

ภาคผนวกที่ 4

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด

ภาคผนวกที่ 4-1

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
โรงเรียนแสงหิรัญและสถาบันการbinพลเรือน
ครั้งที่ 3/2564
วันที่ตรวจวัดวันที่ 19-24 กุมภาพันธ์ 2565

Verification Test Report

Report No.:
SO2200014-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1516358 E 672867

Calibrated Date: 19 February 2022
Site : โรงเรียนแสงศิรินทร์
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1811

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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Verification Test Report

Report No.:
SO2200014-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P N 1526261 E 667884

Calibrated Date: 19 February 2022
Site : การบินพลเรือน
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 2199

Environment: Temperature 28 °C Humidity 61 %RH

Reference Standard: Acoustic Calibrator Model 106
Serial No. 37098
Date of Calibration : Mar.12, 2021

Result of Test			
Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
94.13	94.20	0.07	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.
SO2200014-E001 -TSP 01

☐ PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM : 47P N 1516342 E 672857
 Sampler: ETSP#41
 Recorder: ECRANG15315240

Date: 19 Feb 22
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1009.0
Temperature (deg C): 34.0
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 756.8
Temperature (deg K): 307.0
Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

Qstd Slope: 1.63957
Qstd Intercept: -0.01202
Date Certified: 19 Jan 22

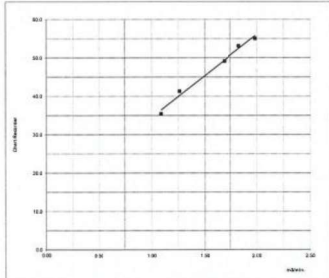
Plate or Test #	H ₂ O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.66	1.983	56.0	55.06
2	9.22	1.828	54.0	53.09
3	7.84	1.666	50.0	49.16
4	4.38	1.262	42.0	41.29
5	3.25	1.088	36.0	35.39

LINEAR REGRESSION

Slope = 21.6359
Intercept = 12.8364
Corr. coeff. = 0.9940

of Observations: 5

Range of Chart	38
at 1.1 - 1.7 m3/min	50



Calibrated by: XXXXXXXXXX
19 February 2022

Approved by: XXXXXXXXXX
19 February 2022

TSP High Volume Sampler Calibration

Verification Report No.
SO2200014-E001 -TSP 02

☐ PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM : 47P N 1526241 E 667874
 Sampler: ETSP#37
 Recorder: ECRANG15315237

Date: 19 Feb 22
 Technical: XXXXXXXXXX
 Approval: XXXXXXXXXX

CONDITIONS

Barometric Press. (hPa): 1009.0
Temperature (deg C): 34.0
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 756.8
Temperature (deg K): 307.0
Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

Qstd Slope: 1.63957
Qstd Intercept: -0.01202
Date Certified: 19 Jan 22

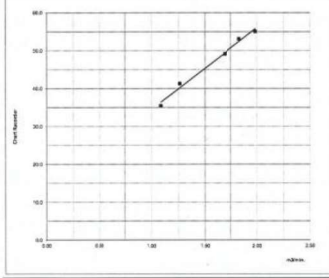
Plate or Test #	H ₂ O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.96	1.993	56.0	55.06
2	9.23	1.829	54.0	53.09
3	7.52	1.652	50.0	49.16
4	4.87	1.331	44.0	43.26
5	3.25	1.088	36.0	35.39

LINEAR REGRESSION

Slope = 21.4986
Intercept = 13.2570
Corr. coeff. = 0.9901

of Observations: 5

Range of Chart	38
at 1.1 - 1.7 m3/min	50



Calibrated by: XXXXXXXXXX
19 February 2022

Approved by: XXXXXXXXXX
19 February 2022

PM10 High Volume Sampler Calibration

Verification Report No. SO2200014-E001-PM 01

L. PM [x] Onsite
Site: โรงเรียนสตรีศรี
UTM: 47P N 1516342 E 672657
Sampler: EPM#39
Recorder: ECRDS01618154
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 CRIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.68	2.035	54.0	34.39
2	9.34	1.903	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 = 12.3354
Intercept = 9.4805
Corr. coeff = 0.9901
SFR = 1.149
SSP = 37.15
of Observations: 5
Range of Chart: 36
at SFR ±10%: 39

Calibrated by: [redacted]
19 February 2022

Approved by: [redacted]
19 February 2022

PM10 High Volume Sampler Calibration

Verification Report No. SO2200014-E001-PM 02

L. PM [x] Onsite
Site: โรงเรียนสตรีศรี
UTM: 47P N 1526241 E 667674
Sampler: EPM#36
Recorder: ECRDS01618136
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 CRIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.22	1.991	54.0	34.39
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

LINEAR REGRESSION
Slope = 12.4907
Intercept = 9.1483
Corr. coeff = 0.9941
SFR = 1.149
SSP = 36.91
of Observations: 5
Range of Chart: 35
at SFR ±10%: 38

Calibrated by: [redacted]
19 February 2022

Approved by: [redacted]
19 February 2022

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-12531, 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	44.88 PPM	G1	+/- 1.4% NIST Traceable	02/12/2021, 02/19/2021
NITRIC OXIDE	45.00 PPM	44.82 PPM	G1	+/- 1.4% NIST Traceable	02/12/2021, 02/19/2021
SULFUR DIOXIDE	45.00 PPM	45.34 PPM	G1	+/- 1.1% NIST Traceable	02/12/2021, 02/19/2021
CARBON MONOXIDE	4500 PPM	4500 PPM	G1	+/- 1.0% NIST Traceable	02/15/2021
NITROGEN	Balance				

CALIBRATION STANDARDS					
Type	Lot ID	Cylinder No	Concentration	Uncertainty	Expiration Date
NTRM	200611-04	CC707968	49.82 PPM NITRIC OXIDE/NITROGEN	+/-1.0%	Feb 02, 2025
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMS	124208883	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.87 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 5 NTKD579	NDR	Jan 27, 2021
Nicolet IS80 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet IS80 FTIR AUP2010245 NO2	FTIR	Jan 21, 2021
Nicolet IS80 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

Approved for Release

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502002

Page:1/1

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

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	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 24.2 °C

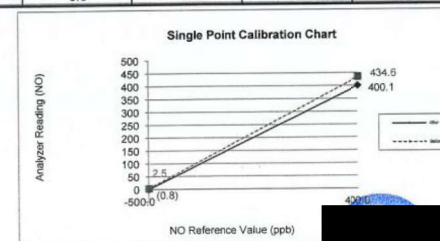
Humidity: 52 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.9	0.0	0.9	445.5	400.0	5.4
NO ₂	1.5	0.0	1.6	-10.9	0.0	-1.2
NOx	2.5	0.0	2.5	434.6	400.0	4.1

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.2	0.0	0.2	399.7	400.0	0.0
NO ₂	-1.0	0.0	-1.0	0.4	0.0	0.1
NOx	-0.8	0.0	-0.8	400.1	400.0	0.0



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502002

Page:1/1

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Feb-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 +/- 50	cc/min	505	480	
Ozone Flow	60-90	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	-	-	
RCCELL TEMP	50 +/- 1	Degree C	50	50	
BOX TEMP	20-35	Degree C	30.2	32.0	
PMT TEMP	7 +/- 1	Degree C	7.2	7.2	
IZS TEMP	50 +/- 4	Degree C	-	-	
MOLY Temp	315 +/- 5	Degree C	315.0	315.0	
RCCEL PRES	4-10 contant	IN-Hg-A	4	5	
SAMP PRES	20-30 contant	IN-Hg-A	29	29	
NO Slope	1 +/- 0.3		0.890	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	0.9	0.2
	NOx	0	ppb	2.5	-0.8
Span Value	NO	400	ppb	445.5	399.7
	NOx	400	ppb	434.8	400.1

Calibrate By :

Approve By :

Date: 1-Feb-22

Date: 1-Feb-22

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502001

Page:1/1

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENQAIT20000108
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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

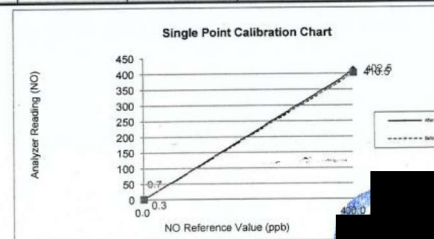
Humidity: 54 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-0.1	0.0	-0.1	389.6	400.0	-1.3
NO ₂	0.3	0.0	0.8	12.9	0.0	1.6
NOx	0.7	0.0	0.7	402.5	400.0	0.3

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.0	0.0	0.0	397.9	400.0	-0.3
NO ₂	0.3	0.0	0.3	12.6	0.0	1.6
NOx	0.3	0.0	0.3	410.5	400.0	1.3



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6502001

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	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	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 +/- 200	mV	-	-	
ROCELL TEMP	50 +/- 1	Dreagee C	50	50	
BOX TEMP	20-35	Dreagee C	33.7	32.9	
PMT TEMP	7 +/- 1	Dreagee C	7.1	7.1	
IZS TEMP	50 +/- 4	Dreagee C	-	-	
MOLY Temp	315 +/- 5	Dreagee C	314.4	315.0	
ROCEL 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	NC	0	ppb	-0.1	0.0
	NOx	0	ppb	0.7	0.3
Span Value	NC	400	ppb	389.6	397.9
	NOx	400	ppb	402.5	410.5

Calibrate By :

Approve By :

Date: 1-Feb-22

Date: 1-Feb-22

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S8502002

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

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

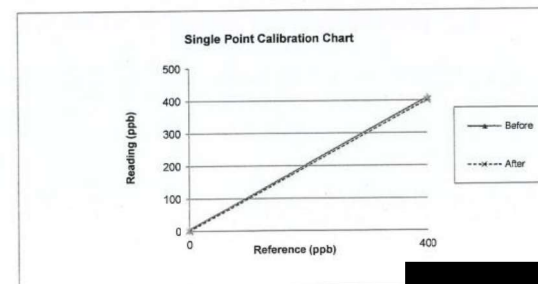
Calibrator Unit	Standard Gas
Dilutor Model: ESA MGCT01 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.6 °C

Humidity: 64 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	4.5	4.5	400.0	408.5	1.1
After	0.0	0.2	0.2	400.0	401.0	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502002

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	8:30				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	850 (+/- 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	-	-	
CELL TEMP	50 (+/- 1)	Dreagee C	50	50	
BOX TEMP	20-40	Dreagee C	32.6	35.1	
PMT TEMP	7 (+/-1)	Dreagee C	8.3	8.3	
UV lamp	1000-4900	mV	3251	3251	
Lamp Ratio	30-120	%	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 contant	IN-Hg-A	28.9	27.3	
Electric Test/Optic 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 @ 400 ppb	PPB	0.4	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	4.5	0.2	
Span Gas (400 PPB)	400	ppb	408.5	401.0	± 5% of Range

Calibrate By: [Redacted]

Date: 1-Feb-22

Approve By: [Redacted]

Date: 1-Feb-22

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502001

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API S/N: ESOAI100E01002
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Calibration System

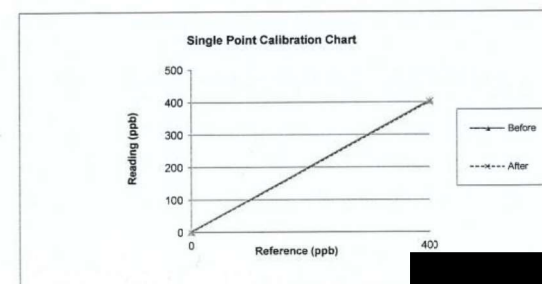
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.8 °C

Humidity: 66 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	2.2	2.2	400.0	404.5	0.6
After	0.0	0.5	0.5	400.0	401.1	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6502001

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 2/2

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	850 (+/- 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	-	-	
RCCELL TEMP	50 (+/- 1)	Degree C	50.0	50.0	
BOX TEMP	20-40	Degree C	34.0	34.1	
PMT TEMP	7 (+/-1)	Degree C	8.0	8.0	
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	3.8	
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	2.2	0.5	
Span Gas (400 PPB)	400	ppb	404.5	401.1	± 5% of Range

Calibrate By :

Date: 1-Feb-22

Approve By :

Date: 1-Feb-22

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CO Analyzer Verification Test Report

Calibration Report No.: AP-C6502002

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

Analyzer Type: CO Analyzer Model: 300	Manufacturer API S/N: ECOAI300E01510
--	---

Calibration System

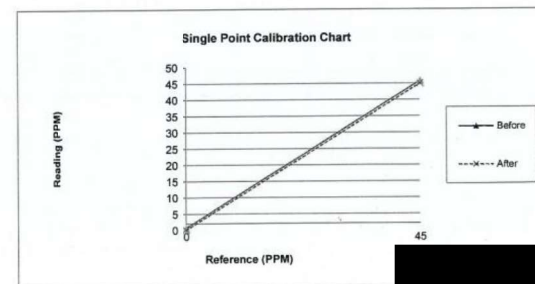
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 25.5 °C

Humidity: 66 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.6	0.6	45.0	45.8	0.9
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.: AP-C6502002

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 2/2

Detail	Range	Unit	Before	After	Note
Date	1-Feb-22				
Time	16:13				
Range	0.1-1000 PPM	PPM	50	50	
Stability	(0.1-2PPB)	ppb	0.1	0.4	
CO Measure	2500 - 4800 MV.	mV	3035.9	3055.2	
CO Reference	2500 - 4800 MV.	mV	2957.4	2975.3	
MR Ratio	1.2 +/- 0.5		1.03	1.03	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	29.8	29.9	
Sample Flow	720 - 880 cc/min	cc/min	785	793	
Sample Temp	44 - 52 deg.C	deg.C	38.9	38.3	
Bench Temp	47 - 49 deg.C	deg.C	51	50.5	
Wheel Temp	66 - 70 deg.C	deg.C	67.9	68	
Box Temp	27 - 50 deg.C	deg.C	33	34	
PHT drive	250 - 4750 mv.	mV	3680	3685	
Slope	0.800 - 1.200		0.957	0.957	
Offset	0.05 +/- 0.2		-0.094	-0.095	
Gas Test Response					
Zero Gas	0	PPM	-2.4	0.0	
Span Gas	45	PPM	45.0	45.1	± 5% of Range

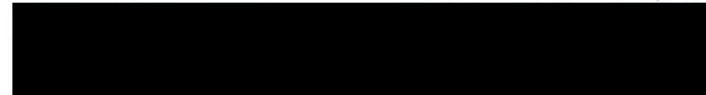
Calibrate By :

Approve By :

Date: 1-Feb-22

Date: 1-Feb-22

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CO Analyzer Verification Test Report

Calibration Report No.: AP-C6502001

Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

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

Calibration System

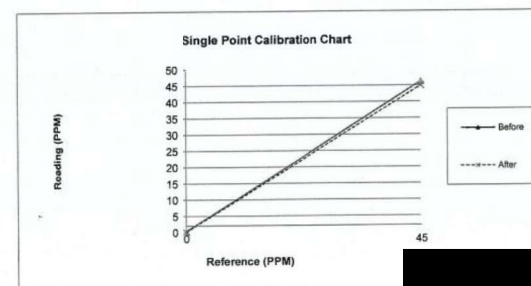
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 24.6 °C

Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.3	0.3	45.0	46.2	1.3
After	0.0	0.1	0.1	45.0	44.9	-0.1



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CO Analyzer Verification Test Report

Calibration Report No.: AP-C6502001
Calibrated Date: 1-Feb-22

☒ PM ☐ Onsite

Page: 2/2

Detail	Range	Unit	Before	After	Note
Date	1-Feb-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	
MR Ratio	1.2 +/- 0.5		1.21	1.21	
Sample Pressure	26 - 30 in-Hg-A	in-Hg-A	28.5	28.4	
Sample Flow	720 - 880 cc/min	cc/min	790	783	
Sample Temp	44 - 52 deg.C	deg.C	48.2	48.2	
Bench Temp	47 - 49 deg.C	deg.C	48	48	
Wheel Temp	66 - 70 deg.C	deg.C	68	68	
Box Temp	27 - 50 deg.C	deg.C	35.2	35.4	
PHT drive	250 - 4750 mv.	mV	3114.8	3106.5	
Slope	0.800 - 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

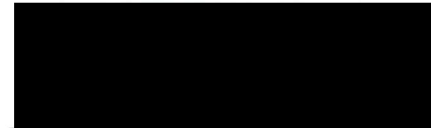
Calibrate By: [Redacted]

Approve By: [Redacted]

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

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH:	calibrator manometer reading (in H2O)
ΔP:	rootsometer 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 Recdved : 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]

The Uncertainties are for a confidence probability of approximately 95%
 This certificate may not be reproduced other than in full except with the prior written approval of [REDACTED]

CAL-F0031-01

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

-0.0000

CAL-F0031-01



Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue : 25 June, 2021

Certification No. 325/21

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : Novalynx

Type : Data Logger NDWD100

Serial No. : EWSNV110WS2505

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1007.9 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)

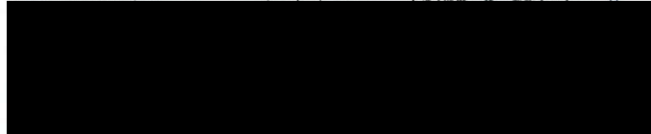
Serial Number 110730029 (sensor 120629586)

JAPAN QUALITY ASSURANCE ORGANIZATION

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

: Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala PTB220 No. 1015



The Result of Calibration

Sensor model

EWSNV110WS2505

Certification No. 325/21

25 June, 2021

Page : 2 of 6

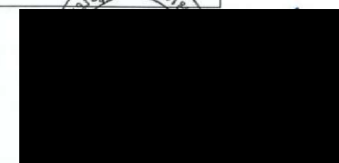
Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches	Vacuum inches	Pressure hPa	Velocity m/sec	Correction m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	3.0	0.02
5.00	-	-	-	4.9	0.10
7.04	-	-	-	6.9	0.14
9.02	-	-	-	8.8	0.22
11.01	-	-	-	10.8	0.21
13.01	-	-	-	12.8	0.21
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
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	

Calibrated



Mechanical Engineer





The Result of Calibration

Sensor model EWSNV110WS2505

Certification No. 325/21

25 June, 2021

Page : 3 of 6

Standard Barometer Pressure	Tested Barometer Pressure	Correction
1009.73	1010.26	-0.53
1009.37	1009.93	-0.56
1009.18	1009.65	-0.47
1008.83	1009.36	-0.53
1008.60	1009.08	-0.48
1008.28	1008.79	-0.51
1008.16	1008.51	-0.35
1007.88	1008.22	-0.34
1006.91	1007.65	-0.74
1006.85	1007.37	-0.52
1006.62	1007.08	-0.46
1006.30	1006.80	-0.50
1006.91	1009.65	-0.74
1008.84	1009.36	-0.52
1008.54	1008.08	0.46
1008.26	1008.79	-0.53
1008.07	1008.57	-0.50
1007.34	1007.87	-0.53
1007.44	1007.94	-0.50
1006.54	1007.04	-0.50

Average

Calib

Mechanical Engineer



The Result of Calibration

Sensor model EWSNV110WS2505

Certification No. 325/21

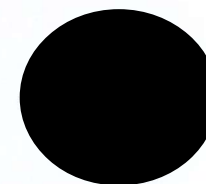
25 June, 2021

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.6	45.1	0.5
31.2	30.8	0.4
16.4	16.2	0.2

Calib

Mechanical Engineer



The Result of Calibration

Sensor model

EWSNV110WS2505

Certification No. 325/21

25 June, 2021

Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
84.8	77.8	6.8
62.5	57.2	5.3
42.3	39.1	3.2

Calibrated by

Mechanical Engineer

Date of Issue 25 June, 2021

Certification No. 325/21

Page : 6 of 6

ใบรับรอง

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

วิศวกรชำนาญการ



Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 10 August, 2021

Certification No. 375/21

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุณหภูมิตามวิธีมาตรฐาน

Manufacturer : Novalynx

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

Serial No. : EWSNV110WS2508

Customer :

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.5 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.91889

STANDARD BAROMETER : Digital Barometer Vaisala PTB220 No. 10015



The Result of Calibration

Sensor model

EWSNV110WS2508

Certification No. 375/21

10 August, 2021

Page : 2 of 6

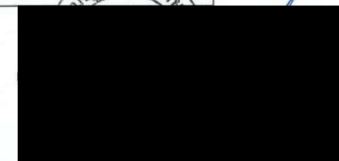
Standard	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacuum	Pressure	Velocity	Correction
m/sec	inches	inches	hPa	m/sec	m/sec
1.00	-	-	-	0.4	0.60
3.02	-	-	-	2.6	0.42
5.00	-	-	-	4.6	0.40
7.04	-	-	-	6.8	0.24
9.02	-	-	-	8.8	0.22
11.01	-	-	-	11.0	0.01
13.01	-	-	-	13.2	-0.19
15.01	-	-	-	15.2	-0.19
17.02	-	-	-	17.5	-0.48
20.02	-	-	-	21.0	-0.98

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

Calibrated



Mechanical Engineer





The Result of Calibration

Sensor model EWSNV110WS2508

Certification No. 375/21

10 August, 2021

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1009.87	1010.15	-0.28
1009.53	1009.62	-0.09
1007.23	1007.49	-0.26
1007.00	1007.23	-0.23
1006.68	1006.96	-0.28
1006.46	1006.69	-0.23
1006.27	1006.43	-0.16
1006.44	1006.64	-0.20
1006.78	1007.23	-0.45
1007.64	1008.29	-0.65
1008.23	1008.56	-0.33
1007.79	1008.29	-0.50
1008.96	1009.35	-0.39
1007.85	1008.29	-0.44
1008.02	1008.56	-0.54
1008.30	1008.82	-0.52
1008.77	1008.09	0.68
1009.28	1009.62	-0.34
1009.65	1009.89	-0.24
1009.75	1010.15	-0.40

Average

Calibration

Mechanical Engineer



The Result of Calibration

Sensor model EWSNV110WS2508

Certification No. 375/21

10 August, 2021

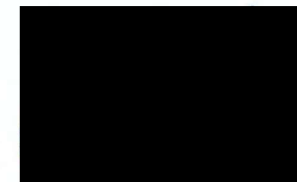
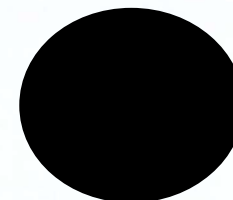
Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.2	45.5	-0.3
31.3	31.5	-0.2
15.8	16.0	-0.2

Calibration



Mechanical Engineer



The Result of Calibration		
Sensor model EWSNV110WS2508 Certification No. 375/21		
10 August, 2021 Page : 5 of 6		
Standards Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading % R.H.	Correction % R.H.
85.2	78.2	7.0
61.4	57.4	4.0
41.5	40.5	1.0

Calibrated by [Redacted]
Mechanical Engineer

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ชื่อ Davis แบบ TIPPING BUCKET Model 7342.026 ID No.EWSNV110WS2508 ทำการสอบเทียบกับแก้วฝนแบบแก้ว ตวง GAUGE DIAMETER 8.0 INCHES , NEGRETTI & ZAMBRA LONDON No 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องวัด (Certificate of Calibration)

วิศวกรชำนาญการ

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 Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N 4106495.
7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

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

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

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

Date of Receipt : 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 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 Bruel&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 Bruel&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 Bruel&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

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FM.BLMTC.002 Rev.4

เอกสารผลการสอบเทียบเครื่องมือตรวจวัด
โรงเรียนแสงหิรัญและสถาบันการbinพลเรือน
ครั้งที่ 4/2564
ตรวจวัดวันที่ 25-30 เมษายน 2565

TSP High Volume Sampler Calibration

Verification Report No. SO2200072-E001-TSP-01

☐ PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM: 47P N 1516343 E 672853
 Sampler: TSP#07
 Recorder: EVFCDIGITAL037

Date: 25 Apr 22
 Technical: XXXXXXXXXX
 Approval: 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 OFFICE

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 #	H ₂ O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	9.82	1.887	50.0	49.18
2	8.11	1.716	48.0	47.21
3	7.36	1.635	46.0	45.25
4	5.42	1.404	42.0	41.31
5	3.30	1.097	36.0	35.41

LINEAR REGRESSION

Slope = 17.7810
Intercept = 16.1512
Corr. coeff = 0.9971

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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16-0007-02 Rev.001/03/2012

TSP High Volume Sampler Calibration

Verification Report No. SO2200072-E001-TSP-02

☐ PM ☒ Onsite
 Site: กรุงเทพมหานคร
 UTM: 47P N 1526245 E 667674
 Sampler: ETSP#18
 Recorder: EVFCDIGITAL018

Date: 25 Apr 22
 Technical: XXXXXXXXXX
 Approval: 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 OFFICE

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 #	H ₂ O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	10.12	1.916	52.0	51.15
2	8.96	1.803	48.0	47.21
3	7.38	1.637	46.0	45.25
4	4.69	1.307	40.0	39.35
5	3.46	1.123	36.0	35.41

LINEAR REGRESSION

Slope = 18.6918
Intercept = 14.5668
Corr. coeff = 0.9941

of Observations: 5

Range of Chart at 1.1 - 1.7 m3/min

36
47

Calibrated by: XXXXXXXXXX

25 April 2022

Approved by: XXXXXXXXXX

25 April 2022

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16-0007-02 Rev.001/03/2012

ภาควิชาวิทยาศาสตร์สิ่งแวดล้อม คณะสิ่งแวดล้อม มหาวิทยาลัยเกษตรศาสตร์

ผ4-22

PM10 High Volume Sampler Calibration

Verification Report No. SO220072-E001-PM 01

L PM ☒ Onsite
 Site: รัชภิเษกมัย
 UTM: 47P N 1516343 E 872863
 Sampler: PM10K28
 Recorder: EVFCDIGITAL028
 Date: 25 Apr 22
 Technical:
 Approver:

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

Plate or Test #	H ₂ O (in)	Qa (m3/min)	CALIBRATIONS		LINEAR REGRESSION
			I (chart)	IC (corrected)	
1	7.46	1.701	46.0	29.28	Slope = 13.7873 Intercept = 6.5397 Corr. coeff = 0.9938 SFR = 1.148 SSP = 34.23 # of Observations: 5 Range of Chart: 33 at SFR ±10%: 36
2	6.18	1.549	42.0	26.74	
3	5.22	1.424	40.0	25.46	
4	4.32	1.296	38.0	24.19	
5	3.42	1.154	34.0	21.64	

Calibrated by: 25 April 2022

Approved by: 25 April 2022

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PM10 High Volume Sampler Calibration

Verification Report No. SO220072-E001-PM 02

L PM ☒ Onsite
 Site: รัชภิเษกมัย
 UTM: 47P N 1526245 E 867674
 Sampler: PM10K28
 Recorder: EVFCDIGITAL038
 Date: 25 Apr 22
 Technical:
 Approver:

CONDITIONS

Barometric Press. (hPa): 1006.4 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

Plate or Test #	H ₂ O (in)	Qa (m3/min)	CALIBRATIONS		LINEAR REGRESSION
			I (chart)	IC (corrected)	
1	7.84	1.744	46.0	29.29	Slope = 10.8489 Intercept = 10.3280 Corr. coeff = 0.9905 SFR = 1.149 SSP = 35.43 # of Observations: 5 Range of Chart: 34 at SFR ±10%: 37
2	6.34	1.569	42.0	26.74	
3	5.48	1.459	40.0	25.47	
4	4.32	1.296	38.0	24.20	
5	3.46	1.161	36.0	22.92	

Calibrated by: 25 April 2022

Approved by: 25 April 2022

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Verification Test Report

Report No.:
SO2200082-E001 -SLM 01

☐ PM ☒ Onsite UTM : 47P N 1406336 E 732254

Calibrated Date: 22 April 2022
Site : EV โขสุม
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1575

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: 22 April 2022

Approve By:
Date: 22 April 2022

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Verification Test Report

Report No.:
SO2200072-E001 -SLM 01

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

Calibrated Date: 25 April 2022
Site : โรงเรียนแสวงเจริญ
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 2198

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

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

Calibrated Date: 25 April 2022
Site : การบินพลเรือน
Equipment: Sound Level Meter
Manufacturer: PULSAR
Model: 44
Serial : 1973

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

Report No.:
SO2200072-E001 -SLM 02

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 15, 2023

Certificate of Calibration

Calibration Certification Information

Cal. Date: January 19, 2022 Rootsmeter S/N: 438320 Ta: 294 °K
 Operator: _____ 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:	
$Qstd = 1/m \left(\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)} - b \right)$	$Qa = 1/m \left(\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)} - b \right)$

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

ID No.	Cert. No.	Due Date	Traceability
E261-E3624	C02213103	18 Nov 2022	National Institute of Metrology (Thailand), (NIMT)

The Uncertainties are for a confidence probability of approximately 95%
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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
 Stdev. : 0.00005 g

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

[Redacted Signature]

Supervisor

Approved By

[Redacted Signature]

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-0023-REV. 02/08-02-99

[Redacted]

[illegible]

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

SGF-0021-REV. 02/08-02-58

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-0021-REV. 02/08-02-58



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

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

CALIBRATION CERTIFICATE

Submitted by : Envilab Co.,Ltd.
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

/ 2

The results relate only to the items tested/calibrated or value assigned.
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FM.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	4.55	± 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

End of Certificate 2 / 2

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

CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number: E04N99E15A00V3 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. 0.7 megapascals.

ANALYTICAL RESULTS				
Component	Requested Concentration	Actual Concentration	Protocol Method	Total Relative Uncertainty
NOX	45.00 PPM	44.68 PPM	G1	+/- 1.4% NIST Traceable
NITRIC OXIDE	45.00 PPM	44.52 PPM	G1	+/- 1.4% NIST Traceable
SULFUR DIOXIDE	45.00 PPM	45.34 PPM	G1	+/- 1.1% NIST Traceable
CARBON MONOXIDE	4500 PPM	4500 PPM	G1	+/- 1.0% NIST Traceable
NITROGEN	Balance			02/19/2021

CALIBRATION STANDARDS				
Type	Lot ID	Cylinder No	Concentration	Uncertainty
NTRM	200811-04	CC707868	49.82 PPM NITRIC OXIDE/NITROGEN	+/- 1.0%
PRM	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.3%
GMS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%
NTRM	0141709	KAL003190	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 8 NTR0679	NDIR	Jan 27, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Jan 21, 2021
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Jan 21, 2021

Triad Data Available Upon Request

NOTES:

Gross Weight: 28.4 Kg

Net Weight: 4.5 Kg

PO# 5221000405

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504003

Calibrated Date: 1-Apr-22

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

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

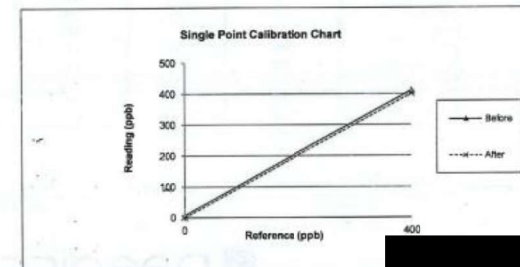
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC151 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

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	7.3	7.3	400.0	411.0	1.4
After	0.0	0.4	0.4	400.0	401.0	0.1



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504003
Calibrated Date: 1-Apr-22

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-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	400-800 constant	V	632	630	
DCPS	2500 (+/- 200)	mV	-	-	
ICELL TEMP	50 (+/- 1)	Dewgee C	50	50	
BOX TEMP	20-40	Dewgee C	35.4	36.0	
PMT TEMP	7 (+/- 1)	Dewgee C	8.5	8.0	
UV lamp	1000-4900	mV	2900	2900	
Lamp Ratio	30-120	%	82.9	82.9	
STR. Light (Zero Gas)	<100	PPB	25.4	25.4	
Dark PMT	(-50) - (+200)	mV	12.5	12.5	
Dark lamp	(-50) - (+200)	mV	1.5	1.5	
SAMP PRES	20-30 constant	IN-Hg-A	27.8	28.3	
Electric Tests/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	7.3	0.4	
Span Gas (400 PPB)	400	ppb	411.0	401.0	± 5% of Range

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6504002
Calibrated Date: 1-Apr-22

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Instruments Information

Analyzer Type: SO2 Analyzer Model: 100A	Manufacturer API S/N: ESOA1100EU0091
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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
--	---

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	8.1	6.1	400.0	403.2	0.4
After	0.0	0.5	0.5	400.0	404.0	0.5

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-N6504002

Calibrated Date: 1-Apr-22

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-22				
Time	13:45				
Range	50 - 20000	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.2	0.1	
Sample Flow	850 (+/- 50)	cc/min	582.0	581.0	
PMT Detector	0 - 5000	mV	255.6	61.0	
Norm PMT Detector	0 - 5000	mV	59.7	65.2	
HVPS	400-800 constant	V	607.0	607.0	
DCPS	2500 (+/- 200)	mV	-	-	
CELL TEMP	50 (+/- 1)	Deegee C	50.0	50.0	
BOX TEMP	20-40	Deegee C	34.0	34.1	
PMT TEMP	7 (+/-1)	Deegee 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	3.5	3.6	
Dark lamp	(-50) - (+200)	mV	56.5	57.0	
SAMP PRES	20-30 constant	IN-Hg-A	29.3	29.3	
Electric Test/OpGc Test					
PMT Vulta	2000 (+/- 500)	mV	1682.0	2044.0	
SO2 Conc	1000 (+/- 250)	PPB	641.0	1022.0	
SO2 Slope	1 (+/- 0.3)	-	1.224	1.104	
SO2 Offset	< 250	mV	24.5	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	6.1	0.5	
Span Gas (400 PPB)	400	ppb	403.2	404.0	± 5% of Range

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504006

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Calibrated Date: 1-Apr-22

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Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENOA1200A01679
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Calibration System

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

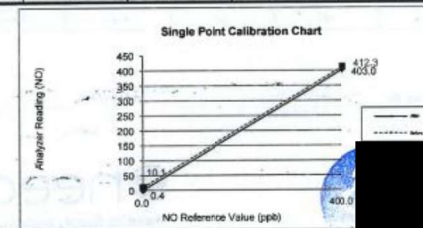
Environment: Temperature 26.5 °C Humidity 47 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	4.6	0.0	4.6	410.1	400.0	1.2
NO2	5.5	0.0	5.5	2.2	0.0	0.3
NOx	10.1	0.0	10.1	412.3	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	0.1	0.0	0.1	401.6	400.0	0.2
NO2	0.3	0.0	0.3	1.4	0.0	0.2
NOx	0.4	0.0	0.4	403.0	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504006

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Calibrated Date: 1-Apr-22

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Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Apr-22				
Time	10:10				
Range	0.00 - 500.00 PPM	PPM	500	500	
Stability (Zero Gas)	< 0.2	PPM	0.4	0.2	
Sample Flow	500±1.50	cc/min	482	484	
Ozone Flow	60-80	cc/min	74	77	
PMT Detector	0-5000	mV	51	28	
AZERO	-20-150	mV	53.3	33.3	
HVPS	400-900 constant	V	821	821	
DCPS	2500 ±1.200	mV	2556	2556	
RCCELL TEMP	50±1	Oneseg C	50	50	
BOX TEMP	20-35	Oneseg C	30.2	32.8	
PMT TEMP	7 ±1.1	Oneseg C	7.5	7.5	
IZS TEMP	50±1.4	Oneseg C	-	-	
MOLY Temp	315 ±1.5	Oneseg C	315.0	314.5	
RCCL PRES	4-10 constant	IN-Hg-A	8.8	8.8	
SAMP PRES	20-30 constant	IN-Hg-A	30.2	31.8	
NO Slope	1 ±1.0.3		0.820	0.822	
Nox Slope	1 ±1.0.3		0.854	0.858	
NO Offset	-10 to +150	mV	17.8	17.8	
NOx Offset	-10 to +150	mV	5.0	5.0	
Span and Cal Values					
Zero Value	NO	0	ppb	4.6	0.1
	NOx	0	ppb	10.1	0.4
Span Value	NO	400	ppb	410.1	401.6
	NOx	400	ppb	412.3	403.0

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504005

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Calibrated Date: 1-Apr-22

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Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENCAIT20000108
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC131 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

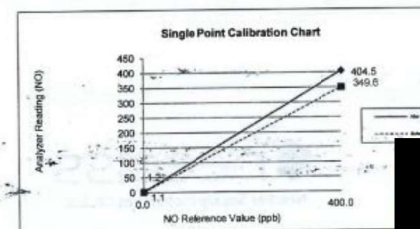
Environment: Temperature 28.2 °C Humidity 51 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	-1.8	0.0	-1.8	359.0	400.0	-5.4
NO ₂	3.0	0.0	3.0	-9.4	0.0	-1.3
NOx	1.2	0.0	1.2	349.6	400.0	-6.7

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.3	0.0	1.3	399.8	400.0	-0.1
NO ₂	-0.2	0.0	-0.2	4.9	0.0	0.6
NOx	1.1	0.0	1.1	404.6	400.0	0.6



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6504005

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Calibrated Date: 1-Apr-22

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Test Function Value	Normal range	Unit	Before	After	Note
Date	1-Apr-22				
Time	10:10				
Range	0.00 - 500.00 PPM	PPM	500	500	
Stability (Zero Gas)	< 0.2	PPM	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	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	400-800 constant	V	819	819	
DOPS	2500 +/- 200	mV	-	-	
RECELL TEMP	50 +/- 1	Dewegge C	50	50	
BOX TEMP	20-35	Dewegge C	33.7	32.9	
PMT TEMP	7 +/- 1	Dewegge C	7.1	7.1	
IZS TEMP	50 +/- 4	Dewegge C	-	-	
MCLY Temp	315 +/- 5	Dewegge C	314.4	315.0	
RECEL PRES	4-10 constant	IN+kg-A	10	10	
SAMP PRES	20-30 constant	IN+kg-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	-1.8	1.3
	NOx	0	ppb	1.2	1.1
Span Value	NO	400	ppb	359.0	399.0
	NOx	400	ppb	349.6	404.5

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6504006

Calibrated Date: 1-Apr-22

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Instruments Information

Analyzer Type: CO Analyzer Model: CO12E	Manufacturer: Environnement SA, France S/N: ECOESACO12E205
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Calibration System

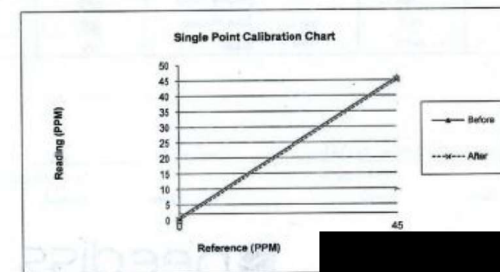
Calibrator Unit	Standard Gas
Dilutor Model ESA MSC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO Conc 44.68 PPM SO2 Conc 45.34 PPM CO Conc 4500 PPM Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 26.7 °C

Humidity: 47 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.813	0.8	45.0	45.79	0.9
After	0.0	0.030	0.0	45.0	45.01	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6504006

Calibrated Date: 1-Apr-22

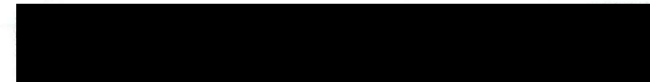
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Analyzer Signal Values					
Date	1-Apr-22	Time	10:09:00		
Power Supplies					
Option	0.0	mV	+5 V Sensor	5	V
+3.3 V	3.3	V	+24 V	24.2	V
+12 V	11.8	V	+5 V	5.1	V
+24 V	1.1	mV			
Optical Bench					
IR current ratio	884.7	mA	Pbse current	618.2	mV
Optical 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



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6504005

Calibrated Date: 1-Apr-22

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Instruments Information

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

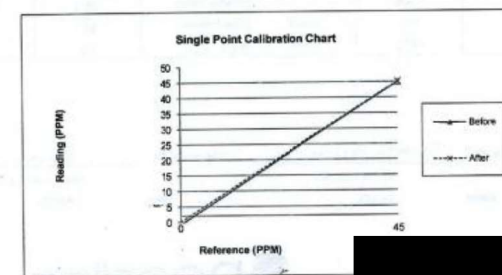
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NO Conc 44.68 PPM
ZERO AIR Generator ZAG7001 S/N: 644	SO2 Conc 45.34 PPM
	CO Conc 4500 PPM
	Expire Date: Feb 19, 2024 EB0140762

Environment: Temperature 26.6 °C


Humidity 47 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	-0.376	-0.9	45.0	44.98	0.0
After	0.0	-0.010	0.0	45.0	45.11	0.1




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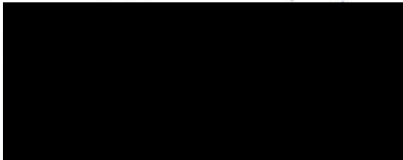

CO Analyzer Verification Test Report

Calibration Report No.: ES-C6504005
Calibrated Date: 1-Apr-22
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Analyzer Signal Values					
Date	1-Apr-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	Pbase current	618.2	mV
Optical T.	46.0	deg C	Pbase 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-Apr-22 Date: 1-Apr-22



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