502004

Page:1/1

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

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 EB0140762

Environment: Temperature 25.1 °C

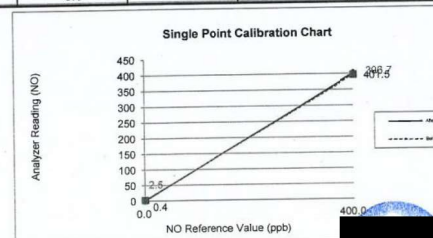
Humidity: 54 %RH

Calibration Check (Before adjust)

Zero				Span		
GAS	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
GAS	3.6	0.0	3.6	384.0	400.0	-0.8
NO	-1.1	0.0	-1.1	2.7	0.0	0.3
NO2	2.5	0.0	2.5	396.7	400.0	-0.4

Calibration Check (After adjust)

Zero				Span		
GAS	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
GAS	0.3	0.0	0.3	401.4	400.0	0.2
NO	0.1	0.0	0.1	0.1	0.0	0.0
NO2	0.4	0.0	0.4	401.5	400.0	0.2



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502004

Page: 1/1

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-22				
Time	10:10				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	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	-	-	
CELL TEMP	50 +/- 1	Degree C	50	50	
BOX TEMP	20-35	Degree C	33.7	32.9	
PMT TEMP	7 +/- 1	Degree C	7.1	7.1	
IZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	314.4	315.0	
CELL 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	3.6	0.3
	NOx	0	ppb	2.5	0.4
Span Value	NO	400	ppb	394.0	401.4
	NOx	400	ppb	396.7	401.5

Calibrate By: [Signature]

Date: 1-Feb-22

Approve By: [Signature]

Date: 1-Feb-22

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502003

Page: 1/1

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200E	Manufacturer API S/N: ENOAI200E01526
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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 26.3 °C

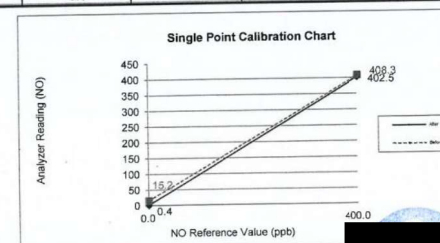
Humidity: 65 %RH

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	388.1	400.0	-1.5
NO ₂	4.0	0.0	4.0	20.2	0.0	2.5
NOx	15.2	0.0	15.2	408.3	400.0	1.0

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.2	0.0	0.2	398.0	400.0	-0.3
NO ₂	0.2	0.0	0.2	4.5	0.0	0.6
NOx	0.4	0.0	0.4	402.5	400.0	0.3



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502003

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	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±1.50	cc/min	470.0	478.0	
Ozone Flow	60-90	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 ±1.200	mV	-	-	
RCCELL TEMP	50±1.1	Dreagee C	50.3	50.3	
BOX TEMP	20-35	Dreagee C	28.0	27.5	
PMT TEMP	7 ±1.1	Dreagee C	7.7	7.8	
IZS TEMP	50±1.4	Dreagee C	-	-	
MOLY Temp	315 ±1.5	Dreagee 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 ±1.0.3		0.647	0.963	
Nox Slope	1 ±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	NC	0	ppb	11.2	0.2
	NOx	0	ppb	15.2	0.4
Span Value	NC	400	ppb	388.1	398.0
	NOx	400	ppb	408.3	402.5

Calibrate By :

Approve By :

Date: 1-Feb-22

Date:

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502004

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page:1/2

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API SIN: ESOAI100EU0091
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Calibration System

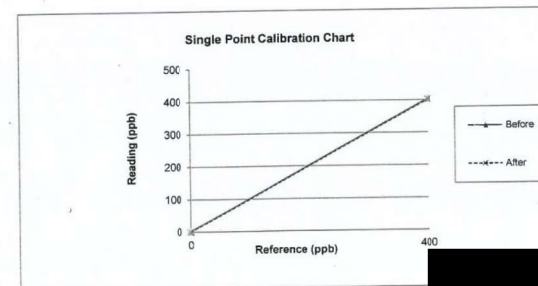
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19,2024 EB0140762

Environment: Temperature 25.5 °C

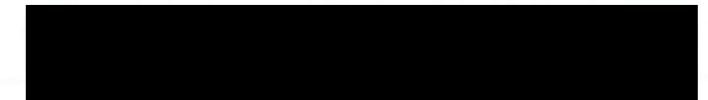
Humidity: 61 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	2.0	2.0	400.0	403.6	0.4
After	0.0	0.1	0.1	400.0	401.2	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502004

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	13:45				
Range	50 - 20000	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.2	0.1	
Sample Flow	650 (+/- 50)	cc/min	592.0	591.0	
PMT Detector	0 - 5000	mV	255.6	61.0	
Norm PMT Detector	0 - 5000	mV	59.7	65.2	
HVPS	400-900 constant	V	607.0	607.0	
DCPS	2500 (+/- 200)	mV	-	-	
ROCELL TEMP	50 (+/- 1)	Dreagee C	50.0	50.0	
BOX TEMP	20-40	Dreagee C	34.0	34.1	
PMT TEMP	7 (+/-1)	Dreagee 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 contant	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	2.0	0.1	
Span Gas (400 PPB)	400	ppb	403.6	401.2	± 5% of Range

Calibrate By: [Redacted]

Approve: [Redacted]

Date: 1-Feb-22

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502003

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

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Instruments Information

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

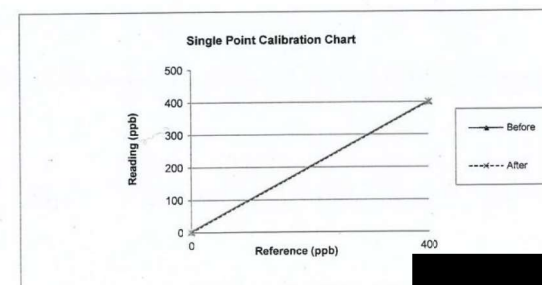
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.5 °C

Humidity: 62 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	3.1	3.1	400.0	402.0	0.2
After	0.0	0.2	0.2	400.0	400.0	0.0



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502003

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-22				
Time	15:20				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	637	620	
PMT Detector	0 - 5000	mV	24.2	24.2	
Norm PMT Detector	0 - 5000	mV	19.3	40.5	
HVPS	400-900 constant	V	632	630	
DCPS	2500 (+/- 200)	mV	-	-	
RCCELL 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 contant	IN-Hg-A	27.8	28.3	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2010	2022	
SO2 Conc	1000 (+/- 250)	PPB	1005	1011	
SO2 Slope	1 (+/- 0.3)	-	1.040	0.824	
SO2 Offset	< 250	mV	51.9	145.5	
Stability at Zero	< 0.2	PPB	0.2	0.6	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	3.1	0.2	
Span Gas (400 PPB)	400	ppb	402.0	400.0	± 5% of Range

Calibrate By: [Redacted]

Approve: [Redacted]

Date: 1-Feb-22

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6502004

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

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

Calibration System

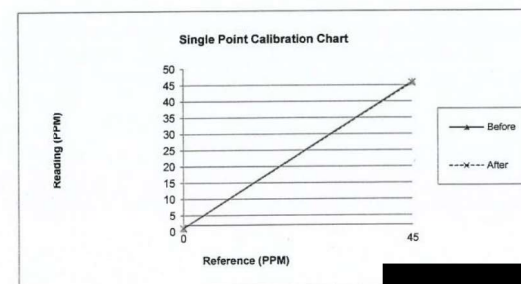
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.1 °C

Humidity: 66 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.014	1.0	45.0	45.98	1.1
After	0.0	0.992	1.0	45.0	45.73	0.8



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6502004

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: [Redacted]

Date: 1-Feb-22

Approve By: [Redacted]

Date: 1-Feb-22

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6502003

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer Environnement SA., France S/N: NCOESACO12E355
--	---

Calibration System

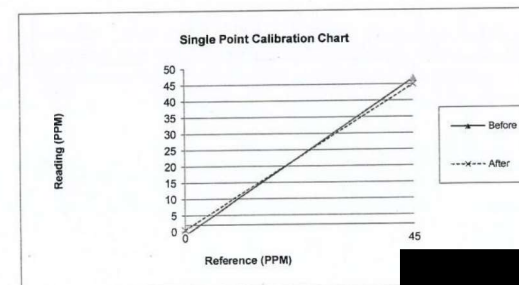
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 E80140762

Environment: Temperature 24.3 °C

Humidity: 62 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	-1.178	-1.2	45.0	46.81	2.0
After	0.0	0.442	0.4	45.0	45.01	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6502003

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 :

Approve By :

Date: 1-Feb-22

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: [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)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (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
m=		1.63957	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)

The Uncertainties are
 This certificate may ne

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

g

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 : 29 October, 2021

Certification No. 481/21

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิตามวิธีมาตรฐาน

Manufacturer : NovusLynx

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

Serial No. : EWSNV110WS2503

Customer : [Redacted]

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1011.2 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)

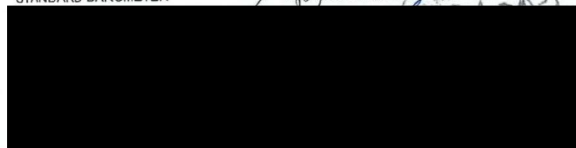
Serial Number 110730029 (sensor 120629586)

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 Model 1220015



The Result of Calibration

Sensor model

EWSNV110WS2503

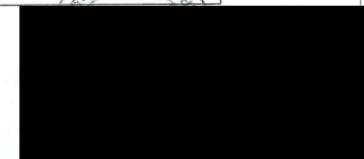
Certification No. 481/21

29 October, 2021

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	ft/min	m/sec	m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.8	0.22
5.00	-	-	-	4.3	0.70
7.04	-	-	-	7.0	0.04
9.02	-	-	-	9.0	0.02
11.01	-	-	-	11.0	0.01
13.01	-	-	-	12.7	0.31
15.01	-	-	-	14.8	0.21
17.02	-	-	-	16.8	0.22
20.02	-	-	-	20.5	-0.48

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 modelEWSNV110WS2503

Certification No. 481/21

29 October, 2021

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1009.71	1010.63	-0.92
1010.54	1010.86	-0.32
1011.21	1011.66	-0.45
1011.63	1011.92	-0.29
1011.77	1012.19	-0.42
1008.92	1009.29	-0.37
1009.14	1009.53	-0.39
1009.30	1009.79	-0.49
1010.37	1010.59	-0.22
1011.25	1011.66	-0.41
1011.70	1011.92	-0.22
1011.81	1012.19	-0.38
1010.77	1011.12	-0.35
1010.88	1011.39	-0.51
1011.13	1011.66	-0.53
1011.43	1011.92	-0.49
1011.91	1012.19	-0.28
1012.00	1012.45	-0.45
1012.13	1012.72	-0.59
1012.45	1012.99	-0.54
Average		

The Result of Calibration

Sensor modelEWSNV110WS2503

Certification No. 481/21

29 October, 2021

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.5	45.8	-0.3
30.2	30.4	-0.2
15.4	15.6	-0.2

The Result of Calibration

Sensor model EWSNV110WS2503 Certification No. 481/21
29 October, 2021 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
83.5	90.2	-6.7
62.4	68.1	-5.7
42.5	47.8	-5.3

Date of Issue 29 October, 2021

Certification No. 481/21

Page : 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ Davis แบบ TIPPING BUCKET
ID No.EWSNV110WS2503 ทำการสอบเทียบกับแก้วฝนแบบแก้วดวง GAUGE
DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No. 71982 และ
สามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 มม. / TIP)

วิศวกรชำนาญการ



Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau
Date of issue : 29 October, 2021 Certification No. 480/21
Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิตามวิธีมาตรฐาน

Manufacturer : NovaLynx

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

Serial No. : EWSNV110WS2501

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1011.2 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 No. V4220015



The Result of Calibration

Sensor model EWSNV110WS2501 Certification No. 480/21

29 October, 2021

Page : 2 of 6

Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
Ultrasonic Anemometer	Pressure	Vacuum	Velocity	Velocity	Correction
m/sec	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.3	0.70
3.02	-	-	-	2.4	0.62
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.9	0.14
9.02	-	-	-	8.8	0.22
11.01	-	-	-	10.8	0.21
13.01	-	-	-	12.8	0.21
15.01	-	-	-	14.8	0.21
17.02	-	-	-	17.2	-0.18
20.02	-	-	-	21.0	-0.98

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

The Result of Calibration

Sensor model EWSNV110WS2501

Certification No. 480/21

29 October, 2021

Page : 3 of 6

Standard Barometer Pressure	Tesed Barometer Pressure	Correction
1009.71	1009.76	-0.05
1010.54	1010.56	-0.02
1011.21	1011.09	0.12
1011.63	1011.63	0.00
1011.77	1011.89	-0.12
1008.92	1008.96	-0.04
1009.14	1009.23	-0.09
1009.30	1009.50	-0.20
1010.37	1010.29	0.08
1011.25	1011.09	0.16
1011.70	1011.63	0.07
1011.81	1011.89	-0.08
1010.77	1010.56	0.21
1010.88	1010.83	0.05
1011.13	1011.09	0.04
1011.43	1011.36	0.07
1011.91	1011.63	0.28
1012.00	1011.89	0.11
1012.13	1012.16	-0.03
1012.45	1012.42	0.03

Average

0.031 มม.วท

The Result of Calibration

Sensor model

EWSNV110WS2501

Certification No. 480/21

29 October, 2021

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.5	45.7	-0.2
30.2	30.1	0.1
15.4	15.3	0.1

The Result of Calibration

Sensor model EWSNV110WS2501 Certification No. 480/21
29 October, 2021 Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
83.5	87.6	-4.1
62.4	65.2	-2.8
42.5	43.2	-0.7

Date of Issue 29 October, 2021

Certification No. 480/21

Page : 6 of 6


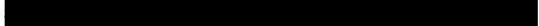
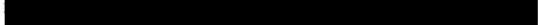
ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชีต้อ Davis แบบ TIPPING BUCKET
ID No.EWSNV110WS2501 ทำการสอบเทียบกับแก้วฝนแบบแก้วดวง GAUGE
DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No 71082 และ
สามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 มม.)

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

CALIBRATION CERTIFICATE

Submitted by : 
Address : 
Calibrated at : 

Instrument Calibrated :

Description : Acoustic Calibrator	Ambient Environment
Manufacturer : Pulsar	Temperature : (23 ± 3) °C
Model : 106	Relative Humidity : (50 ± 15) %
Serial No. : 87098	Ambient Pressure : (101.325 ± 1.500) kPa

Standards used :

- Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
- Measuring Amplifier Brüel&Kjaer 2636 S/N 1537484.
- Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
- Digital Multimeter Agilent 34401A S/N MY44005560.
- Pressure Transmitter Vaisala PTB202ADS/N T0650001.
- Audio Analyzer Keithley 2015-P S/N 4106495.
- 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.BL.MTC.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 20 µPa at 1000 Hz

Acoustic Output in dB re 20 µPa, 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 :

- No adjustment.
- The calibrator pressure correction was not included.
- The microphone volume correction was not included.

Calibrated by : 

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.BL.MTC.002 Rev.4

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
สถานีรถไฟฟ้าชองนนทบุรี (อาคารโดมอันทาวเวอร์)
สถานีรถไฟฟ้าศาลาแดง (สถานีอาคารหอแว่น)
ครั้งที่ 4/2564
วันที่ตรวจวัด วันที่ 25-30 เมษายน 2565

TSP High Volume Sampler Calibration

Verification Report No.
SO2200071-E001 -1 SP 01

☐ PM ☒ Onsite
 Site: BTS ศาลาแดง
 UTM: 47P N 1518190 E 665453
 Sampler: TSP#9
 Recorder: EVFCDIGITAL009
 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 Qstd Slope: 1.63957
 Model: TE-5028A Qstd Intercept: -0.01202
 Serial#: 1328 Date Certified: 19 Jan 22

CALIBRATIONS

Plate or Test #	H ₂ O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	9.76	1.882	50.0	49.18
2	8.34	1.740	48.0	47.21
3	7.42	1.642	46.0	45.25
4	5.30	1.388	42.0	41.31
5	3.26	1.091	36.0	35.41

LINEAR REGRESSION
 Slope = 17.4188
 Intercept = 16.7022
 Corr. coeff = 0.9983
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min: 37 / 47

Calibrated by: XXXXXXXXXX
25 April 2022

Approved by: XXXXXXXXXX
25 April 2022

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05-0047-01 Rev. 001/06/03

TSP High Volume Sampler Calibration

Verification Report No.
SO2200071-E001 -TSP 02

☐ PM ☒ Onsite
 Site: BTS ศาลาแดง
 UTM: 47P N 1517739 E 665366
 Sampler: ETSP#33
 Recorder: EVFCDIGITAL033
 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 Qstd Slope: 1.63957
 Model: TE-5028A Qstd Intercept: -0.01202
 Serial#: 1328 Date Certified: 19 Jan 22

CALIBRATIONS

Plate or Test #	H ₂ O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.12	1.916	52.0	51.15
2	9.45	1.852	50.0	49.18
3	7.31	1.629	46.0	45.25
4	4.26	1.246	40.0	39.35
5	3.26	1.091	36.0	35.41

LINEAR REGRESSION
 Slope = 18.0282
 Intercept = 16.1849
 Corr. coeff = 0.9968
 # of Observations: 5
 Range of Chart at 1.1 - 1.7 m3/min: 37 / 47

Calibrated by: XXXXXXXXXX
25 April 2022

Approved by: XXXXXXXXXX
25 April 2022

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05-0047-01 Rev. 001/06/03

[Redacted]

PM10 High Volume Sampler Calibration

Verification Report No.
SO2200071-E001-PM 01

<p>L PM <input type="checkbox"/> Onsite</p> <p>Site: BTS สถานเอกอัครราชทูต</p> <p>UTM : 47P N 1518190 E 665653</p> <p>Sampler: PM10M23</p> <p>Recorder: EVFCDIGITAL019</p>	<p>Date: 25 Apr 22</p> <p>Technical: [Redacted]</p> <p>Approval: [Redacted]</p>
--	---

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	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	7.46	1.701	46.0	29.28	<p>Slope = 13.5809</p> <p>Intercept = 6.4473</p> <p>Corr. coeff = 0.9935</p> <p>SFR = 1.148</p> <p>SSP = 34.63</p> <p># of Observations: 5</p> <p>Range of Chart at SFR ±10%: 33</p>
2	6.18	1.549	44.0	28.01	
3	5.22	1.424	40.0	25.46	
4	4.32	1.296	38.0	24.19	
5	3.25	1.125	34.0	21.64	

Calibrated by: [Redacted]

25 April 2022

Approved by: [Redacted]

25 April 2022

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10-0007-28 Rev. 02/20/2012

[Redacted]

PM10 High Volume Sampler Calibration

Verification Report No.
SO2200071-E001-PM 02

<p>L PM <input type="checkbox"/> Onsite</p> <p>Site: BTS สถานเอกอัครราชทูต</p> <p>UTM : 47P N 1517739 E 665366</p> <p>Sampler: PM10M14</p> <p>Recorder: EVFCDIGITAL014</p>	<p>Date: 25 Apr 22</p> <p>Technical: [Redacted]</p> <p>Approval: [Redacted]</p>
--	---

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	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	7.45	1.700	46.0	29.29	<p>Slope = 13.1789</p> <p>Intercept = 6.6356</p> <p>Corr. coeff = 0.9959</p> <p>SFR = 1.149</p> <p>SSP = 34.20</p> <p># of Observations: 5</p> <p>Range of Chart at SFR ±10%: 33</p>
2	6.85	1.631	44.0	28.02	
3	5.46	1.457	40.0	25.47	
4	4.52	1.326	38.0	24.20	
5	3.86	1.226	36.0	22.92	

Calibrated by: [Redacted]

25 April 2022

Approved by: [Redacted]

25 April 2022

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10-0007-28 Rev. 02/20/2012

Verification Test Report

Report No.:

SO2200071-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1518198 E 665853

Calibrated Date: 25 April 2022

Site : BTS ศาลาแดง

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1915

Environment: Temperature 34.1 °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.:

SO2200071-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1517748 E 665368

Calibrated Date: 25 April 2022

Site : BTS ช่องนนทรี

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1897

Environment: Temperature 34.1 °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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ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

ผ4-59

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

Certificate of Calibration

Page : 1 of 2

Certificate No. : 65-200022-1

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, Envislab 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)

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 \pm (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	-0.0001
B	-0.0002
C	-0.0002
D	-0.0001
E	0.0000

Repeatability

Load test	200 g
Stdev.	0.00005 g

C
B E D
A

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

Certificate of Calibration

Certificate No. SG-H-00003/65
Issue By Humidity Laboratory Page : 1 of 4

Customer :
Address :
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
Supervisor

Approved By
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 %.
This Calibration Certificate may not be reproduced the Calibration Manager of Success Gateway Co., Ltd.

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

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>2500ST-LT</td> <td>14081021</td> <td>Success</td> <td>SG-T-01408/64</td> <td>6-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	2500ST-LT	14081021	Success	SG-T-01408/64	6-Oct-22					Success	SG-P-00518/64	5-Oct-22																																																															
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Success : Success Gateway Co.,Ltd.

SGF-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	27.67	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

SGF-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-3 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-0021-REV. 02/08-02-08

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

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.

PA.BL.MTC.002 Rev.4

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.66	-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	±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	±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

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.

IABL MTC-009 Rev.4

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 medium. All concentrations are on a mole/mole basis unless otherwise noted.
Do Not Use This Cylinder below 100 psig, i.e. 0.7 megapascals.

Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty	Assay Dates
NOX	45.00 PPM	44.65 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				

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	2.5%	Feb 20, 2020
GMS	124206889	CC323707	4.328 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.87 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 28, 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 GMS used in the assay and not part of the analysis.

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

NOTES:
Gross Weight: 28.4 Kg
Net Weight: 4.5 Kg
PO# 5221000405

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504005
Calibrated Date: 1-Apr-22
☒ PM ☐ Onsite

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Instruments Information

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 ZERO AIR Generator: ZA-G7001 S/N: 644	NO Conc: 44.68 PPM SO2 Conc: 45.34 PPM CO Conc: 4500 PPM Expire Date: Feb 19, 2024 EBO140762

Environment: Temperature 25.6 °C Humidity: 47 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	-3.5	-3.5	400.0	382.0	-2.3
After	0.0	-0.2	-0.2	400.0	405.0	0.6

Single Point Calibration Chart

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504005
Calibrated Date: 1-Apr-22
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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	32.8	
HVPS	400-900 constant	V	719	648	
DCPS	2500 (+/- 200)	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	
LIV 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 PPS-B	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	0.966	
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 Responses					
Zero Gas (0.00 PPB)	0	ppb	-3.5	-0.2	
Span Gas (400 PPB)	400	ppb	382.0	405.0	± 5% of Range

Calibrate By: [Signature]
 Date: 1-Apr-22

Approve By: [Signature]
 Date: 1-Apr-22

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504004
Calibrated Date: 1-Apr-22

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Instruments Information

Page: 1/2

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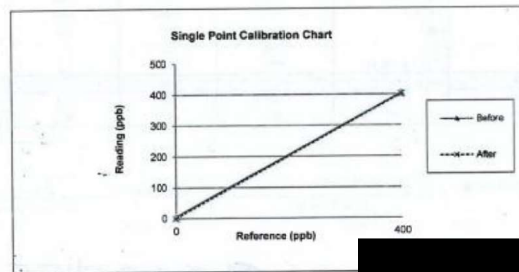
Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	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	5.5	5.5	400.0	404.3	0.5
After	0.0	0.1	0.1	400.0	401.2	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504004
Calibrated Date: 1-Apr-22

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-22				
Time	8:30				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	650 (+/- 50)	cc/min	666	662	
PMT Detector	0 - 5000	mV	24.3	28.2	
Norm PMT Detector	0 - 5000	mV	31.4	34.3	
HVPS	400-900 constant	V	725	725	
DCPS	2500 (+/- 200)	mV	-	-	
RECELL TEMP	50 (+/- 1)	Degree C	50	50	
BOX TEMP	20-40	Degree C	32.5	35.1	
PMT TEMP	7 (+/- 1)	Degree C	8.3	8.3	
L/V lamp	1000-4600	mV	3251	3251	
Lamp Ratio	20-120	%	87.4	87.4	
STR. Light (Zero Gas)	<100	PPB	38.5	38.5	
Dark PMT	(-50) - (+200)	mV	27.6	27.6	
Dark lamp	(-50) - (+200)	mV	3.6	3.6	
SAMP PRES	20-30 constant	IN-Hg-A	26.9	27.3	
Electric Test/OpSic Test					
PMT Volts	2000 (+/- 500)	mV	2010	2006	
SO2 Conc	1000 (+/- 250)	PPB	1005	1003	
SO2 Slope	1 (+/- 0.3)	-	1.054	1.053	
SO2 Offset	< 250	mV	94.7	90.4	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 100 ppb	PPB	0.4	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	5.5	0.1	
Span Gas (400 PPB)	400	ppb	404.3	401.2	± 5% of Range

Calibrate By: _____

Approve By: _____

Date: 1-Apr-22

Date: 1-Apr-22

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504004
Calibrated Date: 1-Apr-22

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Instruments Information

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

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

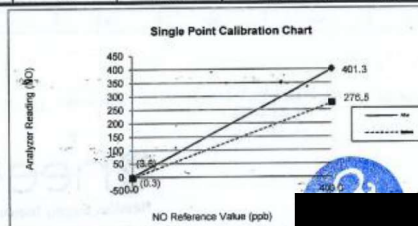
Environment: Temperature 27.5 °C Humidity 50 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-0.6	0.0	-0.6	276.1	400.0	-19.4
NO ₂	-3.2	0.0	-3.2	6.4	0.0	1.1
NOx	-3.8	0.0	-3.8	276.5	400.0	-18.3

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-0.1	0.0	-0.1	395.7	400.0	-0.5
NO ₂	-0.2	0.0	-0.2	5.6	0.0	0.7
NOx	-0.3	0.0	-0.3	401.3	400.0	0.2



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504004
Calibrated Date: 1-Apr-22

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-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±10	cc/min	474.0	441.0	
Ozone Flow	60-90	cc/min	76.0	76.0	
PMT Detector	0-5000	mV	34.5	62.2	
AZERO	-20-150	mV	8.6	67.5	
HVPS	400-900 constant	V	839.0	836.0	
DCPS	2500 ±1-200	mV	-	-	
CELL 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	
IS TEMP	50±4	Dreogee C	-	-	
MOLY Temp	315 ±1-5	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	28.6	
NO Slope	1 ±0.3		1.258	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	-0.6	-0.1
	NOx	0	ppb	-3.8	-0.3
Span Value	NO	400	ppb	270.1	395.7
	NOx	400	ppb	276.5	401.3

Calibrate By :

Approve By :

Date: 1-Apr-22

Date: 1-Apr-22

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504003
Calibrated Date: 1-Apr-22

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Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20002469
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.58 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

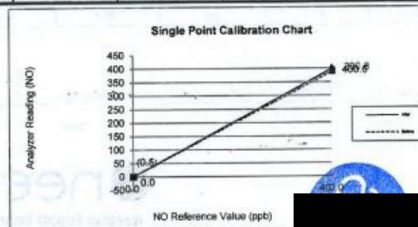
Environment: Temperature 26.5 °C Humidity: 47 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.8	0.0	0.8	390.9	400.0	-1.2
NO ₂	-1.3	0.0	-1.3	-0.1	0.0	0.0
NOx	-0.5	0.0	-0.5	390.8	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	-0.2	0.0	-0.2	397.9	400.0	-0.3
NO ₂	0.2	0.0	0.2	2.7	0.0	0.3
NOx	0.0	0.0	0.0	400.5	400.0	0.1



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504003
Calibrated Date: 1-Apr-22

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-22				
Time	13:30:00 AM				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500±1.50	cc/min	505	480	
Ozone Flow	60-80	cc/min	79	72	
PMT Detector	0-5000	mV	26.2	29.3	
AZERO	-20-150	mV	56.0	55.0	
HVPS	400-800 constant	V	755	755	
DCPS	2500 ± 200	mV	-	-	
ROCELL TEMP	50±1	Dreogee C	50	50	
BOX TEMP	20-35	Dreogee C	30.2	32.0	
PMT TEMP	7 ±1	Dreogee C	7.2	7.2	
ZS TEMP	50±1.4	Dreogee C	-	-	
MOLY Temp	315 ±1.5	Dreogee C	315.0	315.0	
ROEL PRES	4-10 constant	IN-Hg-A	4	5	
SAMP PRES	20-30 constant	IN-Hg-A	29	29	
NO Slope	1 ± 0.3		0.880	1.118	
Nox Slope	1 ± 0.3		0.911	1.046	
NO Offset	-10 to + 150	mV	12.9	2.2	
NOx Offset	-10 to + 150	mV	-2.4	9.1	
Span and Cal Values					
Zero Value	NO	0	ppb	0.8	-0.2
	NOx	0	ppb	-0.5	0.0
Span Value	NO	400	ppb	390.9	397.9
	NOx	400	ppb	390.8	400.5

Calibrate By : [Redacted]

Approve By : [Redacted]

Date: 1-Apr-22

Date: 1-Apr-22

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CO Analyzer Verification Test Report

Calibration Report No.: AP-C6504004

Calibrated Date: 1-Apr-22

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Instruments Information

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Analyzer Type: CO Analyzer Model: 300E	Manufacturer API S/N: ECOA/300E01034
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Calibration System

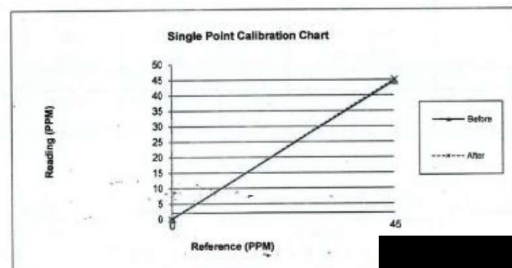
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO ₂ Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 E80140762

Environment: Temperature 27.3 °C

Humidity 50 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.15	0.2	45.0	44.6	-0.5
After	0.0	0.02	0.0	45.0	45.1	0.1



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CO Analyzer Verification Test Report

Calibration Report No.: AP-C6504004

Calibrated Date: 1-Apr-22

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Detail	Range	Unit	Before	After	Note
Date	1-Apr-22				
Time	16:06				
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	
MIR 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	0.800 - 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

Calibrate By :

Approve By :

Date: 1-Apr-22

Date: 1-Apr-22

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CO Analyzer Verification Test Report

Calibration Report No.: AP-C8504003

Calibrated Date: 1-Apr-22

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Instruments Information

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

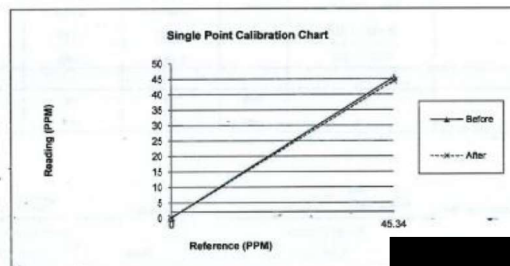
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 782 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc: 44.68 PPM SO2 Conc: 45.34 PPM CO Conc: 4500 PPM Expire Date: Feb 19, 2024 E80140762

Environment: Temperature 27.5 °C

Humidity 52 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.11	0.1	45.3	45.4	0.1
After	0.0	0.12	0.1	45.0	44.4	-0.7



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CO Analyzer Verification Test Report

Calibration Report No.: AP-C8504003

Calibrated Date: 1-Apr-22

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Detail	Range	Unit	Before	After	Note
Date	1-Apr-22				
Time	11:00				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.73	1.11	
CO Measure	2500 - 4800 MV.	mV	2913.3	2923.5	
CO Reference	2500 - 4800 MV.	mV	2444.3	2421.4	
MIR Ratio	1.2 +/- 0.5		1.18	1.21	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	29.1	29	
Sample Flow	720 - 880 cc/min	cc/min	890	886	
Sample Temp	44 - 52 deg.C	deg.C	50.3	50.4	
Bench Temp	47 - 49 deg.C	deg.C	48	48	
Wheel Temp	66 - 70 deg.C	deg.C	68.3	68.4	
Box Temp	27 - 50 deg.C	deg.C	35.2	35.1	
PHT drive	250 - 4750 mv.	mV	3323.4	3353.6	
Slope	0.800 - 1.200		1.051	1.112	
Offset	0.05 +/- 0.2		0.088	0.088	
Gas Test Response					
Zero Gas	0	PPM	0.2	0.0	
Span Gas	45	PPM	47.6	45.0	± 5% of Range

Calibrate By :

Approve By :

Date: 1-Apr-22

Date: 1-Apr-22

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