



บริษัท เอ็นไวแล็บ จำกัด 540,540/1 ซอยบางแค 7 แขวงบางแค เขตบางแค กรุงเทพฯ 10160
Envilab Co., Ltd. 540,540/1 Soi Bangkhae 7 Bangkhae Bangkok Bangkok 10160
Tel : 02-802-3577-8 Fax: 02-802-3773 E-mail : info@evltesting.com



Envilab & Nipponkai Quality Inspection

TSP High Volume Sampler Calibration

Verification Report No.

SO2300299-E001 -TSP 01

<input type="checkbox"/> PM	<input checked="" type="checkbox"/> Onsite
Site: โรงเรียนเซนต์แมรี	
UTM : 47P N 1582246 E 676422	
Sampler: ETSP#35	
Recorder: ECRDS016339508	
Date: 8 Nov 23	
Technical: [Redacted]	
Approval: [Redacted]	

CONDITIONS

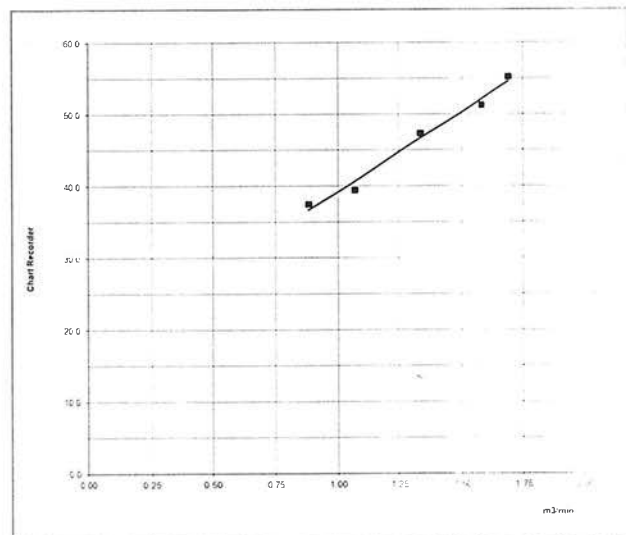
Barometric Press. (hPa): 1008.0	Corrected Pressure (mm Hg): 756.1
Temperature (deg C): 32.0	Temperature (deg K): 305.0
Average Press. (hPa): 1013.0	Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION Slope = 22.1668 Intercept = 17.0224 Corr. coeff. = 0.9920 # of Observations: 5 Range of Chart at 1.1 - 1.7 m3/min. 42 55
1	11.98	1.693	56.0	55.21	
2	10.46	1.583	52.0	51.27	
3	7.44	1.338	48.0	47.32	
4	4.69	1.066	40.0	39.44	
5	3.22	0.887	38.0	37.46	



Calibrated by : [Redacted]

Approved by : [Redacted]

8 November 2023

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Environmental responsibility with accuracy measurement

FE-MNT-29 Rev 00.01/08/63



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ผู้จัดการฝ่ายควบคุมคุณภาพ



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TSP High Volume Sampler Calibration

Verification Report No.

SO2300299-E001 -TSP 05

☒ PM ☐ Onsite

Site: วัดโดนด้าย

UTM : 47P N 1586144 E 680230

Sampler: ETSP#44

Recorder: ECRAN000031065

Date: 8 Nov 23

Technical:

Approval:

CONDITIONS

Barometric Press. (hPa): 1008.0

Temperature (deg C): 32.0

Average Press. (hPa): 1013.0

Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 756.1

Temperature (deg K): 305.0

Corrected Avg. Press. (mm Hg): 759.8

Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 759

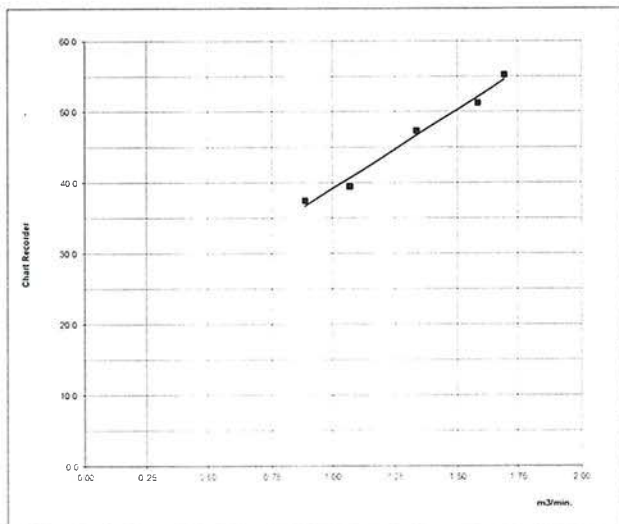
Qstd Slope: 2.03736

Qstd Intercept: -0.03733

Date Certified: 18 Jan 23

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
1	11.56	1.664	56.0	55.21	Slope =	24.8306
2	10.69	1.600	52.0	51.27	Intercept =	12.5181
3	7.55	1.348	46.0	45.35	Corr. coeff.=	0.9927
4	4.99	1.099	40.0	39.44	# of Observations:	5
5	3.32	0.900	36.0	35.49	Range of Chart	41
					at 1.1 - 1.7 m3/min.	55



Calibrated by :

8 November 2023

Approved by :

(V) 8 November 2023

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FE-MNT-29 Rev.00 C1/08/63



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Envilab & Nippon Display Instrument

TSP High Volume Sampler Calibration

Verification Report No.
SO2300299-E001 -TSP 04

<input type="checkbox"/> PM	<input checked="" type="checkbox"/> Onsite
Site: วัดโคกมเหยม	
UTM : 47P N 1585051 E 677731	
Sampler: ETSP#31	
Recorder: ECRAN000031066	
Date: 8 Nov 23	
Technical: [Redacted]	
Approval: [Redacted]	

CONDITIONS

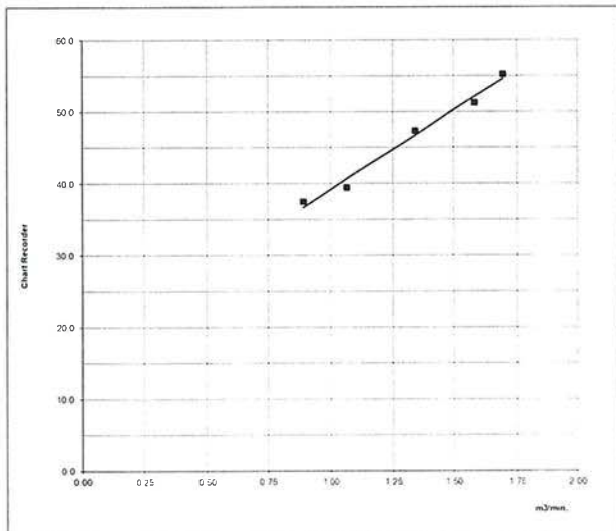
Barometric Press. (hPa): 1006.0	Corrected Pressure (mm Hg): 754.6
Temperature (deg C): 33.0	Temperature (deg K): 306.0
Average Press. (hPa): 1013.0	Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION Slope = 22.1668 Intercept = 16.9767 Corr. coeff.= 0.9920 # of Observations: 5 Range of Chart at 1.1 - 1.7 m3/min. 43 55
1	11.98	1.689	56.0	55.07	
2	10.46	1.579	52.0	51.13	
3	7.44	1.335	48.0	47.20	
4	4.69	1.064	40.0	39.33	
5	3.22	0.884	38.0	37.37	



Calibrated by : [Redacted]

8 November 2023

Approved by : [Redacted]

8 November 2023

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EnviLab is a Member Supply Instrument

TSP High Volume Sampler Calibration

Verification Report No.

SO2300299-E001 -TSP 02

☐ PM ☒ Onsite

Site: ขนขนนองไม่ขง

UTM : 47P N 1582069 E 677904

Sampler: ETSP#37

Recorder: ECRAN000031071

Date: 8 Nov 23

Technical:

Approval:

CONDITIONS

Barometric Press. (hPa): 1008.0

Temperature (deg C): 32.0

Average Press. (hPa): 1013.0

Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 756.1

Temperature (deg K): 305.0

Corrected Avg. Press. (mm Hg): 759.8

Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 759

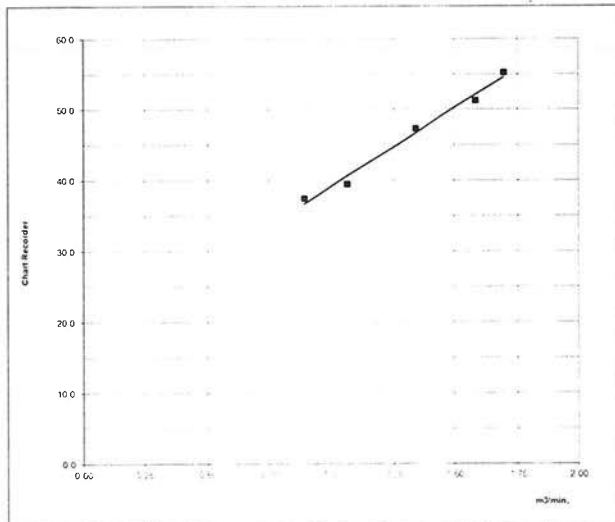
Qstd Slope: 2.03736

Qstd Intercept: -0.03733

Date Certified: 18 Jan 23

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
1	11.56	1.664	56.0	55.21		
2	10.69	1.600	52.0	51.27	Slope = 24.8306 Intercept = 12.5181 Corr. coeff.= 0.9927	
3	7.55	1.348	46.0	45.35		
4	4.99	1.099	40.0	39.44		
5	3.32	0.900	36.0	35.49	# of Observations: 5	
					Range of Chart	41
					at 1.1 - 1.7 m3/min.	55



Calibrated by :

8 November 2023

Approved by :

8 November 2023

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FE-MNT-29 Rev.00 01/08/63



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Printed in Thailand Supply Instructions

TSP High Volume Sampler Calibration

Verification Report No.

SO2300299-E001 -TSP 03

<input type="checkbox"/> PM	<input checked="" type="checkbox"/> Onsite
Site: หมู่บ้านสุขสิริ	
UTM : 47P N 1583850 E 678005	
Sampler: ETSP#33	
Recorder: ECRAN000031078	
Date: 8 Nov 23	Technician: [Redacted]
Approver: [Redacted]	

CONDITIONS

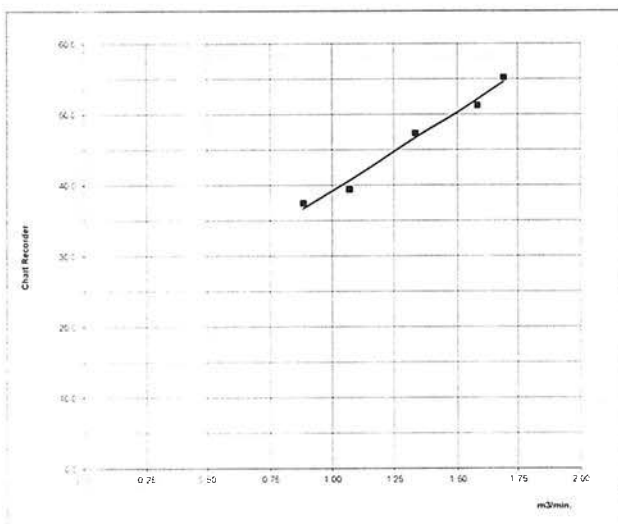
Barometric Press. (hPa): 1006.0	Corrected Pressure (mm Hg): 754.6
Temperature (deg C): 33.0	Temperature (deg K): 306.0
Average Press. (hPa): 1013.0	Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	11.98	1.689	56.0	55.07	Slope = 22.1668
2	10.46	1.579	52.0	51.13	Intercept = 16.9767
3	7.44	1.335	48.0	47.20	Corr. coeff. = 0.9920
4	4.69	1.064	40.0	39.33	# of Observations: 5
5	3.22	0.884	38.0	37.37	Range of Chart at 1.1 - 1.7 m3/min: 43
					55



Calibrated by :

8 November 2023

Approved by :

8 November 2023

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TE-MN1-27 Rev. 00 (01/08/83)

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ผู้จัดการฝ่ายควบคุมคุณภาพ



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Tel : 02-802-3577-8 Fax: 02-802-3773 E-mail : info@evltesting.com



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PM10 High Volume Sampler Calibration

Verification Report No.

SO2300299-E001 -PM 01

<input checked="" type="checkbox"/> PM	<input type="checkbox"/> Onsite
Site: โรงเรียนเซนต์แมรี	
UTM : 47P N 1582246 E 676422	
Sampler: EPM#4	
Recorder: ECRDS016180801	
Date: 8 Nov 23	
Technical: [Redacted]	
Approval: [Redacted]	

CONDITIONS

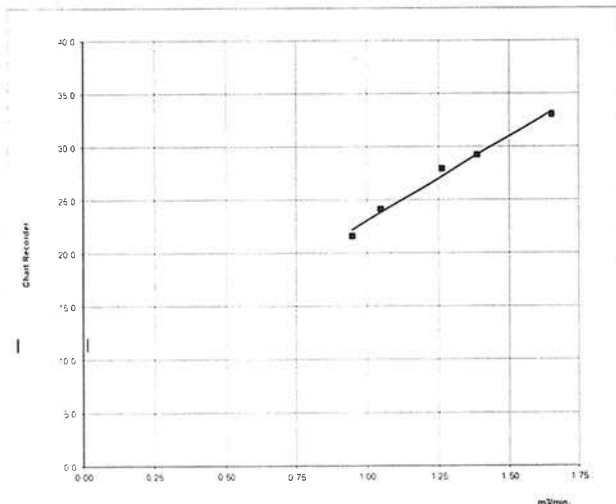
Barometric Press. (hPa): 1008.0	Corrected Pressure (mm Hg): 756.1
Temperature (deg C): 32.0	Temperature (deg K): 305.0
Average Press. (hPa): 1013.0	Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	10.73	1.649	52.0	33.03	Slope = 15.8412
2	7.59	1.390	46.0	29.22	Intercept = 7.2432
3	6.23	1.261	44.0	27.95	Corr. coeff. = 0.9929
4	4.28	1.048	38.0	24.14	SFR = 1.143
5	3.47	0.946	34.0	21.59	SSP = 39.91
					# of Observations: 5
					Range of Chart 38
					at SFR $\pm 10\%$ 42



Calibrated by :

([Redacted Signature])
8 November 2023

Approved by :

([Redacted Signature])
8 November 2023

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FE-MNT-29 Rev 00 01/08/63



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Envilab & Envilab Supply Instruments

PM10 High Volume Sampler Calibration

Verification Report No.

SO2300299-E001 -PM 05

<input checked="" type="checkbox"/> PM	<input type="checkbox"/> Onsite
Site: วัดโดนด้าย	
UTM : 47PN 1586144 E 680230	
Sampler: EPM#16	
Recorder: NCRTI500904871	
Date: 8 Nov 23	Technical: [Redacted]
Approval: [Redacted]	

CONDITIONS

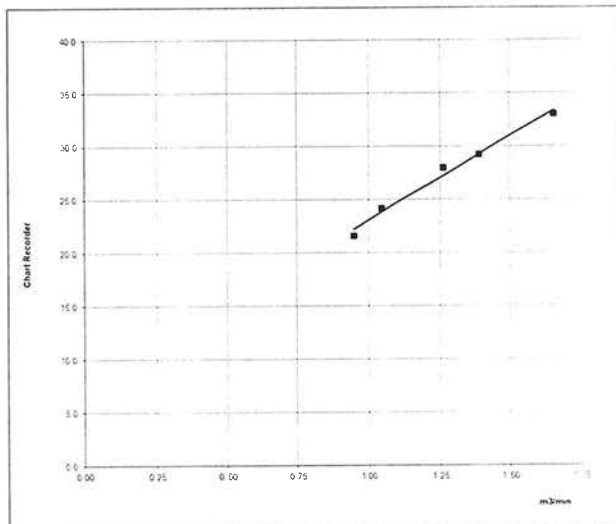
Barometric Press. (hPa): 1008.0	Corrected Pressure (mm Hg): 756.1
Temperature (deg C): 32.0	Temperature (deg K): 305.0
Average Press. (hPa): 1013.0	Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
1	10.73	1.649	52.0	33.03	Slope =	15.8412
2	7.59	1.390	46.0	29.22	Intercept =	7.2432
3	6.23	1.261	44.0	27.95	Corr. coeff.=	0.9929
4	4.28	1.048	38.0	24.14	SFR =	1.143
5	3.47	0.946	34.0	21.59	SSP =	39.91
					# of Observations:	5
					Range of Chart	38
					at SFR ±10%	42



Calibrated by :

8 November 2023

Approved by :

8 November 2023

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PM10 Cal. Rev.07 / Iss. Date: Mar 12, 2020

FE-MNT-29 Rev.00 01/08/63



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 ผู้จัดการฝ่ายควบคุมคุณภาพ



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PM10 High Volume Sampler Calibration

Verification Report No.

SO2300299-E001 -PM 04

☐ PM

☐ Onsite

Site: วัดโคกมะขาม

UTM : 47P N 1585051 E 677731

Sampler: EPM#31

Recorder: NCRTI500904833

Date: 8 Nov 23

Technical:

Approval:

CONDITIONS

Barometric Press. (hPa): 1006.0

Temperature (deg C): 33.0

Average Press. (hPa): 1013.0

Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 754.6

Temperature (deg K): 306.0

Corrected Avg. Press. (mm Hg): 759.8

Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 759

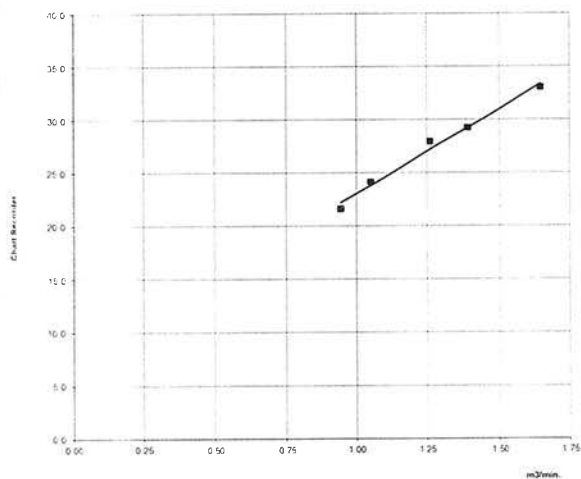
Slope: 1.27576

Intercept: -0.02337

Date Certified: 18 Jan 23

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	10.73	1.653	52.0	33.11	Slope = 15.8412
2	7.59	1.394	46.0	29.29	Intercept = 7.2631
3	6.23	1.264	44.0	28.02	Corr. coeff. = 0.9929
4	4.28	1.051	38.0	24.20	SFR = 1.149
5	3.47	0.948	34.0	21.65	SSP = 39.99
					# of Observations: 5
					Range of Chart at SFR $\pm 10\%$
					38
					42



Calibrated by :

8 November 2023

Approved by :

8 November 2023

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PM10 Cal. Rev.07 / Iss. Date: Mar 17, 2020

FE/MNT-29 Rev.00:01/06/63



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Control & Review Sample Instruments

PM10 High Volume Sampler Calibration

Verification Report No.

SO2300299-E001 -PM 02

<input checked="" type="checkbox"/> PM	<input type="checkbox"/> Onsite
Site: <u>ชุมชนหนองไม้ซุง</u>	
UTM : <u>47P N 1582069 E 677904</u>	
Sampler: <u>EPM#36</u>	
Recorder: <u>NCRTI500904859</u>	
Date: <u>8 Nov 23</u>	
Technical: <u>[Redacted]</u>	
Approval: <u>[Redacted]</u>	

CONDITIONS

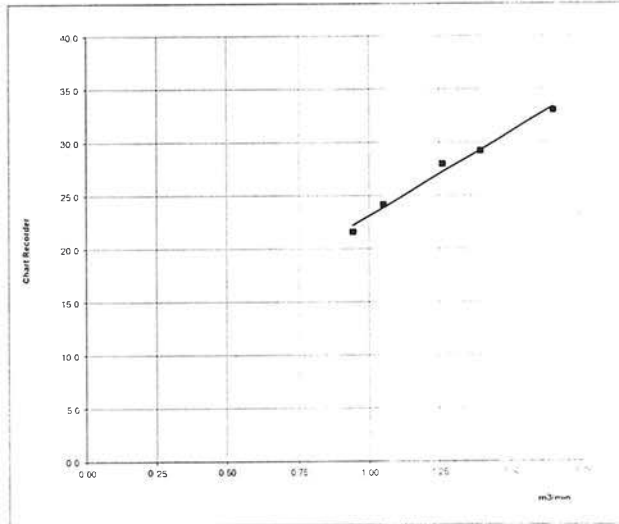
Barometric Press. (hPa): 1008.0	Corrected Pressure (mm Hg): 756.1
Temperature (deg C): 32.0	Temperature (deg K): 305.0
Average Press. (hPa): 1013.0	Corrected Avg. Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

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

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
1	10.98	1.668	52.0	33.03	Slope =	15.3558
2	7.89	1.417	48.0	30.49	Intercept =	7.9384
3	6.61	1.298	44.0	27.95	Corr. coeff. =	0.9943
4	4.45	1.069	38.0	24.14	SFR =	1.143
5	3.12	0.898	34.0	21.59	SSP =	40.14
					# of Observations:	5
					Range of Chart at SFR ±10%	38 42



Calibrated by : [Redacted]
 8 November 2023

Approved by : [Redacted]

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PM10 Cal. Rev.07 / Iss.Date: Mar 17, 2020

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 ผู้จัดการฝ่ายควบคุมคุณภาพ



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Tel : 02-802-3577-8 Fax: 02-802-3773 E-mail : info@evltesting.com



Envilab & Associate Supply Instrument

PM10 High Volume Sampler Calibration

Verification Report No.

SO2300299-E001 -PM 03

L PM

Onsite

Site: หมู่บ้านสุขสิริ

UTM : 47P N 1583850 E 678005

Sampler: EPM#33

Recorder: NCRTI500904844

Date: 8 Nov 23

Technical:

Approval:

CONDITIONS

Barometric Press. (hPa): 1006.0

Temperature (deg C): 33.0

Average Press. (hPa): 1013.0

Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 754.6

Temperature (deg K): 306.0

Corrected Avg. Press. (mm Hg): 759.8

Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 759

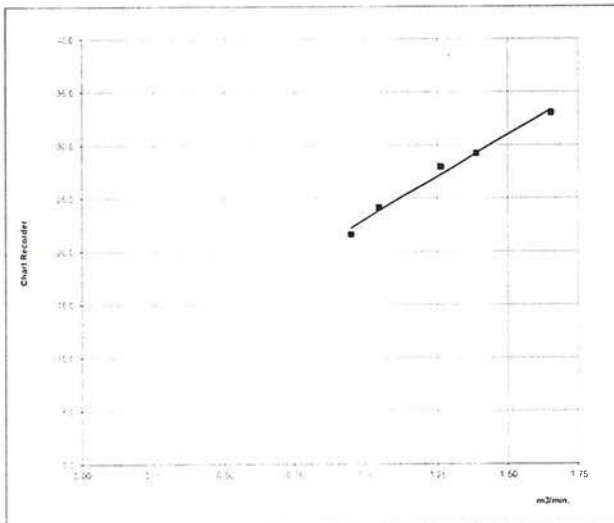
Slope: 1.27576

Intercept: -0.02337

Date Certified: 18 Jan 23

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
1	10.98	1.672	52.0	33.11	Slope =	15.3558
2	7.89	1.420	48.0	30.57	Intercept =	7.9600
3	6.61	1.302	44.0	28.02	Corr. coeff. =	0.9943
4	4.45	1.071	38.0	24.20	SFR =	1.149
5	3.12	0.900	34.0	21.65	SSP =	40.21
					# of Observations:	5
					Range of Chart at SFR $\pm 10\%$	38 42



Calibrated by :

8 November 2023

Approved by :

8 November 2023

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www.evltesting.com

Environmental responsibility with accuracy measurement

PM10 Cal Rev 07 / Iss Date Mar 17, 2020



รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



บริษัท เอ็นไวแล็บ จำกัด 540,540/1 ซอยบางแค 7 แขวงบางแค เขตบางแค กรุงเทพฯ 10160
Envilab Co., Ltd. 540,540/1 Soi Bangkhoe 7 Bangkhoe Bangkok Bangkok 10160
Tel : 02-802-3577-8 Fax. 02-802-3773 E-mail : info@evltesting.com



Envilab & Needless Supply Instrument

Verification Test Report

Report No.:

SO2300299-E001 -SLM 01

☐ PM ☒ Onsite UTM: 47P 677904 1582069

Calibrated Date: 9 November 2023

Site : จุดที่ 1 บริเวณริมรั้วด้านทิศตะวันออกเฉียงใต้

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1970

Environment: Temperature 32 °C Humidity 65 %RH

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

Serial No.1351075

Date of Calibration : 16 March 2023

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.57	-0.21	93.78

Calibrated By:

Date:

9 November 2023

Approve By:

Date:

9 November 2023

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Envilab Co., Ltd. 540,540/1 Soi Bangkhae 7 Bangkhae Bangkok Bangkok 10160
Tel : 02-802-3577-8 Fax. 02-802-3773 E-mail : info@evltesting.com



Envilab & Needless Supply Instrument

Verification Test Report

Report No.:

SO2300299-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P 706191 1643665

Calibrated Date: 9 November 2023

Site : จุดที่ 2 บริเวณสายพานลำเลียงขยะเข้าเตา

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1805

Environment: Temperature 32 °C Humidity 65 %RH

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

Serial No.1351075

Date of Calibration : 16 March 2023

Result of Test

Reference Standard (dB)	Instrument reading (dB)	Error (dB)	Adjust (dB)
93.78	93.50	-0.28	93.78

Calibrated By:

Date:

9 November 2023

Approve By:

Date:

9 November 2023

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รับรองผลการสอบ
ผู้สอบ



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Envilab Co., Ltd. 540,540/1 Soi Bangkhae 7 Bangkhae Bangkok Bangkok 10160
Tel : 02-802-3577-8 Fax. 02-802-3773 E-mail : info@evltesting.com



Envilab & Needleless Supply Instruments

Verification Test Report

Report No.:

SO2300299-E001 -PU 01

Calibrated Date: 12-Nov-23

Equipment: Air Sampling Pump

Manufacturer: Gillian

Model: HFS-113A

Serial or ID No. 03023

Environment: Temperature 25 °C Humidity 67 %RH

Reference Standard: Primary Flow Calibrator Model Defender 520 H, MESALABS

Serial No. 164578

Date of Calibration : 04 May 2023

Result of Test			
Reference Flow (ml/min)	Test No.	Reading (ml/min)	Average (ml/min)
2000	1	2001.1	2000.1
	2	1999.8	
	3	1999.4	
	4	2000.2	
	5	2000.0	

Calibrated By:



Date: 12-Nov-23

Approve By:



Date: 12-Nov-23

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Envilab Co., Ltd. 540,540/1 Soi Bangkhoe 7 Bangkhoe Bangkok Bangkok 10160
Tel : 02-802-3577-8 Fax. 02-802-3773 E-mail : info@evltesting.com



Envilab is Notified Supply Instruments

Verification Test Report

Report No.:

SO2300299-E001 -PU 02

Calibrated Date: 12-Nov-23

Equipment: Air Sampling Pump

Manufacturer: Gillian

Model: HFS-113A

Serial or ID No. 02138

Environment: Temperature 32 °C Humidity 67 %RH

Reference Standard: Primary Flow Calibrator Model Defender 520 H, MESALABS

Serial No. 164578

Date of Calibration : 04 May 2023

Result of Test			
Reference Flow (ml/min)	Test No.	Reading (ml/min)	Average (ml/min)
1700	1	1699.8	1700.4
	2	1700.4	
	3	1701.6	
	4	1700.2	
	5	1700.0	

Calibrated By: _____

Date: 12-Nov-23

Approve By: _____

Date: 12-Nov-23

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Envilab Co., Ltd. 540,540/1 Soi Bangkhae 7 Bangkhae Bangkok Bangkok 10160
Tel : 02-802-3577-8 Fax. 02-802-3773 E-mail : info@evltesting.com



Envilab & Needless Supply Instruments

Verification Test Report

Report No.:

SO2300299-E001 -PU 03

Calibrated Date: 12-Nov-23

Equipment: Air Sampling Pump

Manufacturer: Gillian

Model: HFS-113A

Serial or ID No. 10510

Environment: Temperature 32 °C Humidity 67 %RH

Reference Standard: Primary Flow Calibrator Model Defender 520 H, MESALABS

Serial No. 164578

Date of Calibration : 04 May 2023

Result of Test			
Reference Flow (ml/min)	Test No.	Reading (ml/min)	Average (ml/min)
2000	1	2000.2	2000.5
	2	1999.8	
	3	2000.1	
	4	2002.2	
	5	2000.2	

Calibrated By:

Date: 12-Nov-23

Approve By:

Date: 12-Nov-23

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Envilab Co., Ltd. 540,540/1 Soi Bangkhae 7 Bangkhae Bangkok 10160
Tel : 02-802-3577-8 Fax. 02-802-3773 E-mail : info@evltesting.com



Envilab & Needles Supply Instruments

Verification Test Report

Report No.:

SO2300299-E001 -PU 04

Calibrated Date: 12-Nov-23

Equipment: Air Sampling Pump

Manufacturer: Gillian

Model: HFS-113A

Serial or ID No. 02297

Environment: Temperature 32 °C Humidity 67 %RH

Reference Standard: Primary Flow Calibrator Model Defender 520 H, MESALABS

Serial No. 164578

Date of Calibration : 04 May 2023

Result of Test			
Reference Flow (ml/min)	Test No.	Reading (ml/min)	Average (ml/min)
1700	1	1700.2	1699.9
	2	1701.2	
	3	1699.2	
	4	1699.0	
	5	1700.0	

Calibrated By

Date: 12-Nov-23

Approve By:

Date: 12-Nov-23

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รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ

CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhprachasan 3 Rd., Bangpood, Pakkred, Nonthaburi 11120

Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com



NSC-TISI-TIS17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 66-200066-2

Page : 1 of 2

Submitted by : Envilab Co., Ltd.
540, 540/1 Soi Bangkhae7, Bangkhae, Bangkok 10160

Equipment : Electronic Balance
Manufacturer : METTLER TOLEDO **Model :** XSR205DU
Serial No. : B911363567 **ID No. :** ELABBALANCEN06
Capacity : 220 g **Resolution :** 0.00001g/81g, 0.0001g/220g

Environment : On site calibration was carried out at the B304 Balance Room, Envilab Co., Ltd.
Ambient Temperature : (24.6 to 24.9) °C
Relative Humidity : (57.0 to 67.8) %
Air Pressure : 1015.0 mbar

Date of Received : 01 March 2023

Date of Calibration : 01 March 2023

Date of Issue : 04 March 2023

Calibrated by : [REDACTED]

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 14
Edition 7 - November 2022

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

Standard Weights

<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>	<u>Traceability</u>
E261-E2624	C02222345	10 Nov 2023	National Institute of Metrology (Thailand), (NIMT)

Approved by

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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CAL-F0031-03



Envilab Co.,Ltd.

รับ
ผู้จัดการฝ่ายควบคุมคุณภาพ



CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhprachasan 3 Rd., Bangpood, Pakkred, Nonthaburi 11120

Tel.(02) 964-6211 Fax.(02) 964-5155; e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com

Certificate of Calibration

Certificate No. : 66-200066-2

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)
0.1	0.00000	0.000014
0.5	0.00002	0.000022
1	0.00000	0.000026
2	0.00001	0.000034
5	-0.00001	0.000043
10	0.00000	0.000053
50	0.00004	0.00011
100	-0.0001	0.00020
150	-0.0001	0.00038
200	-0.0002	0.00038

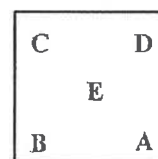
This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.07$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 50 g

A B C D E
0.00000 0.00000 0.00001 0.00001 0.00000 g



Repeatability

Load test : 200 g

Stdev. : 0.000042 g

- 000 -



Certificate of Calibration

Certificate Number : SPR23050051-1

Page : 1 of 3

Customer : Envilab Co., Ltd.

540, 540/1 Soi Bangkhae 7, Bangkhae, Bangkhae Bangkok 10160

Equipment Name : Primary Flow Meter (Drycal)

Manufacturer : MesaLabs

Model : Defender 520-H

Serial Number : 164578

ID. Number : N/A

Environmental Conditions

Ambient Temperature : $23\text{ }^{\circ}\text{C} \pm 2\text{ }^{\circ}\text{C}$

Received Date : 04 May 2023

Relative Humidity : $50\% \pm 15\%$

Calibration Date : 04 May 2023

Location of Calibration : In-Lab

Recommend Due Date : 04 May 2024

Calibration Procedure : SP-CPM-04-13

Date of Issue : 05 May 2023

Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by :



Calibration Officer

Approved by :



Authorized Signatory



Envilab Co., Ltd.

รับรองมาตรฐานห้อง

จัดการฝ่ายควบคุมคุณภาพ

FM-04-15 rev.0



Calibration Report

Certificate Number : SPR23050051-1

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Mass Flow Calibrator	AFC-COMPLETE-10	12532	AD2207-177-0001	17 Jul 2023
Standard Flow Meter	520-H	200353	MW-0071-22	25 Aug 2023

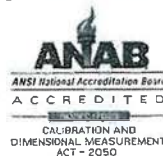
Traceability

This certification is traceable to the International System of Unit maintained at :

MIT - Miracle International Technology Co.,Ltd.

MesaLabs - Mesa Laboratories, Inc.NVLEP Lab Code 200661-0 (ISO17025)





Result of Calibration

Certificate No. : SPR23050051-1

Page : 3 of 3

Range : 0 to 30 L/Min

Resolution : 0.0001 L/Min

Function : Air Flow Measurement

Unit : L/Min

Calibration Point	UUC Reading	Standard Reading	UUC Error	K Factor Value	Uncertainty (±)
5.0	4.9722	4.9752	-0.0030	1.00060	0.050
10.0	10.296	10.325	-0.029	1.00282	0.10
15.0	15.076	15.037	0.039	0.99741	0.20
20.0	20.331	20.274	0.057	0.99720	0.20

Note:

The result of calibration was found accurate as show on date and place of calibration only.
This Certificate is not certified for any commercial transaction.

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2$, providing a level of confidence approximately 95 %

- End of Certificate -





Certificate of Calibration

Method 5 Pre-Test Calibration - Liters (L)

UUT Meter - Console Information

Model #: 800-STACKS-5
Serial #: 1837
DGM Model #: GBT6968-2011
DGM Serial #: L1500033637

Calibration Conditions

Bar. Pressure (mm Hg): 759.8
Ambient Temperature (°C): 24.4
Relative Humidity (%): 47
Altitude (m): 1.83
Bar. Pressure Corr. (mm Hg): 759.7

Factors/Conversions

Std. Temp. (K): 293.15
Std. Press. (mm Hg): 760
K₁ (K/mm Hg): 0.3857

Reference Equipment

Calibration Meter Model: DGMR-2000H
Cal. Date: 03-Jun-22
Serial No.: 0000026
Gamma: 1.0000

UUT Meter (DGM)

Run Time (sec=45)	Orifice ΔH (mm H ₂ O)	Volume			Meter Temperature (°C)		Meter Pressure (in H ₂ O)	Reference Meter (WTM)		
		Initial (L)	Final (L)	Total (L)	Initial	Final		Initial	Total	Final
Θ	P _{mf}	V _{mf}	V _{mf}	V _m	t _{mf}	t _{mf}	P _w	V _{wf}	V _w	t _{wf}
840.00	13.00	469033.5	469195.0	161.5	24.0	24.0	0.3	0.00	154.93	24.0
630.00	25.00	469195.0	469362.5	167.5	24.0	25.0	0.5	0.00	161.02	24.0
450.00	50.00	469362.5	469530.2	167.7	25.0	25.0	0.6	0.00	161.83	24.0
360.00	80.00	469530.2	469698.7	168.5	25.0	25.0	2.0	0.00	162.93	24.0
300.00	120.00	469698.7	469869.4	170.7	25.0	26.0	2.4	0.00	164.81	24.0

Standardized Data

Reference Meter (L)		UUT Meter (L)		Correction Factor		ΔH @ (mm H ₂ O)	
Std. Vol.	Std. Flow	Std. Vol.	Std. Flow	Value	Variance	ΔH @	Variance
V _{w(Std)}	Q _{w(Std)}	V _{m(Std)}	V _{w(Std)}	Y	ΔY	ΔH @	ΔΔH @
152.89	10.92	159.46	10.9	0.9588	-0.0048	48.6	-0.819
158.97	15.14	165.29	15.1	0.9618	-0.0018	48.7	-0.769
159.82	21.31	165.61	21.3	0.9650	0.0014	49.2	-0.241
161.45	26.91	166.88	26.9	0.9675	0.0039	49.9	0.410
163.47	32.69	169.43	32.7	0.9649	0.0013	50.9	1.419
		= Y Avg.		0.9636		49.4	

Metric

ΔH @ Avg.

Pass/Fail Judgment : **Pass**

Note: For Calibration Factor Y, the ratio of the reading of the calibration meter to the dry gas meter, acceptable tolerance of individual values from the average is +0.02.

Note: For ΔH_g, orifice pressure differential that equates to 0.0212 mm H₂O at standard temperature and pressure, acceptable tolerance of individual values from the average is +0.2 inches (5.1 mm) H₂O.

Calibrate By :

Approved By :

Date: 16 Mar 23

The instruments have been calibrated against standards traceable to the NIST Technology (N.I.S.T.) and in reference to EPA Method 5, Section 10.3.1.



neediss

neediss Supply Instrument Co.,Ltd.



รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ

Nomenclature

P_b - Barometric Pressure
 DGM - Dry Gas Meter
 K_1 - Constant based on standard temp and press
 t - Run time, in minutes
 $P_m \pm \Delta H$ (Meter Pressure, gauge)
 V_m - Volume collected by test meter, corrected for STP
 Q_{std} - Calculated flow rate of test meter
 K' - Critical orifice coefficient
 P_w - Measured pressure of reference meter
 t_w - Temperature measured in reference meter

Equations

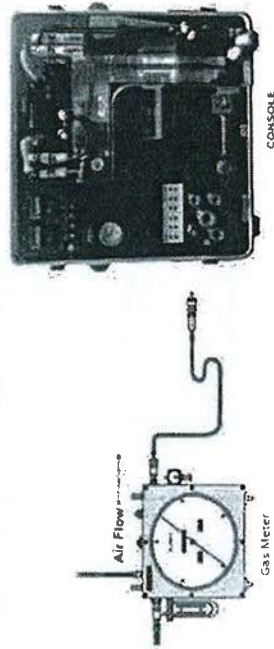
$$V_{w(std)} = Y * K_1 * \frac{V_w * (P_{bar} + \frac{P_{std}}{13.6})}{T_w}$$

$$K_1 = \frac{V_m * (P_{bar} + \frac{\Delta H}{13.6})}{T_m}$$

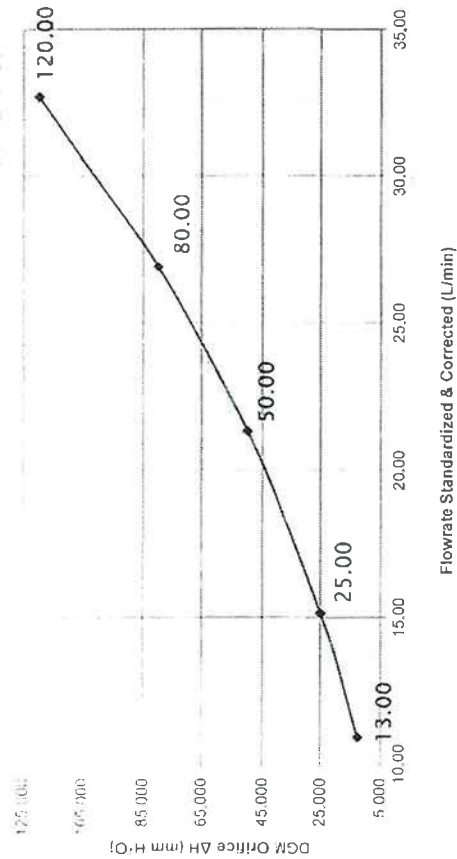
$$K_1 = \frac{T_{std}}{P_{std}} \quad Y = \frac{V_{w(std)}}{V_m(std)} \quad Q_{w(std)} = \frac{V_{w(std)}}{t}$$

$$\Delta t \pm \Delta H_w = \frac{P_{std} * 0.0011636 * (P_{bar} + \frac{P_{std}}{13.6})}{T_m} * \left(\frac{T_w + t}{T_w * P_{bar}} \right)^2$$

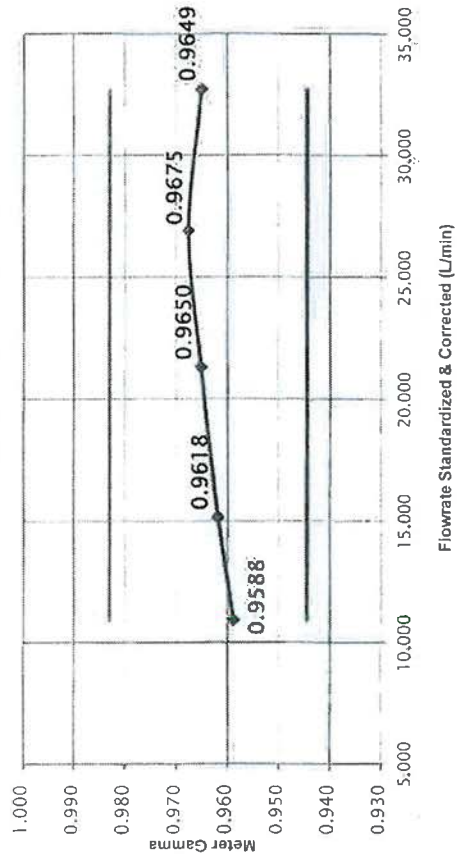
Calibration Train



Meter Pressure vs. Flowrate



Meter Gamma vs. Flowrate





Certificate of Calibration

Method 5 Console Sensor Calibration - Metric Units

Console Information

Model #: 800-STACKS-5
Serial #: 1837
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 759.8
Humidity (%): 47
Tamb (°C): 24.4
Elevation (m): 1.8
Corr. Pbar (mm. Hg): 759.7

Reference Devices

TC Calibrator Model: CC-VTR-SH
Reference #: 091109269
Barometer Model: 736930
Reference #: EBARODIALSPE01
Pressure Model: 718 30G
Reference #: 9543013

Temperature Display Calibration Data

Reference Point ¹	Reference Temp.	Test Thermocouple Calibrations					Reference Point Status ²
		Stack	Probe	Filter	Dryer	Aux	
#	°C	°C	°C	°C	°C	°C	Pass/Fail
1	-18	-17	-17	-17	-16	-17	PASS
2	38	37	38	39	39	39	PASS
3	93	93	94	94	95	94	PASS
4	149	149	150	151	150	150	PASS
5	260	259	260	260	260	260	PASS
6	371	371	372	373	372	372	PASS
7	482	482	483	484	483	483	PASS
8	593	593	594	595	594	594	PASS
9	816	815	816	817	816	817	PASS
10	1038	1036	1038	1038	1037	1039	PASS
PASS							Overall Audit Status

NIST Reference Thermocouple ID: 12702001

Ref Point	Theoretical Temp.	DGM Thermocouple Sensor Reading	ΔT_{abs} ⁴
#	°C	°C	°C
1	0.3	1	0.26%
2	24.4	25	0.12%

Maximum² 0.26%

Status PASS

Internal temperature thermocouple is not audited to EPA standards, and should not be used as an official reference for ambient temperature.

Calibrate By:

Approved By:

Date: 16 Mar 23

Notes

¹ Suggested minimum reference points are 10, 100, 200, 300, 500, 700, 900, 1100, 1500, 1900 °F, can test for more.

² For valid test results, the maximum difference between temperature and reference readings should be less than ± 5.4 °F (± 3 °C), for all thermocouples except for the stack thermocouple which should be less than $\pm 1.5\%$ absolute temperature from the reference reading and the exit thermocouple which should be less than ± 2 °F (± 1 °C) from the reference reading (EPA Method 2, Section 6.3 and EPA Method 5, Sections 6.1.1.7, 6.1.1.8)

³ Do not change this cell value. It is instead based on input from Cell H8 at the top of this sheet under "Calibration Conditions"

⁴ Absolute temperature difference and other formulas are calculated based on unit input from cell C8 at the top of this sheet under "Meter Console Information"

⁵ For valid test results, the maximum difference between console and reference barometric pressure readings should be less than ± 0.1 in. Hg (± 2.5 mm Hg), (EPA Method 5, Section 6.1.2)

⁶ For valid test results, the maximum difference between console and reference vacuum readings should be less than ± 0.5 in. Hg (± 12.5 mm Hg)

⁶ For valid test results, the maximum difference between console and reference vacuum readings should be less than ± 0.05 in. H₂O (± 1.25 mm H₂O) or 5% of full scale


Neediss Supply Instrument Co., Ltd.



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neediss Console Sensor Calibration Data Sheet

Console Information

Model #: 800-STACKS-5
 Serial #: 1837
 Units: Metric
 Type:
 "English"

Calibration Conditions

Pbar (mm. Hg): 759.8
 Humidity (%): 47.0
 Tamb (°C): 24.4
 Corr. Pbar (mm. Hg): 759.7

Reference Devices

TC Simulator Model: CC-VTR-SH
 Reference #: 091109269
 Barometer Model: 736930
 Reference #: EBARODIALSPE01
 Digital Pressure Calibrator Model: 718 30G
 Reference #: 3891001

Pressure Gauge / Manometer Calibration Data

Console Vacuum Calibration			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point
#	in. Hg	in. Hg	Status ⁶ Pass/Fail
1	-5.0	-4.5	PASS
2	-15.0	-14.5	PASS
3	-20.0	-19.5	PASS

Reference Point ¹	ΔH Manometer Calibration			Reference Point Status ² Pass/Fail
	Reference mm H2O	Positive (+) Pitot mm H2O	Negative (-) Pitot mm H2O	
#				
1	-200.000	0.0	-200.0	PASS
2	-150.000	0.0	-150.0	PASS
3	-100.000	0.0	-100.0	PASS
4	-80.000	0.0	-80.0	PASS
5	-50.000	0.0	-50.0	PASS
6	0.000	0.0	0.0	PASS
7	50.000	50.0	0.0	PASS
8	80.000	80.0	0.0	PASS
9	100.000	100.0	0.0	PASS
10	150.000	150.0	0.0	PASS
11	200.000	200.0	0.0	PASS
ΔH Overall Audit Status				PASS

Reference Point ¹	ΔP Manometer Calibration			Reference Point Status ² Pass/Fail
	Reference mm H2O	Positive (+) Pitot mm H2O	Negative (-) Pitot mm H2O	
#				
1	-200.000	0.0	-200.0	PASS
2	-150.000	0.0	-150.0	PASS
3	-100.000	0.0	-100.0	PASS
4	-80.000	0.0	-80.0	PASS
5	-50.000	0.0	-50.0	PASS
6	0.000	0.0	0.0	PASS
7	50.000	50.0	0.0	PASS
8	80.000	80.0	0.0	PASS
9	100.000	100.0	0.0	PASS
10	150.000	150.0	0.0	PASS
11	200.000	200.0	0.0	PASS
ΔP Overall Audit Status				PASS

Calibrate By:  Approved By:  Date: 16 Mar 23

Notes

- ¹ Suggested, minimum reference points are 10 (0, 100, 200, 300, 500, 700, 900, 1100, 1500, 1900 °F) can test for more.
- ² For valid test results, the maximum difference between temperature and reference readings should be less than ±5.4 °F (±3 °C), for all thermocouples except for the stack thermocouple which should be less than ±1.5% absolute temperature from the reference reading and the exit thermocouple which should be less than ±2°F (±1 °C) from the reference.
- ³ Do not change this cell value, it is instead based on input from Cell H8 at the top of this sheet under "Calibration Conditions"
- ⁴ At absolute temperature difference and other formulas are calculated based on unit input from cell C6 at the top of this sheet under "Meter Console Information"
- ⁵ For valid test results, the maximum difference between console and reference barometric pressure readings should be less than ±0.1 in. Hg (±2.5 mm Hg) (IPA Method 5, Section 6.1.2)
- ⁶ For valid test results, the maximum difference between console and reference vacuum readings should be less than ±0.5 in. Hg (±12.5 mm Hg)
- ⁷ For valid test results, the maximum difference between console and reference vacuum readings should be less than ±0.05 in. H2O (±1.25 mm H2O) or 5% of full scale
- I certify that the above Thermocouple Sensors were calibrated in accordance with US EPA Methods 2 and 5 CFR 40 Part 60

neediss Console Sensor Audit QA Sheet

Meter Console Information (UUT)

Model #: 800-STACKS-5
 Serial #: 1837
 Units: Metric

Calibration Conditions

Pbar (mm. Hg): 759.8
 Humidity (%): 47
 Amb. Temp. (°C): 24.4
 Altitude (m): 1.8
 Corrected Pbar (mm. Hg): 759.7

Reference Devices

TC Simulator Model: CC-VTR-SH
 Reference #: 91109269
 Barometer Model: 369307
 Reference #: EBARODIALSPE01
 DP Calibrator Model: 718.30G
 Reference #: 9543013

Audit Data

Reference Point	Reference Temp.	Thermocouple Probe Audit					Reference Point Status ¹
		Stack	Probe	Filter	Dryer	Aux	
	°C	°C	°C	°C	°C	°C	Pass/Fail
Room	24.4	24	25	25	26	26	PASS
Ice Water	0.4	0	0	1	1	2	PASS

Console Vacuum Audit

Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status ²
#	in. Hg	in. Hg	Pass/Fail
1	17.0	16.5	PASS

Calibrate

Approved By:

Date:

16 Mar 23

Notes

¹For valid test results, the maximum difference between test and reference readings should be less than 5.4 °F (3 °C), for all thermocouples except for the stack thermocouple which should be less than 1.5% absolute temperature from the reference reading and the exit thermocouple which should be less than 2°F (1 °C) from the reference reading (EPA Method 2, Section 6.3 and EPA Method 5 Sections 6.1.1,7-6.1.1.8)

²For valid test results, the maximum difference between console and reference barometric pressure readings should be less than 0.1 in. Hg (2.5 mm Hg), (EPA Method 5, Section 6.1.2)

³For valid test results, the maximum difference between console and reference vacuum readings should be less than 0.5 in. Hg (12.5 mm Hg)

I certify that the above Thermocouple, Barometric, and Vacuum Sensors were calibrated and audited in accordance with US EPA Methods, CFR 40 Part 60.

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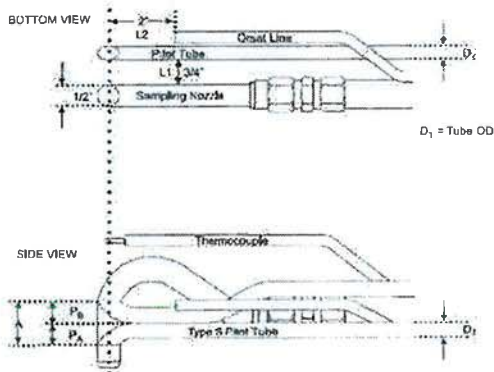
Sampling Probe and Pitot Validation

Sampling System Equipment Information

Probe Sheat	Apex 1 in., 3 ft.
Probe Number	W2001490
Pitot tube Number	A8996
Pitot tube Type	S Type 3/8 Inc.
Validation method	Standard Probe 1 in. and 1/2 in. Sampling Nozzle

Valibration Conditions and Equipment

Digital Calipers	CD-15APX
Reference No.	A22070181
Digital Inclnometer	BASELINE
Reference No.	FEI 12-1057
Temperatute	25.6 °C±3
Barometric Pressure	758.2 mm Hg



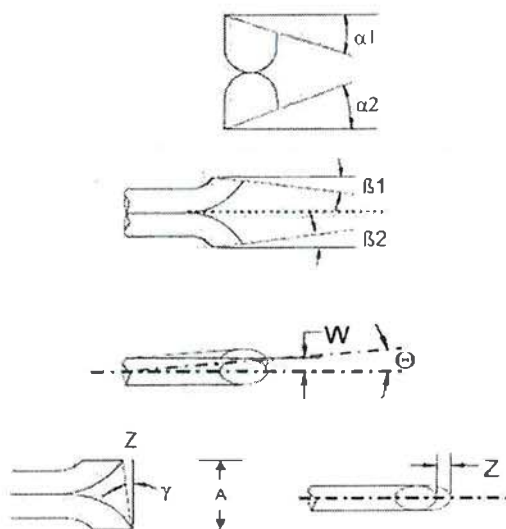
Sampling Probe Validation with Tune up

☒ Measure and Alinment with 1/2" Sampling Nozzle(12.7 mm)

Measured	Standard Range
$L_1 = 1.80 \text{ cm.}$	(1.905 cm, or 3/4 in.)
$L_2 = 5.04 \text{ cm.}$	(5.08 cm, or 2.0 in.)
$D_T = 0.954 \text{ cm.}$	(3/8 in.)
$A = 2.01 \text{ cm.}$	($2.1 D_T \leq A \leq 3 D_T$)
$A/2D_T = 1.053 \text{ cm.}$	($1.05 P_A / D_T \leq A \leq 1.5$)

Pitot Tube Validations and Engles measurement Result

☒ : Measure Result after Maintanance and Adjustable



P_B Size	Standard Range
$\alpha_1 = -4.10^\circ$	$\leq 10^\circ$
$\beta_1 = 2.10^\circ$	$\leq 5^\circ$
P_A Size	
$\alpha_2 = -2.70^\circ$	$\leq 10^\circ$
$\beta_2 = 2.00^\circ$	$\leq 5^\circ$

Engles measurement	Calculated Result	Standard Range
$W = -3.00^\circ$	-0.106 cm.	$W < 0.08 \text{ cm (1/32 in.)}$
$Z = -1.70^\circ$	-0.060 cm.	$Z < 0.032 \text{ cm (1/8 in.)}$

Can be use 0.84 for $C_p(s)$ if the type of face-opening misafgnment show above with not affect the base line value of $C_p(s)$ Solong as standard range

Validation By: _____

Approved By: _____

Date: 16 Mar 23

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Nozzle Validation

Samplig System Equipment Information

Console Model 800-STACKS-5
 Console Number 1837
 DGM Model GB/T6968-2011
 DGM Number L1500033637

Validation Conditions

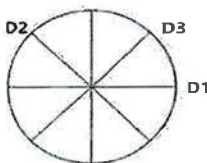
Digital Calipers CD-15APX
 Reference No A22070181
 Temperature 24.4 °C±3
 Barometric Pressure 759.7 mm Hg

Validation Data					Results	
Nozzle ID	Nozzle Diameter				Different	(D ₁ + D ₂ + D ₃) / 3
Sizes		D ₁	D ₂	D ₃	ΔD	Davg
	mm	mm	mm	mm	mm	mm
NS-4	3.17	3.17	3.17	3.16	0.006	3.167
NS-6	4.77	4.84	4.85	4.85	0.006	4.847
NS-8	6.35	6.42	6.45	6.48	0.030	6.450
NS-10	7.92	7.94	7.94	7.94	0.000	7.940
NS-12	9.52	9.53	9.52	9.52	0.006	9.523
NS-14	11.09	11.10	11.11	11.11	0.006	11.107
NS-16	12.70	12.44	12.45	12.44	0.006	12.443

Where :

D1, D2, D3 = There difference nozzle diameters , mm ; diameter must be with:n 0.025 mm

Δ D = Maximum difference between any two diameters, must be ≤ 0.100 mm

D avg = (D₁ + D₂ + D₃) / 3

Validation By:



Approved By:



Date

16 Mar 23



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Verification Test Report

Page:1/2

Instruments Information

Analyzer Type:	Flue Gas Analyser	Manufacturer:	MRU
Model:	Optima7	S/N:	332604

Calibration Gas information

Calibrator Unit	Standard Gas Mid Range			Standard Gas High Range		
ZERO AIR Gen: Ecotech8301 Dilutor Model: EcotechGasCal1100	O2 Conc	2.2	%vol.	O2 Conc	10.22	%vol.
	Cd/Ex:	343014/Jul 24,2025		Cd/Ex:	343018/Jan 10,2025	
	CO Conc	99.94	ppm	CO Conc	594.5	ppm
	NO Conc	99.69	ppm	NO Conc	197.2	ppm
	NOX Conc	99.76	ppm	NOX Conc	197.2	ppm
	SO2 Conc	100.5	ppm	SO2 Conc	200.9	ppm
	Cd/Ex:	ED5716/May 16,2030		Cd/Ex:	ND7514/Jun 21,2030	

Environment: Temperature 31.6 °C Humidity: 35 %RH

SO2 calibration test					
Before Adj					Reading (After Adj)
Set point	Std.gas (ppm)	Reading (ppm)	Difference	% error	Reading (ppm)
Low/Zero	0.0	0	0.0	0.0	0
Mid	100.5	99	-1.5	-1.5	99
Hight	200.9	198	-2.9	-1.4	198

NO calibration test					
Before Adj					Reading (After Adj)
Set point	Std.gas (ppm)	Reading (ppm)	Difference	% error	Reading (ppm)
Low/Zero	0.0	0	0.0	0.0	0
Mid	99.69	99	-0.7	-0.7	99
Hight	197.2	199	1.8	0.9	199

NOX calibration test					
Before Adj					Reading (After Adj)
Set point	Std.gas (ppm)	Reading (ppm)	Difference	% error	Reading (ppm)
Low/Zero	0.0	0	0.0	0.0	0
Mid	99.76	99.0	-0.8	-0.8	99
Hight	197.2	199.0	1.8	0.9	199

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Neediss Supply Instrument Co., Ltd.

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Verification Test Report

Page:2/2

Instruments Information

Analyzer Type:	Flue Gas Analyser	Manufacturer:	MRU
Model:	Optima7	S/N:	332604

Calibration Gas information

Calibrator Unit	Standard Gas Mid Range	Standard Gas High Range
ZERO AIR Gen:	O2 Conc 2.2 %vol.	O2 Conc 10.22 %vol.
Ecotech8301	Cd/Ex: 343014/Jul 24,2025	Cd/Ex: 343018/Jan 10,2025
Dilutor Model:	CO Conc 99.94 ppm	CO Conc 594.5 ppm
EcotechGasCal1100	NO Conc 99.69 ppm	NO Conc 197.2 ppm
	NOX Conc 99.76 ppm	NOX Conc 197.2 ppm
	SO2 Conc 100.5 ppm	SO2 Conc 200.9 ppm
	Cd/Ex: ED5716/May 16,2030	Cd/Ex: ND7514/Jun 21,2030

Environment: Temperature 31.6 °C Humidity: 35 %RH

CO calibration test					
Before Adj					Reading (After Adj)
Set point	Std.gas (ppm)	Reading (ppm)	Difference	% error	Reading (ppm)
Low/Zero	0.0	0.0	0.0	0.0	0
Mid	99.69	100.0	0.3	0.3	100
Hight	594.5	603	8.5	1.4	601

O2 calibration test					
Before Adj					Reading (After Adj)
Set point	Std.gas (ppm)	Reading (ppm)	Difference	% error	Reading (ppm)
Low/Zero	0.0	0.2	0.2	0.2	0.2
Mid	2.20	2.2	0.0	0.0	2.2
Hight	10.22	10.2	0.0	-0.2	10.2

Note

Technical Data Calibration results.:Calibration reading response discrepancy

O2 parameter	± 0.2 Vol-% at Range 0-21 Vol-%
CO2 parameter	± 0.3 Vol-% at Range 0-CO2 Max
CO parameter	± 5 % at Range 0-500 PPM
NO parameter	± 5 % at Range 0-1000 PPM
NO2 parameter	± 5 % at Range 0-1000 PPM
SO2 parameter	± 5 % at Range 0-2000 PPM

Calibrate By :



Approve By :



Date: 30 Mar 23

Date: 30 Mar 23

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Agilent CrossLab Start Up Services Agilent 7890 Gas Chromatograph Preventive Maintenance Checklist

Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results.

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides everything you need to reduce unplanned downtime and keep your systems operating at their peak. This checklist will be completed at the end of the service and provided to you as a record of the preventive maintenance activities.



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Agilent 7890 GC Preventive Maintenance Checklist

Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures.
- Any parts, not included in the Parts Lists section of this document, are not part of the recommended Preventive Maintenance service, nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.

Important Customer Web Links

- For more information about Agilent Technologies services, please visit our website using the following URL: <http://www.agilent.com/en-us/products/crosslab-instrument-services/service-repair>
- The Agilent Community is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>.
- To access Agilent University, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- A useful Agilent Resource Center web page is available, which includes short videos on maintenance, quick lists of consumables for new instruments, and other valuable information. Check out the Resource Page here: <https://www.agilent.com/en-us/agilentresources>.
- Need technical support, FAQs, supplies? – visit our Support Home page <http://www.agilent.com/search/support>.
- Videos about specific preparation requirements for your instrument can be found by searching the Agilent YouTube channel at <https://www.youtube.com/user/agilent>.
- 7890B Manuals are also available on Agilent.com:
 - Safety https://www.agilent.com/cs/library/usermanuals/public/7890B_Safety.pdf
 - Installation and First Startup https://www.agilent.com/cs/library/usermanuals/Public/7890B_Installation.pdf
 - Operation Manual https://www.agilent.com/cs/library/usermanuals/Public/7890B_Operation.pdf
 - Maintaining Your GC https://www.agilent.com/cs/library/usermanuals/public/G3430-90052%207890B_Maintaining%20Guide.pdf

Revision: 2.01, Issued: September 15, 2021
Agile Document Number: D0013618
DE number: 44166759722222
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Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Check "Section not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance service in the order of the tasks listed.
- Complete the Service Review section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Complete the initial number of pages field in the Service Completion section
- Ask the customer to sign the Service Completion section including the customer's and your signature.

Additional Instruction Notes

- Check for any active service notes for this unit. If there are any applicable "Safety" or "Modification Recommended" Service notes, plan to implement the changes on this unit before doing any qualification service
- Do not implement firmware updates, unless you get approval from the customer and are sure that they are compatible with the instrument control software.

System Information

Check this box if an instrument configuration report is attached instead of completing the table below.

Instrument System Name and ID	6C 78908
Instrument System Site and Location	EnviLab Company / IngT1 Room 667 8305

List System Component Product Numbers	List the Serial Numbers of each Component
1. 634408	CN16403029
2. 64513A	CN15450762
3. 64514A	CN16403048
4.	
5.	
6.	
7.	
8.	
9.	
10.	

Preparation

- ✓ Discuss any specific issues with the customer before starting.
- ✓ Review the instrument logbook for recorded problems and comments.
- ✓ Save instrument control settings before starting the procedure.
- ✓ Perform a general inspection of the system for cleanliness.
- ✓ Check for proper installation of parts, assemblies, sensors etc.
- ✓ Check system for required installation of components, settings as defined by current Service Notes.
- ✓ Check for required firmware updates and verify with customers if they would like them installed.
- ✓ Before starting the following procedures, record the Detector Signal Output(s) in the results table. If the GC is turned OFF or in a service mode, comparing the detector outputs before and after the service is not possible.

Preventive Maintenance Procedure

Clean and inspect GC

- ☒ Unplug power cord from the power source.
- ☒ Open GC covers and vacuum/remove any dust/debris. Pay particular attention to cooling fans.
- ☒ Inspect internal connectors for proper contact and placement.
- ☒ Reconnect Power to the GC. Power the GC on and verify the power-on self-test passed.
- ☒ Verify oven motor spins freely and turns on with the oven door closed; off when the door is opened.
- ☒ Verify operation of all other fans - the inlet and EPC cooling fans.
- ☒ Verify oven intake/outlet flap assembly is operating smoothly while heating and cooling the oven

Inlet and detector consumable replacement

- ☒ For the inlet installed, perform inlet maintenance as defined in the 7890 manual - "Maintaining Your GC" - for the inlet(s) installed.
- ☒ Replace the split vent trap cartridge filter on units with these inlets: Split/Spiltless Capillary (SSL), Multi-Mode Inlet (MMI), Programmed Temperature Vaporizer (PTV), Volatiles Interface (VI).
- ☒ If the inlet system is used in Split Mode with viscous samples, inspect and clean the split vent tube on the inlet and flush or replace the tubing between the inlet and the split vent trap.
- ☒ If the GC includes a Flame Ionization Detector (FID), replace the jet. If the ignitor shows any buildup of sample or corrosion, replace the ignitor. Examine the FID collector and castle assemblies for contamination - clean as necessary.

Zero Sensors and Leak test

- ☒ Zero all pressure sensors per the procedure in the 7890 "Advanced User Guide".
- ☒ Perform inlet pressure decay test(s) as defined in the 7890 "Troubleshooting Manual".
- ☒ If the P-4 is done in preparation for an Operational Qualification, then the pressure decay test defined within that protocol can be used for the PM.
- ☒ Record if test passed or failed in the results table.

ALS Maintenance

- ☐ Section NOT applicable
 - ☒ Check all cabling and configuration settings between GC, tray, and injectors.
 - ☒ Vacuum or remove any dust, especially around fans.
 - ☒ Check operation of all fans.
 - ☒ Check syringe for smooth plunger operation.
 - ☒ Check for smooth operation of the needle support - clean if necessary
- ### Restore Instrument
- ☒ Restore the normal operating conditions or customer method using the Data System.
 - ☒ Purge the system with carrier flow for 15 minutes
 - ☒ Bake out the system, then restore the normal operating conditions
 - ☒ After equilibration, check and record the post PM detector signal output values.
 - ☒ Result: should be similar or lower than the detector outputs recorded prior to PM.
 - ☒ Perform a chemical checkout. If this is a routine PM, inject the customer's sample using the ALS if applicable. This will act as a final checkout of both the ALS and the GC.

Note: If the PM Service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Signature Page

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review with the customer this service, parts replaced, and test results obtained.
- ☐ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box or if necessary, in the customer's IQ records.
- ☐ Supply the customer with a copy of the Smart Alerts flyer.
- ☐ Describe Smart Alerts to the customer.
- ☐ Install Smart Alerts if requested.

7890 Test Results Table

Detector	Before PM Service	After PM Service
Front detector output	n/a	13.1
Back detector output	n/a	n/a
ALX detector output	n/a	n/a
Pressure test	Expected test results	Actual test results
Front pressure decay test	Pass	Pass
Back pressure decay test	Pass	Pass

7890 Parts List Table

The following kits are recommended for capillary and purged packed inlets. If this is a general PM and the customer has a preferred set of consumables, you may use the customer's consumables.

Part description	Part number	Part kit where used	Quantity consumed
SSL Capillary Inlet PM kit, Splitless	5188-6497	7890A/B	1
SSL Capillary Inlet PM kit, split	5188-6496	7890A/B	1
SSL Capillary Inlet Inert Inlet Gold Seal with Wash	5190-6144	7890A/B	-
SSL Capillary Inlet Inert Inlet Splitless Liner - Single Inlet	5190-2293	7890A/B	-
SSL Capillary Inlet Inert Inlet Low Pressure Drop Splitless	5190-2295	7890A/B	-
PT Jet	5188-6498	7890A/B	-
Splitless Inlet Kit, single cartridge (for MMI, PTV)	5188-6495	7890A/B	-
MMI	G3510-60820	7890A/B	-
PTV	5182-9747	7890A/B	-
PTV	5182-9748	7890A/B	-
Inlet assembly with O-ring	19231-60680	7890A/B	1
FID rebuild/cleaning kit	G1531-67000	7890A/B	-
Splitless Inlet FID Jet for capillary FID base	G1531-80560	7890A/B	1
High Purity 0.18-inch FID Jet for capillary	G1531-80620	7890A/B	-
Splitless Inlet FID Jet for packed column with base	18710-20119	7890A/B	-
Splitless Inlet FID Jet for capillary column with base	19244-80560	7890A/B	-
High Purity 0.18-inch FID Jet for capillary	19244-80620	7890A/B	-
High Purity 0.18-inch FID base	G1534-80580	7890A/B	-
High Purity 0.18-inch ID	G1534-80590	7890A/B	-
High Purity 0.18-inch ID Extended	5190-6144	7890A/B	-
High Purity Inlet Gold Seal with Wash	5190-2293	7890A/B	-
High Purity Inlet Splitless Liner - Single Inlet	5190-2295	7890A/B	-
High Purity Inlet Splitless Liner - Single Inlet	G1531-67001	7890A/B	-

Service Engineer Comments

If there are specific points you wish to note as part of performing the service or other items of interest, the customer please write include them in this box.

N/A

Service Completion

Service number 0001214237 Date service completed 01-September-2021
 Agilent Engineer Sungho T. Customer signature _____
 Total number of pages in this document 10



รับรอง
ผู้ตรวจการฝ่ายควบคุมคุณภาพ

Revised: September 15, 2021
 Agilent Document Number: D0013618
 DE Number: 75759722222
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Document Control Logs

Revision:

Revision	Date	Author	Reason for update
1.0	1-Mar-2011	Dave Park	Author to describe main features/changes made for this specific revision Migrated the content of revision A.01.05 to the new Agilent template. Reviewed by subject matter expert, Dave Park.
1.1	10-Jun-2015	Dave Park	Added Split Vent trap to MMI, PTV and VE - also PTV and FID PM Parts
1.2	1-Mar-2015	Dave Park	Added Ultra Inert Gold Seal and Liner to SS Consumables
1.3	1-Dec-2015	Dave Park	Added step to perform maintenance on the Split Vent Tube and .018" FID Jet part numbers - Fixed broken web links
2.0	14-Dec-2020	Gary Boardman	Updated New Template and terminology change: Familiarization to Introduction. Create New Agile Document Number: D0007063

Approver:

Approver	Title of approver
A. H. H.	Add approver's function or title here
A. H. H.	Product support manager
A. H. H.	Product support manager
A. H. H.	Product support manager
A. H. H.	Product support manager
A. H. H.	GC Product Support Manager

Designated Evaluator Log

Designated Evaluator (DE)	Title of DE	DE Number
A. H. H.	Add function or title	Add DE number here
A. H. H.	CrossLab Start Up Services Application Consulting Lead	44166.759722222

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Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES Preventive Maintenance



Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides what you need to reduce unplanned downtime and keep your systems operating at their peak performance.

This checklist is used as a guide for completing the preventive maintenance tasks. A signed copy of this checklist is provided for your records.



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Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures. Customers are responsible for regular maintenance and are encouraged to observe the service representative.
- Any parts not included in the Parts Lists section of this document are not part of the recommended Preventive Maintenance service nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.
- For customers using HF applications, the instrument should be returned to its standard sample introduction system.

Important Customer Web Links

- To access Agilent University, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the **Agilent Resource Center** web page, visit <https://www.agilent.com/en-us/agilentresources>. The following information topics are available:
 - Sample Prep and Containment
 - Chemical Standards
 - Analysis
 - Service and Support
 - Application Workflows
- The **Agilent Community** is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>
- Videos about specific preparation requirements for your instrument can be found by searching the **Agilent YouTube** channel at <https://www.youtube.com/user/agilent>
- **Need to place a service call?** Flexible Repair Options | Agilent



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Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "**Service not applicable**" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the **Service Review** section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section
- **Ask the customer to sign the Service Verification section including the customer's and your signature.**

Instrument Maintenance

System Information

- ☐ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID	Instrument System Site and Location
5110 VDU ICP-OES	EnviLab Company Limited

List System Component	Product Numbers	List the Serial Numbers of each Component
1	G 8415 A	M 17490002
2	G 8410 A	AU 7393769
3	G 8411-80002	1309-05327
4		
5		
6		
7		
8		
9		

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	SeaSpray OneNeb Conikal Other
Spray Chamber	Cyclonic Single Pass Cyclonic Double Pass Other
Torch	Radial Dual View Other
Torch Type	One Piece Semi Demountable Fully Demountable Other
Injector Diameter	2.4mm 1.8mm 1.4mm 10.8mm Other
Injector Material	Quartz Ceramic Other



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Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components and implementation of Service Notes
- ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it. with
- ☒ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

Preventive Maintenance Procedures

Record Pre-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Pre-PM.

Clean and inspect ICP-OES system

- ☒ Look for any obvious external damage or problems.
- ☒ Inspect water cooling hoses, gas lines and power cord for excessive wear or damage.
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary.
- ☒ Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required.
- ☒ Record the instrument operating conditions in the ICP-OES Status Results Table.
- ☒ Replace the polychromator purge filter.
- ☒ Replace the radial pre-optics window
- ☒ Replace the axial pre-optics window for SVDV and VDV instruments.
- ☒ Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications.
- ☒ Replace air inlet dust filter.
- ☐ Replace high capacity air inlet dust filter element if installed. N/A
- ☒ Remove and clean instrument water inlet filter.

Agilent Water Recirculator

- ☐ Service not applicable
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir
- ☒ Remove, clean and reinstall water inlet metal mesh filter if present.
- ☒ Re fill with Agilent Cool Clear cooling fluid.
- ☒ Clean the cooling system Air filter and the condenser.

SPS 3 Auto Sampler

- ☒ Service not applicable
- ☐ Power cycle the autosampler and verify successful initialization.
- ☐ Inspect X and Z axis belts for wear. Replace is necessary.
- ☐ Clean X and Z axis slide shafts.
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

SPS 4 Auto sampler

- ☐ Service not applicable
- ☒ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☒ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
- ☒ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☒ Check the X-axis, Theta-axis and Z-axis FFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ☒ Pump Tubing Replacement. Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles. *Washed, passed*
- ☒ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

AVS 4, 6, 7 Advanced Valve System

- ☒ Service not applicable
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.

Record Post-PM instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table - Post PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following Instrument tests
 - ☒ Subsystem Communications Test
 - ☒ Air Flow
 - ☒ Water Flow
 - ☒ Gas Flows
 - ☒ RF Generator
 - ☒ Camera Test
 - ☒ Optics Test
 - ☒ Nebulizer Test

- ☒ Record the result in the Instrument Test Results Table

Restore Instrument

- ☐ For HF applications, ask the customer to reinstall their sample introduction system. N/A
- ☒ Leave system in an idle state, on and purging.
- ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Record the PM event in the Smart Alerts logbook, if applicable.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box. Systems in a compliant environment may need additional documentation.
- ☒ Complete the Signature Page with both Service Engineer and Customer signatures.

Test Results

Instrument Performance Test Results Table

Note: These measurements do not form part of any specification and are for reference only.

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial *	Radial	Axial*
Zn 213.857 nm SRBR	1537.1	3532.6	2344.2	6129.9
Mn 257.610 nm SRBR	9945.3	16145.9	10714.1	39073.2
Al 355.152 nm SBR	7.0	16.5	4.5	25.7
K 765.491 nm SBR	8.2	67.3	4.7	83.6

* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only

Instrument Test	Result
Subsystem Communications Test	Pass
Air Flow	Pass
Water Flow	Pass
Gas Flows	Pass
RF Generator	Pass
Camera Test	Pass
Optics Test	Pass
Nebulizer test	Pass



ICP-OES Status Results Table

Note: These measurements do not form part of any specification and are for reference only.

Measurement	Standby Mode	Plasma On
Mains Voltage	219.371	VAC 217.484
Mains Current	0.082	A 0.098
Instrument Temperature	25.3	°C 23.1
RF Air Flow (sensor speed)	13.0	Hz 19.0
Plasma Exhaust Temperature	No measurement	°C 86.4
Water Flow Oscillator	No measurement	L/min 1.31
Water Flow Detector	1.09	L/min 1.06
Water Inlet Temperature	16.9	°C 16.7
Polychromator Temperature	35.0	°C 35.0
CCD Temperature	-39.6	°C -39.4
Thermal Stabilizer	53.0	°C 35.0
Argon Supply Pressure	619.13	kPa 560.32
Purge Gas Supply Pressure*1	616.63	kPa 597.43
Option Gas Supply Pressure*1	-	kPa -
Nebulizer Flow	No measurement	L/min 0.70
Nebulizer Back Pressure	No measurement	kPa 293.17
Plasma Gas Flow	No measurement	L/min 11.98
Auxiliary Gas Flow	No measurement	L/min 1.00
RF Power	No measurement	W 1198.1
RF Supply Current	No measurement	A 8.190
RF Supply Voltage	No measurement	V 194.557

*1 If option installed

Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A, G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Agilent Coolant Clear Fluid	5799-0037	Agilent Water Recirculator	1
Purge Gas Filter	G8010-60136	All	1
Air filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	1
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A, G8495	1
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	1
Rinse solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	1
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	1
PVC waste tubing, 8mm od x 5mm id, 2m	G8410-80122	SPS 4	1
Additional Parts may be required from engineer's stock.			
X axis drive belt	5410047500	SPS 3	1
Z axis drive belt	5410047400	SPS 3	1
Peristaltic pump tubing, PVC SolvaFlex, 3 bridged,	3710049000	SPS 4	1

Consumed Parts Reference
(Purchased by customer, not included as part of PM)

☐ Section Not Applicable.

Part Description	Part Number	Product or Model# where used	Quantity consumed
------------------	-------------	------------------------------	-------------------

Signature Page

Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

Service Verification

Service Request Number: 6006121636
Service Engineer Name: Kanpakorn S.
Service Engineer Signature: Kanpakorn S.
Date Service Completed: 21 May 2023
Customer Name: ใจนึก
Customer Signature: ใจนึก
Total number of pages in this document: 14

Report Summary	
Instrument Model	Agilent 5100/5110 VDV ICP-OES
Instrument ID	G8011A/G8015A
Instrument Serial Number	MY17490002
Software Version	7.4.0.10280
Firmware Version	3562
Tested By	Kanyakorn S.
Test Started On	5/31/2023 12:22:01 PM
Test Completed On	5/31/2023 12:26:21 PM
Result Summary	
Subsystem Communications Test	Pass
Air Flow Test	Skipped
Water Flow Test	Skipped
Gas Flows Test	Skipped
RF Generator Test	Skipped
Camera Test	Skipped
Optics Test	Pass
Advanced Valve System Test	Skipped
Resolution Test	Pass
Sensitivity Test	Pass
Precision Test	Pass
Subsystem Communications Test	
Pass	

Optics Test	
Radial	Axial
Intensity	3397602
Wavelength	737.212
Pass	

Resolution Test			
Element	Wavelength	Specification	Width
N	(174.213 nm)	≤ 9.40	6.72
As	(188.980 nm)	≤ 8.20	6.49
C	(193.027 nm)	≤ 11.50	8.01
Mo	(202.032 nm)	≤ 8.20	6.43
Cr	(206.158 nm)	≤ 13.40	8.50
Zn	(213.857 nm)	≤ 8.70	7.16
Pb	(220.353 nm)	≤ 9.50	7.51
Co	(228.615 nm)	≤ 17.20	11.32
Ba	(230.424 nm)	≤ 9.40	7.80
Mn	(257.610 nm)	≤ 13.30	9.78
Mn	(260.568 nm)	≤ 20.30	13.88
Cr	(267.716 nm)	≤ 11.00	9.09
Cu	(324.754 nm)	≤ 25.00	18.88
Cu	(327.395 nm)	≤ 14.20	12.41
Sr	(338.071 nm)	≤ 33.50	24.27
Ba	(455.403 nm)	≤ 44.00	34.07
Sr	(460.733 nm)	≤ 36.00	22.56
Ba	(493.408 nm)	≤ 36.00	27.79
Ba	(614.171 nm)	≤ 42.00	27.97
Ar	(675.283 nm)	≤ 74.00	62.41
K	(766.491 nm)	≤ 80.00	65.95



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Sensitivity Test

Pass

Radial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 46.0	SRBR	108.0	934.0	64.8
Se (196.026 nm)	≥ 41.0	SRBR	110.2	1159.4	93.6
Zn (213.857 nm)	≥ 1421.0	SRBR	2348.2	23561.0	99.8
Pb (220.353 nm)	≥ 46.0	SRBR	98.7	1075.1	98.0
Mn (257.610 nm)	≥ 3518.0	SRBR	10768.1	218704.5	411.0
Al (396.152 nm)	≥ 3.4	SBR	8.5	40909.0	4325.8
Ba (493.408 nm)	≥ 34.0	SBR	111.9	1396218.4	12367.4
K (766.491 nm)	≥ 1.8	SBR	4.7	108989.7	19076.8

Axial

Element Wavelength	Specification	Method	Ratio	Standard	Blank
As (188.980 nm)	≥ 208.0	SRBR	267.6	3134.3	126.3
Se (196.026 nm)	≥ 159.0	SRBR	284.6	4158.5	194.0
Zn (206.200 nm)	≥ 234.0	SRBR	495.4	1165.9	5.5
Zn (213.857 nm)	≥ 1743.0	SRBR	6129.9	92298.3	225.6
Cd (214.439 nm)	≥ 4227.0	SRBR	16998.9	48382.7	8.1
Pb (220.353 nm)	≥ 320.0	SRBR	416.4	6520.1	228.4
Mn (257.610 nm)	≥ 10625.0	SRBR	39073.2	1331904.8	1159.9
Cr (267.716 nm)	≥ 1048.0	SRBR	5986.5	203686.5	1144.7
Cu (324.754 nm)	≥ 19.0	SBR	77.1	389900.7	4991.6
Al (396.152 nm)	≥ 6.0	SBR	25.7	268775.7	10073.7
Ba (493.408 nm)	≥ 60.0	SBR	293.9	8244793.3	27957.8
K (766.491 nm)	≥ 24.0	SBR	83.6	3030541.1	35817.8

Precision Test

Pass

Radial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 2.60	0.75
Se (196.026 nm)	≤ 2.60	0.69
Zn (213.857 nm)	≤ 1.50	0.27
Pb (220.353 nm)	≤ 2.60	1.06
Mn (257.610 nm)	≤ 1.50	0.30
Al (396.152 nm)	≤ 1.50	0.27
Ba (493.408 nm)	≤ 1.50	0.99
K (766.491 nm)	≤ 1.50	0.25

Axial

Element Wavelength	Specification	Measured Value % RSD
As (188.980 nm)	≤ 1.50	0.54
Se (196.026 nm)	≤ 1.50	0.48
Zn (206.200 nm)	≤ 1.50	1.06
Zn (213.857 nm)	≤ 1.50	0.48
Cd (214.439 nm)	≤ 1.50	0.33
Pb (220.353 nm)	≤ 1.50	0.37
Mn (257.610 nm)	≤ 1.50	0.77
Cr (267.716 nm)	≤ 1.50	0.62
Cu (324.754 nm)	≤ 1.50	0.45
Al (396.152 nm)	≤ 1.50	0.45
Ba (493.408 nm)	≤ 1.50	0.80
K (766.491 nm)	≤ 1.50	0.91



Report Summary

Instrument Model	Agilent 5100/5110 VDV ICP-OES
Instrument ID	G8011A/G8015A
Instrument Serial Number	MY17490002
Software Version	7.4.0.10280
Firmware Version	3562
Tested By	Kanyakorn S.
Test Started On	5/31/2023 12:34:17 PM
Test Completed On	5/31/2023 12:46:55 PM

Result Summary

Subsystem Communications Test	Pass
Air Flow Test	Pass
Water Flow Test	Pass
Gas Flows Test	Pass
RF Generator Test	Pass
Camera Test	Pass
Optics Test	Skipped
Advanced Valve System Test	Skipped
Resolution Test	Skipped
Sensitivity Test	Skipped
Precision Test	Skipped

Subsystem Communications Test

Pass

Air Flow Test

Pass

30% Air Flow (relative speed)	75% Air Flow (relative speed)
12.00	18.00

Water Flow Test

Pass

RF Water Flow(L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.45	1.06	16.78

Gas Flows Test			Pass		
Nebulizer Target Flow	Actual Flow	Back Pressure	Auxiliary Target Flow	Actual Flow	Back Pressure
0.70	0.71	280.77	2.00	2.00	93.84
Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow	Back Pressure
2.00	1.99	95.26	18.00	17.94	23.27
RF Generator Test					
Pass					
RF Power Supply Test	Passed				
RF Power Supply (V)	147.418				
RF Oscillator Test	Passed				
RF Oscillator Frequency (MHz)	25.961				
Work Coil Current (A)	45.326				
RF Power Supply Current (A)	2.000				
Camera Test					
Pass					
	Integration Time (ms)		Standard Deviation		Status
Electronic Offset Test	1000		5.120		Passed
Array Test	5		0.015		Passed
Linearity Test			0.122		Passed





TECHNOLOGY PROMOTION ASSOCIATION (THAILAND-JAPAN)
CORPORATE SERVICES 3: EQUIPMENT CALIBRATION AND TESTING SERVICES
534/4 PATTANAKARN ROAD SOI 18, SUANLUANG, SUANLUANG BANGKOK 10250
TEL. 0-2717-3000-29 FAX. 0-2719-9484



Cert.No.: 23CHO128

Page.: 1 of 3

Certificate of Calibration

Equipment : Spectrophotometer
Manufacturer : Agilent
Model : Cary60 (G6860A)
Serial No. : MY17490026
ID No. : ELABSPECTRO002
Condition As-Received: Used Item
Received Date : 09 March 2023
Calibration Date : 09 March 2023
Reference : 2303-0046ON-1
Submitted by : Envilab Co.,Ltd (Head office)
540, 540/1 Soi Bangkhuae 7, Bangkhuae,
Bangkhuae, Bangkok 10160

Calibration Place : B301 CO-THC ROOM
Ambient Temperature : (23.6 - 22.5) °C (On-Site)
Relative Humidity : (75 - 77) % (On-Site)
Calibration Procedure : In - house method :
CP-OCH4 based on ASTM E 275-01

Calibrated by :



Approved by :



Approved Signatory



Issue Date :

15 March 2023

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 the head of Corporate Services 3 : Equipment Calibration and Testing Services.



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A 0052680



Cert. No. : 23CHO128

Page : 2 of 3

Condition of calibration result

1. Reference Standard Material :

<u>Material</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due date</u>
1. Absorbance Standard set	32588	103225	08 July 2024
2. Absorbance Standard set	32592	104226	04 Aug 2024
3. Absorbance Standard set	39130	106269	10 Oct 2024
4. Wavelength Standard set	29829	94776	02 Sep 2023
5. Wavelength Standard set	29829	94777	02 Sep 2023

2. This certificate is valid only to the item calibrated on date and place of calibration.

3. This certificate is traceable to the International System of Unit maintained at :

- National Physical Laboratory (NPL), The United Kingdom of Great Britain and Northern Ireland
- National Institute of Standards and Technology (NIST), The United States of America

4. Spectral BandWidth : 1.5 nm

Scan Speed : 18 nm/min

Calibration Results : without adjustment

Wavelength Accuracy

Certified Values of Reference Material (nm)	UUC Reading (nm)	Uncertainty of Measurement (± nm)	Coverage Factor k
241.72	242.0	0.13	2.00
360.93	360.5	0.13	2.00
536.59	536.6	0.15	2.05
740.72	741.3	0.16	2.05
879.28	879.2	0.16	2.05



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a 1152950



Cert. No. : 23CHO128

Page : 3 of 3

Calibration Results : without adjustment

Photometric Accuracy

Wavelength (nm)	Certified Values of Reference Material (Abs)	UUC Reading (Abs)	Uncertainty of Measurement (\pm Abs)	Coverage Factor <i>k</i>
350.0	Zero	0.0000	0.0046	2.00
	0.4253	0.4249	0.0051	2.00
	Zero	0.0000	0.0050	2.00
	0.6389	0.6388	0.0056	2.00
420.0	Zero	0.0000	0.0028	2.00
	0.5796	0.5790	0.0028	2.00
	0.7105	0.7102	0.0028	2.00
	1.0186	1.0171	0.0028	2.00
546.1	Zero	0.0000	0.0028	2.00
	0.5281	0.5277	0.0028	2.00
	0.6962	0.6963	0.0028	2.00
	0.9984	0.9978	0.0028	2.00

Remark

- Each individual filter is measured against the empty filter holder (blank) used to zero the spectrophotometer
- The Potassium Dichromate filled cells are measured against a Perchloric acid blank.

The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor *k* , providing a level of confidence of approximately 95 %.

-o0o-



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ผู้จัดการฝ่ายควบคุมคุณภาพ

1152949

Certificate of Calibration

Calibration Certification Information			
Cal. Date: January 18, 2023	Rootsmeter S/N: 438320	Ta: 294 °K	
Operator: Jim Tisch		Pa: 750.1 mm Hg	
Calibration Model #: TE-5025A	Calibrator S/N: 0759		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3960	3.2	2.00
2	3	4	1	0.9950	6.4	4.00
3	5	6	1	0.8850	8.0	5.00
4	7	8	1	0.8450	8.8	5.50
5	9	10	1	0.6990	12.8	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9961	0.7135	1.4145	0.9957	0.7133	0.8854
0.9918	0.9968	2.0004	0.9915	0.9964	1.2521
0.9897	1.1183	2.2365	0.9893	1.1179	1.3999
0.9886	1.1700	2.3456	0.9883	1.1695	1.4683
0.9833	1.4067	2.8289	0.9829	1.4062	1.7708
QSTD	m=	2.03736	QA	m=	1.27576
	b=	-0.03733		b=	-0.02337
	r=	0.99997		r=	0.99997

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

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

CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhprachasnn 3 Rd., Bangpood, Pakkred, Nonthaburi 11120

Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com



Certificate of Calibration

Certificate No. : 66-200066-2

Page : 1 of 2

Submitted by : Envilab Co., Ltd.
540, 540/1 Soi Bangkhae7, Bangkhae, Bangkok 10160

Equipment : Electronic Balance
Manufacturer : METTLER TOLEDO **Model :** XSR205DU
Serial No. : B911363567 **ID No. :** ELABBALANCEN06
Capacity : 220 g **Resolution :** 0.00001g/81g, 0.0001g/220g

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

Ambient Temperature : (24.6 to 24.9) °C

Relative Humidity : (57.0 to 67.8) %

Air Pressure : 1015.0 mbar

Date of Received : 01 March 2023

Date of Calibration : 01 March 2023

Date of Issue : 04 March 2023

Calibrated by :

Calibration Method : In-house method CAL-M2001 based on UKAS Publication ref : LAB 14
Edition 7 - November 2022

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02222345	10 Nov 2023	National Institute of Metrology (Thailand), (NIMT)

Approved by :

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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CAL-F0031-03



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Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com

Certificate of Calibration

Certificate No. : 66-200066-2

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)
0.1	0.00000	0.000014
0.5	0.00002	0.000022
1	0.00000	0.000026
2	0.00001	0.000034
5	-0.00001	0.000043
10	0.00000	0.000053
50	0.00004	0.00011
100	-0.00012	0.00020
150	-0.0001	0.00038
200	-0.0002	0.00038

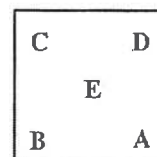
This result of calibration was found accurate as shown on date and place of calibration only.

This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.07$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 50 g

A B C D E
0.00000 0.00000 0.00001 0.00001 0.00000 g



Repeatability

Load test : 200 g

Stdev. : 0.000042 g

- o0o -



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Calibratech Co.,Ltd.

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Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com



Certificate of Calibration

Certificate No. : 66-410024-1

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

540, 540/1 Soi Bangkhac 7, Bangkhac, Bangkok 10160

Equipment : Digital Thermo-Hygrometer

Manufacturer : Jedto

Model : HTC-1

Range Temperature : N/A °C

Resolution : 0.1 °C

Range Humidity : N/A %R.H.

Resolution : 1 %R.H.

Serial No. : PONPE5852094

ID No. : ELABTMHTC10003

Environment : Ambient Temperature : (23 ± 2) °C

Relative Humidity : (50 ± 15) %

Date of Received : 08 March 2023

Date of Calibration : 09 March 2023

Date of Issue : 09 March 2023

Calibrated by : [Redacted]

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4013 by compared with standard probe sensor humidity/temperature into humidity/temperature chamber.

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

Digital Indicator with Standard Probe Temp&Hum

ID No.

Cert. No.

Due Date

Traceability

400034 & 400036 SG-H-00021/66

11 Jul 2023

Success Gateway Co., Ltd., Accredited by TISI Calibration No.0268

Approved by

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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CAL-F0031-03



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Certificate of Calibration

Certificate No. : 66-410024-1

Page : 2 of 2

UUC Condition As-Received : Good

Result of Calibration : Without Adjustment

Function : Temperature measurement

Reference Humidity @ 50 %R.H.

Standard Temperature ($^{\circ}\text{C}$)	UUC Reading ($^{\circ}\text{C}$)	Correction ($^{\circ}\text{C}$)	Uncertainty ($\pm^{\circ}\text{C}$)
25.01	25.0	0.0	0.46

Result of Calibration : Without Adjustment

Function : Humidity measurement

Reference Temperature @ 25 $^{\circ}\text{C}$

Standard Humidity (%R.H.)	UUC Reading (%R.H.)	Correction (%R.H.)	Uncertainty (\pm %R.H.)
50.00	49	1	2.2

Remark

UUC : Unit Under Calibration

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

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

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6611006

Calibrated Date: 1-Nov-23

☒ PM ☐ Onsite

Page: 1/2

Instruments Information

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

Calibration System

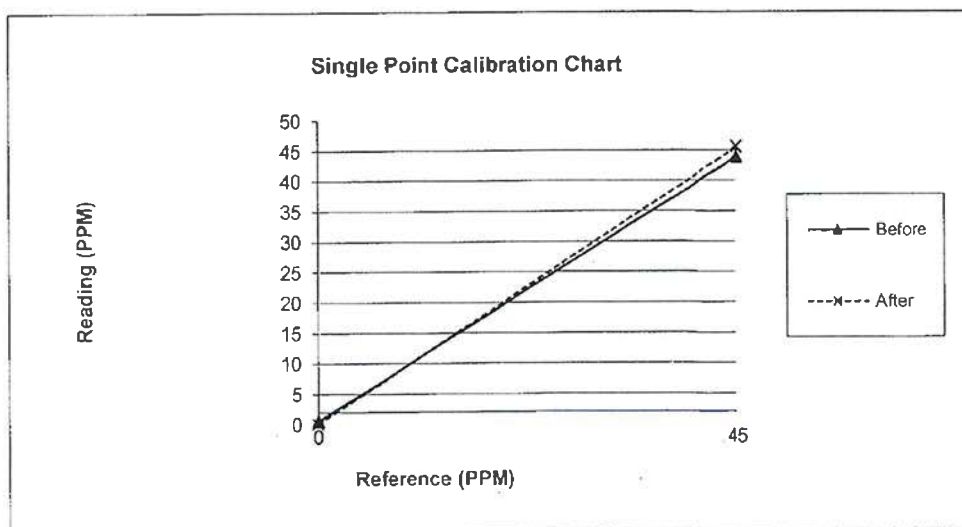
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM SO2 Conc 45.59 PPM CO Conc 45.07 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 24.8 °C

Humidity: 76 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.549	0.5	45.0	44.01	-1.1
After	0.0	0.071	0.1	45.0	45.63	0.7



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6611006

Calibrated Date: 1-Nov-23

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Page:2/2

Date	1-Nov-23	Time	10:09:00		
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			
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
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-Nov-23

Approve By :



Date:

1-Nov-23



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6611003

Calibrated Date: 1-Nov-23

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Instruments Information

Page:1/2

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

Calibration System

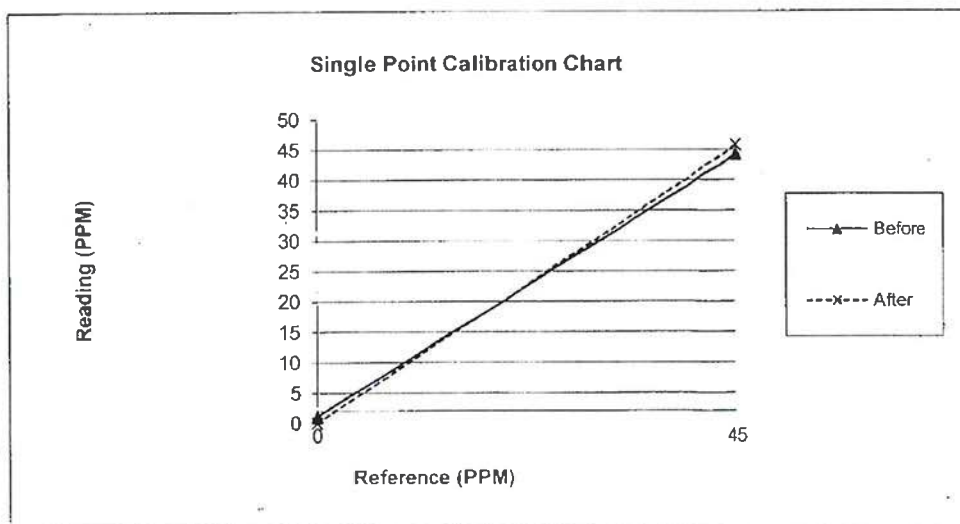
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.9 °C

Humidity: 77 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.089	1.1	45.0	44.29	-0.8
After	0.0	0.020	0.0	45.0	45.81	0.9



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Envilab Co., Ltd.

ผู้จัดการฝ่ายควบคุมคุณภาพ



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C6611003

Calibrated Date: 1-Nov-23

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Page:2/2

Analyzer Signal Values					
Date	1-Nov-23	Time	10:09:00		
Main Signals					
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			
Pbse					
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
Temp					
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-Nov-23

Date:

1-Nov-23

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CO Analyzer Verification Test Report

Calibration Report No.: ES-C66110002

Calibrated Date: 1-Nov-23

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Instruments Information

Page:1/2

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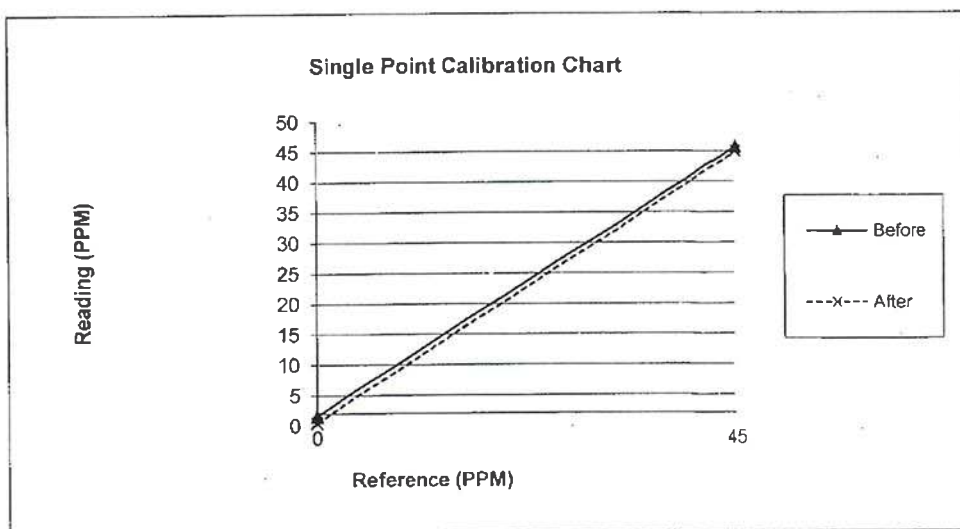
Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.9 °CHumidity: 78 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	1.566	1.6	45.0	45.80	0.9
After	0.0	0.459	0.5	45.0	45.00	0.0



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CO Analyzer Verification Test Report

Calibration Report No.: ES-C66110002

Calibrated Date: 1-Nov-23

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Page:2/2

Analyzer Serial Values					
Date	1-Nov-23	Time	10:09:00		
Input 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			
IR current ratio					
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
inst. Ratio					
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-Nov-23

Approve By :

Date:

1-Nov-23



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Tel. 02-802-3980-2 Fax. 02-802-3988 E: info@neediss.com



CO Analyzer Verification Test Report

Calibration Report No.: AP-C6611001

Calibrated Date: 1-Nov-23

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

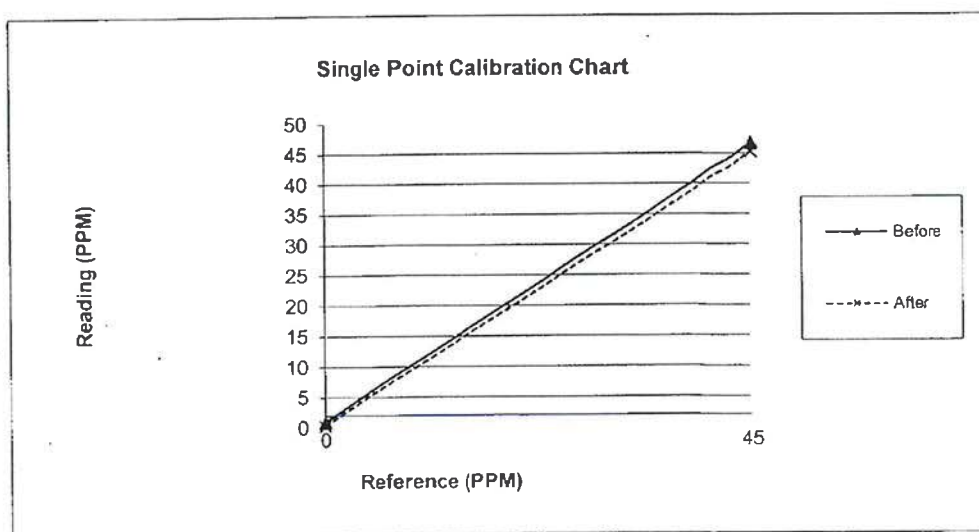
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 45.07 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.8 °C

Humidity: 77 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	0.9	0.9	45.0	46.7	1.8
After	0.0	0.3	0.3	45.0	45.2	0.2



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Co., Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ



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CO Analyzer Verification Test Report

Calibration Report No.: AP-C6611001

Calibrated Date: 1-Nov-23

☒ PM ☐ Onsite

Page:2/2

	Before	Range	Unit	Before	After	Note
Date		1-Nov-23				
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	
Zero Gas		0	PPM	0.9	0.3	
Span Gas		45	PPM	46.7	45.2	± 5% of Range

Calibrate By :



Approve By :



Date:

1-Nov-23

Date:

1-Nov-23



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Neediss Supply Instrument Co., Ltd.

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รับรองสำเนาถูกต้อง

ผู้จัดการฝ่ายควบคุมคุณภาพ



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บริษัท นีดีส ซัพพลาย อินสตรูเมนต์ จำกัด
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Tel. 02-802-3980-2 Fax. 02-802-3988 E.info@neediss.com



CO Analyzer Verification Test Report

Calibration Report No.: AP-C6611007

Calibrated Date: 1-Nov-23

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

Calibration System

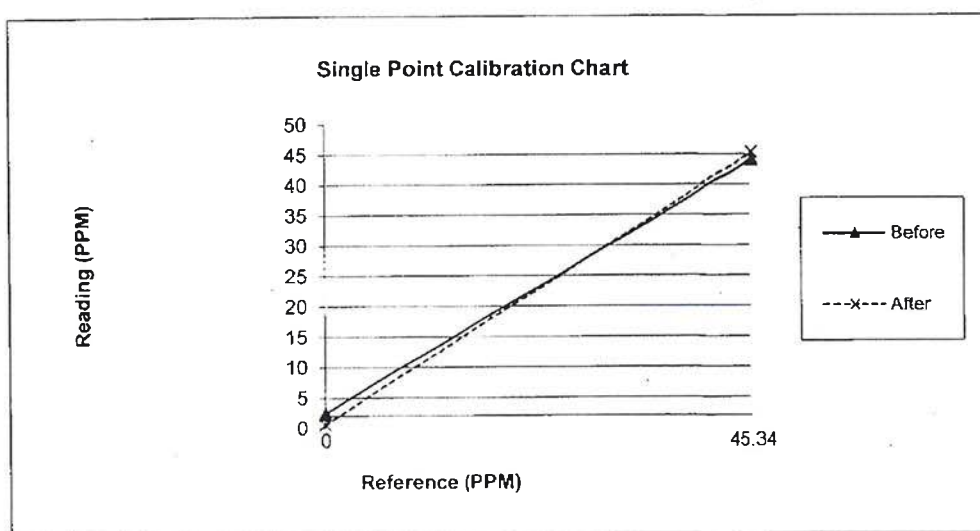
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.8 °C

Humidity: 77 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPM)	Reading (PPM)	Drift (PPM)	Reference (PPM)	Reading (PPM)	Drift%
Before	0.0	2.40	2.4	45.3	44.1	-1.4
After	0.0	0.54	0.5	45.0	45.3	0.3



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CO Analyzer Verification Test Report

Calibration Report No.: AP-C6611007

Calibrated Date: 1-Nov-23

☒ PM ☐ Onsite

Page:2/2

Detail	Range	Unit	Before	After	Note
Date	1-Nov-23				
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	
MR 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	
Zero Gas					
Zero Gas	0	PPM	2.4	0.5	
Span Gas	45	PPM	44.1	45.3	± 5% of Range

Calibrate By : _____

Approve By : _____

Date:

1-Nov-23

Date:

1-Nov-23

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6611004

Calibrated Date: 1-Nov-23

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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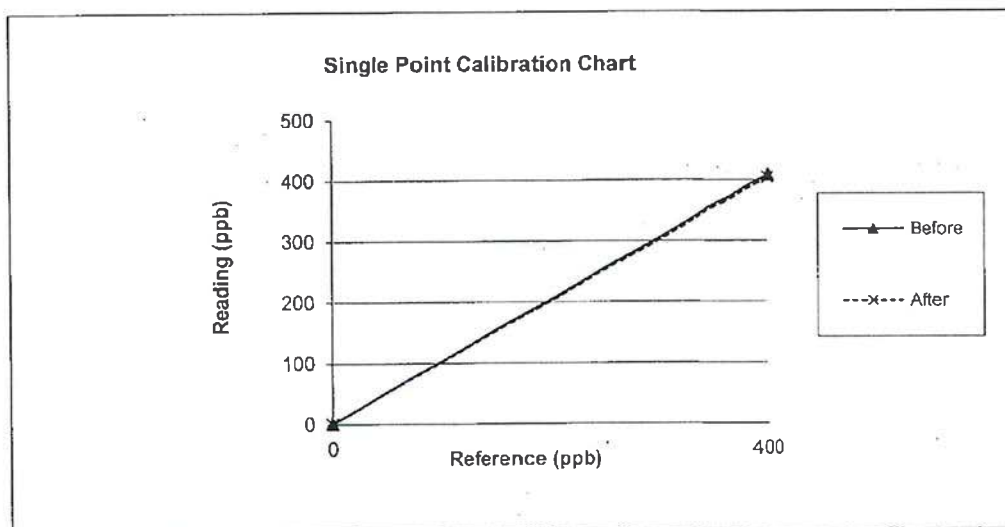
Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.9 °CHumidity: 81 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.0	1.0	400.0	409.0	1.1
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-S6611004

Calibrated Date: 1-Nov-23

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Page: 2/2

Test Item	Setting	Unit	Actual	Target	Pass/Fail
Date	1-Nov-23				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	38.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
HVPS	400-900 constant	V	719	648	
DCPS	2500 (+/- 200)	mV	-	-	
RCELL TEMP	50 (+/- 1)	Dreegee C	50	50	
BOX TEMP	20-40	Dreegee C	34.1	32.7	
PMT TEMP	7 (+/- 1)	Dreegee C	8.0	8.0	
UV lamp	1000-4900	mV	4034.0	4034.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR. Light (Zero Gas)	<100	PPB	29	29	
Dark PMT	(-50) - (+200)	mV	44.7	44.7	
Dark lamp	(-50) - (+200)	mV	5.1	5.1	
SAMP PRES	20-30 constant	IN-Hg-A	28.1	27.8	
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Zero Gas (0.00 PPB)	0	ppb	1.0	0.5	
Span Gas (400 PPB)	400	ppb	409.0	404.0	± 5% of Range

Calibrate By : _____

Date:

1-Nov-23

Approve By : _____

Date:

1-Nov-23

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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6611006

Calibrated Date: 1-Nov-23.

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Instruments Information

Page:1/2

Analyzer Type: SO2 Analyzer Model: AF22e	Manufacturer Environnement SA., France S/N: NSOESAAF32E453
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Calibration System

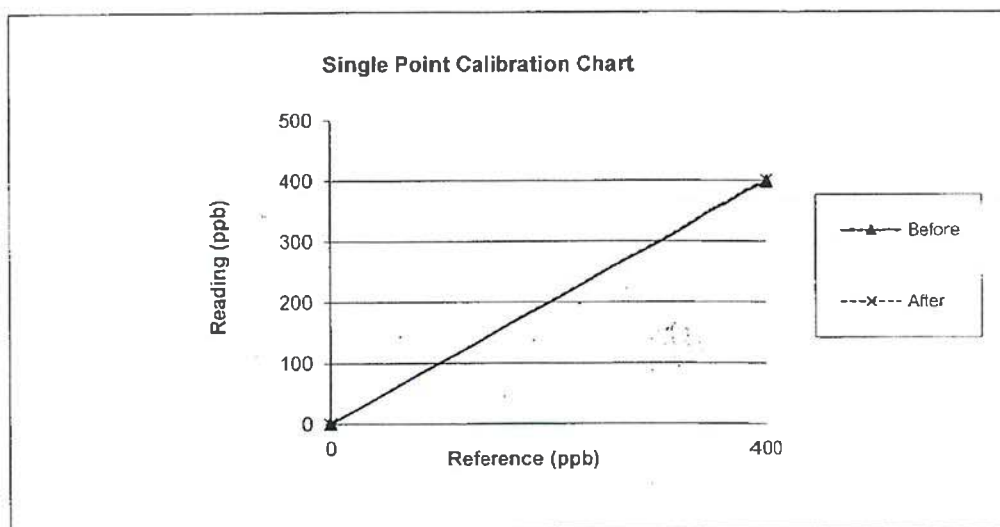
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.8 °C

Humidity: 79 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.5	0.5	400.0	399.0	-0.1
After	0.0	0.2	0.2	400.0	401.0	0.1



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Tel. 02-802-3980-2 Fax. 02-802-3988 E.info@neediss.com**SO2 Analyzer Verification Test Report**

Calibration Report No.: ES-S6611006

Calibrated Date: 1-Nov-23

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Page:2/2

Date	1-Nov-23	Time	13:11:00		
Option	0.00	mV	+5 V Sensor	5	V
+4 V	4068	mV	+3.3 V	3.3	V
+24 V	24.1	V	+12 V	11.9	V
+5 V	5	V	I UV lamp	44.3	mA
I+24 V	1.2	A			
Dark UV sig.	0	mV	Dark PM sig.	88	mV
UV ref.	0	mV	PM ref.	0	mV
UV sig.	24.1	mV	PM sig.	138.6	mV
Ref.ratio	0		Meas ratio	0.34	
Mean sig.	0.7		Raw trend	11	
Raw sig.	24.4	ppb	inst.meas.	22.8	ppb
I UV Lamp	44.7	mA	HV PM	2626.80	mV
Internal Temp.	31.9	deg.C	Chamber T.	50	deg.C
Gas Pr.	970	hPa	Pump Pr.	355.5	hPa
Flow	18.7	l/h			

Calibrate By : _____

Date:

1-Nov-23

Approve By : _____

Date:

1-Nov-23

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เบญจคุณภา



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6611005

Calibrated Date: 1-Nov-23

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Page:1/2

Instruments Information

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

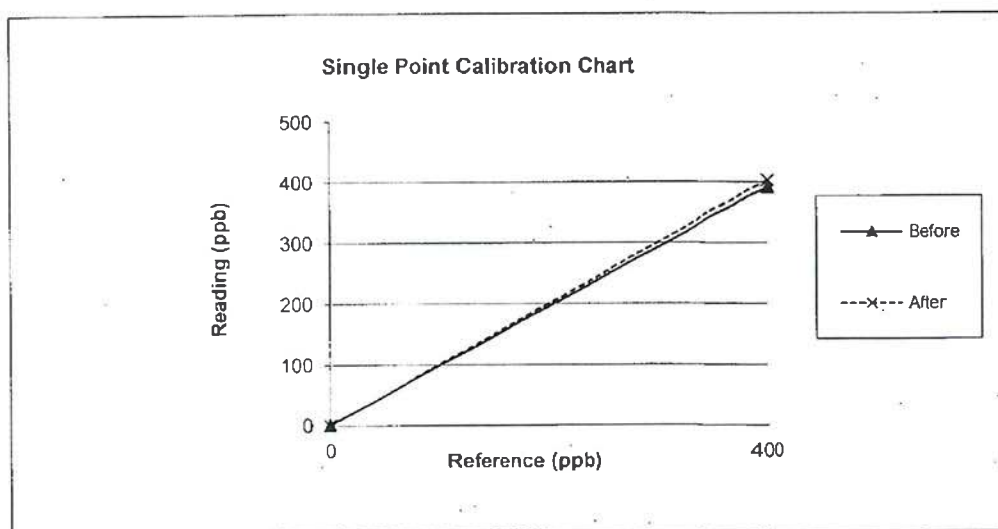
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM
ZERO AIR Generator ZAG7001 S/N: 644	Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.9 °C

Humidity: 80 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.4	1.4	400.0	392.0	-1.0
After	0.0	0.5	0.5	400.0	403.0	0.4



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โดย
บริษัท นีดีส ซัพพลาย อินสตรูเมนต์ จำกัด



บริษัท นีดีส ซัพพลาย อินสตรูเมนต์ จำกัด
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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6611005

Calibrated Date: 1-Nov-23

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Page:2/2

Date	1-Nov-23				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
HVPS	400-900 constant	V	719	648	
DCPS	2500 (+/- 200)	mV	-	-	
RCELL TEMP	50 (+/- 1)	Dreegee C	50	50	
BOX TEMP	20-40	Dreegee C	34.1	32.7	
PMT TEMP	7 (+/-1)	Dreegee C	8.0	8.0	
UV lamp	1000-4900	mV	4034.0	4034.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR. Light (Zero Gas)	<100	PPB	29	29	
Dark PMT	(-50) - (+200)	mV	44.7	44.7	
Dark lamp	(-50) - (+200)	mV	5.1	5.1	
SAMP PRES	20-30 contant	IN-Hg-A	28.1	27.8	
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)		0.920	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Zero Gas (0.00 PPB)	0	ppb	1.4	0.5	
Span Gas (400 PPB)	400	ppb	392.0	403.0	± 5% of Range

Calibrate By : _____

Date: 1-Nov-23

Approve By : _____

Date: 1-Nov-23

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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6611002

Calibrated Date: 1-Nov-23

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Instruments Information

Page: 1/2

Analyzer Type: SO2 Analyzer Model: AF22e	Manufacturer Environnement SA., France S/N: NSOESAAF32E454
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Calibration System

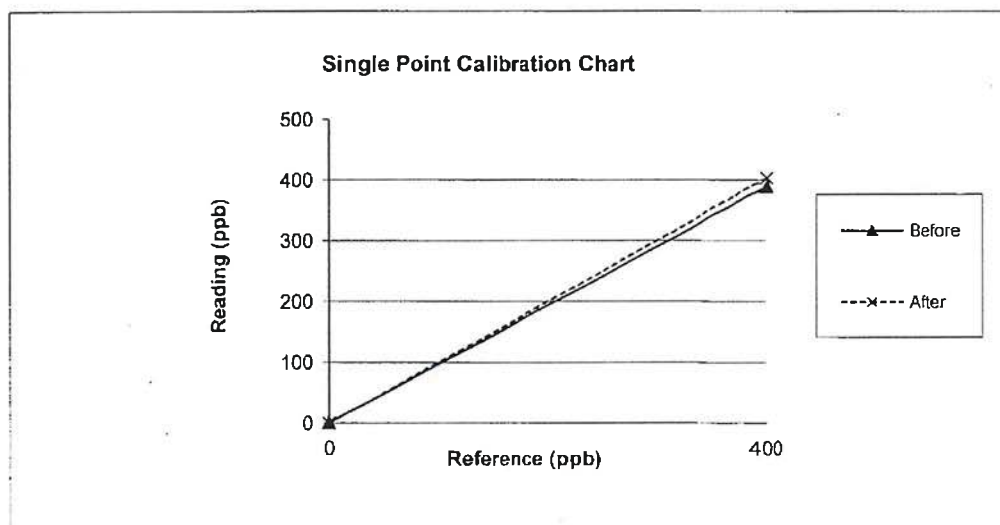
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 23.8 °C

Humidity: 62 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.9	0.9	400.0	389.0	-1.4
After	0.0	0.2	0.2	400.0	403.0	0.4



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SO2 Analyzer Verification Test Report

Calibration Report No.: ES-S6611002

Calibrated Date: 1-Nov-23

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Page:2/2

Date	1-Nov-23	Time	13:11:00		
Option	0.00	mV	+5 V Sensor	5	V
+4 V	4068	mV	+3.3 V	3.3	V
+24 V	24.1	V	+12 V	11.9	V
+5 V	5	V	I UV lamp	44.3	mA
I+24 V	1.2	A			
Dark UV sig.	0	mV	Dark PM sig.	88	mV
UV ref.	0	mV	PM ref.	0	mV
UV sig.	24.1	mV	PM sig.	138.6	mV
Ref.ratio	0		Meas ratio	0.34	
Mean sig.	0.7		Raw trend	11	
Raw sig.	24.4	ppb	inst.meas.	22.8	ppb
I UV Lamp	44.7	mA	HV PM	2626.80	mV
Internal Temp.	31.9	deg.C	Chamber T.	50	deg.C
Gas Pr.	970	hPa	Pump Pr.	355.5	hPa
Flow	18.7	l/h			

Calibrate By :

Date:

1-Nov-23

Approve By :

Date:

1-Nov-23



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6611003

Calibrated Date: 1-Nov-23

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Instruments Information

Page:1/2

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

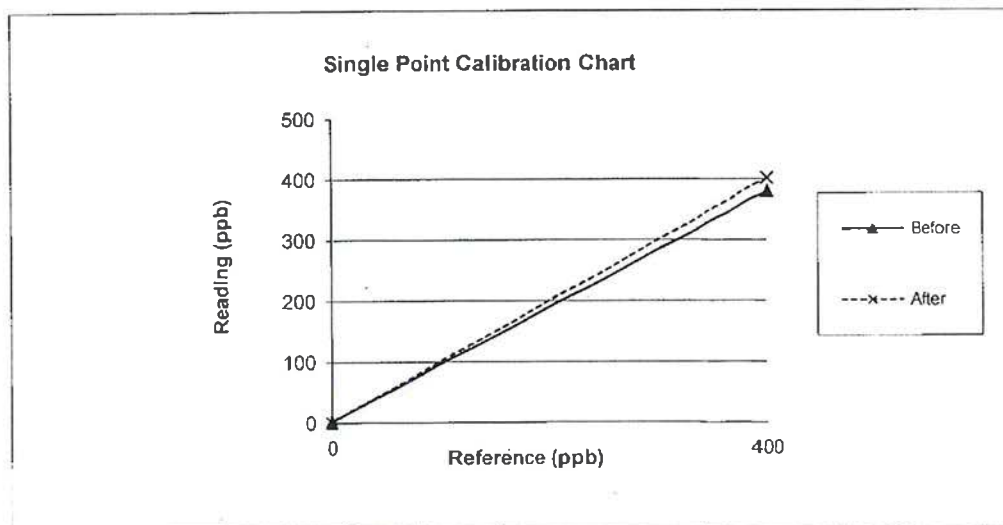
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.9 °C

Humidity: 81 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.3	1.3	400.0	380.0	-2.6
After	0.0	0.7	0.7	400.0	402.0	0.2



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ผู้จัดทำ
ผู้ควบคุม



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S02 Analyzer Verification Test Report

Calibration Report No.: AP-S6611003

Calibrated Date: 1-Nov-23

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Page:2/2

Date	1-Nov-23				
Time	13:10				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.6	0.2	
Sample Flow	650 (+/- 50)	cc/min	663	659	
PMT Detector	0 - 5000	mV	36.5	34.5	
Norm PMT Detector	0 - 5000	mV	34.1	32.8	
HVPS	400-900 constant	V	719	648	
DCPS	2500 (+/- 200)	mV	-	-	
RCELL TEMP	50 (+/- 1)	Dreegee C	50	50	
BOX TEMP	20-40	Dreegee C	34.1	32.7	
PMT TEMP	7 (+/-1)	Dreegee C	8.0	8.0	
UV lamp	1000-4900	mV	4034.0	4034.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR. Light (Zero Gas)	<100	PPB	29	29	
Dark PMT	(-50) - (+200)	mV	44.7	44.7	
Dark lamp	(-50) - (+200)	mV	5.1	5.1	
SAMP PRES	20-30 constant	IN-Hg-A	28.1	27.8	
PMT Volls	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Zero Gas (0.00 PPB)	0	ppb	1.3	0.7	
Span Gas (400 PPB)	400	ppb	380.0	402.0	± 5% of Range

Calibrate By :



Approve By :



Date:

1-Nov-23

Date:



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Neediss Supply Instrument Co., Ltd.

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NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6611005

Page:1/1

Calibrated Date: 1-Nov-23



PM



Onsite

Instruments Information

Analyzer Type: NO/NO ₂ /NO _x Analyzer Model: AC32e	Manufacturer Environnement SA., France S/N: NNOESAAC32E278
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NO _x Conc 46.50 PPM NO Conc 46.50 PPM So ₂ Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 25.5 °C

Humidity: 54 %RH

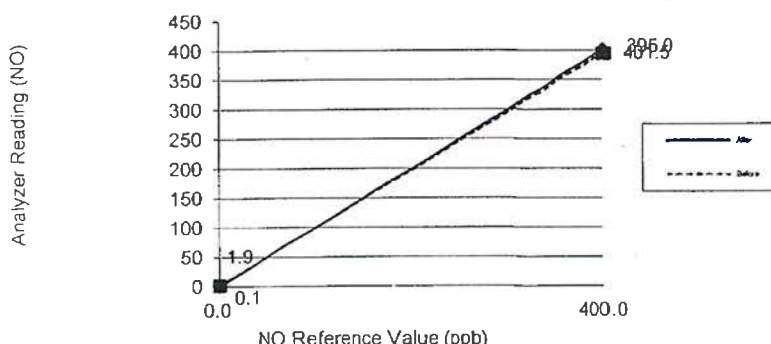
Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.225	0.0	1.2	389.3	400.0	-1.4
NO ₂	0.683	0.0	0.7	5.7	0.0	0.7
NO _x	1.908	0.0	1.9	395.0	400.0	-0.6

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.030	0.0	0.0	401.1	400.0	0.1
NO ₂	0.020	0.0	0.0	0.4	0.0	0.0
NO _x	0.050	0.0	0.1	401.5	400.0	0.2

Single Point Calibration Chart



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NOx Analyzer Verification Test Report

Calibration Report No.: ES-N6611005

Page:1/1

Calibrated Date: 1-Nov-23



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Analyzer Signal Values					
Date	1-Nov-23	Time	14:14		
Input Supply					
Option	-13.52	mV	+5 V Sensor	4.99	V
+3.3 V	3.3	V	+24 V	23.96	V
+12 V	11.88	V	+5 V	4.99	V
+4 V	3974.3	mV	I+ 24V	2.4	A
I O3	82.74	mA			
Dark PM sig.					
Dark PM sig.	0.0	mV	PM NO sig.	84.28	mV
PM Nox sig.	107.0	mV	PM Ny sig.	86.71	mV
Chamber T					
Chamber T	60	deg.C	Internal Temp.	33.33	deg.C
Chamber P	1720.8	hPa	PM T.	1.46	deg.C
Flow	47.21	NI/h	Sample Pr.	993.2	hPa

Calibrate By :



Date:

1-Nov-23

Approve By :



Date:

1-Nov-23



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ผู้จัดทำ: 10/11/23



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6611002

Page:1/1

Calibrated Date: 1-Nov-23

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENOAI200E03217
---	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.8 °C

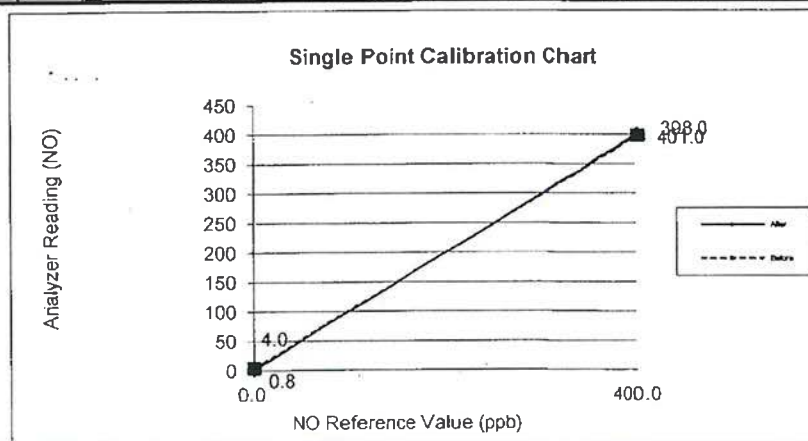
Humidity: 73 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.2	0.0	2.2	392.5	400.0	-0.9
NO ₂	1.8	0.0	1.8	5.5	0.0	0.7
NOx	4.0	0.0	4.0	398.0	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	0.6	0.0	0.6	399.2	400.0	-0.1
NO ₂	0.2	0.0	0.2	1.8	0.0	0.2
NOx	0.8	0.0	0.8	401.0	400.0	0.1



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6611002

Page:1/1

Calibrated Date: 1-Nov-23



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Onsite

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Date	1-Nov-23				
Time	15:30				
Range	0.00 - 500.00 PPB	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.8	0.2	
Sample Flow	500 +/- 50	cc/min	470.0	476.0	
Ozone Flow	60-90	cc/min	90.0	76.0	
PMT Detector	0-5000	mV	24.8	19.6	
AZERO	-20-150	mV	11.7	7.3	
HVPS	400-900 constant	V	768.0	714.0	
DCPS	2500 +/- 200	mV	-	-	
RCELL TEMP	50 +/- 1	Dreegee C	50.3	50.3	
BOX TEMP	20-35	Dreegee C	28.0	27.5	
PMT TEMP	7 +/- 1	Dreegee C	7.7	7.8	
IZS TEMP	50 +/- 4	Dreegee C	-	-	
MOLY Temp	315 +/- 5	Dreegee C	313.1	315.0	
RCEL PRES	4-10 constant	IN-Hg-A	7.30	7.30	
SAMP PRES	20-30 constant	IN-Hg-A	31.4	31.3	
NO Slope	1 +/- 0.3		0.647	0.963	
Nox Slope	1 +/- 0.3		0.652	0.940	
NO Offset	-10 to + 150	mV	17.40	6.60	
NOx Offset	-10 to + 150	mV	24.10	12.70	
Zero Value	NO	0	ppb	2.2	0.6
	NOx	0	ppb	4.0	0.8
Span Value	NO	400	ppb	392.5	399.2
	NOx	400	ppb	398.0	401.0

Calibrate By : _____

Approve By : _____

Date:

1-Nov-23

Date:

1-Nov-23

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6611003

Page:1/1

Calibrated Date: 1-Nov-23



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Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200A	Manufacturer API S/N: ENOAI200A01679
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 46.50 PPM NO Conc 46.50 PPM So2 Conc 45.59 PPM Co Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.8 °C

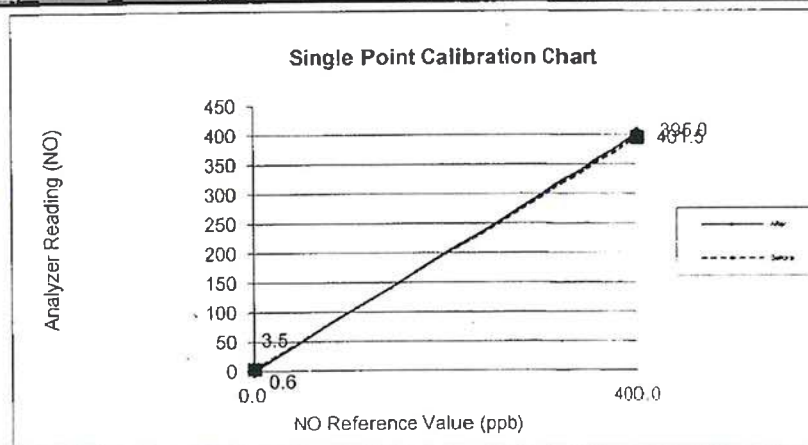
Humidity: 71 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	1.0	0.0	1.0	390.3	400.0	-1.2
NO ₂	2.5	0.0	2.5	4.7	0.0	0.6
NOx	3.5	0.0	3.5	395.0	400.0	-0.6

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	398.1	400.0	-0.2
NO ₂	0.5	0.0	0.5	3.4	0.0	0.4
NOx	0.6	0.0	0.6	401.5	400.0	0.2



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6611003

Page:1/1

Calibrated Date: 1-Nov-23



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	Normal range	Unit	Before	After	
Date	1-Nov-23				
Time	10:10				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.4	0.2	
Sample Flow	500±/ 50	cc/min	482	494	
Ozone Flow	60-90	cc/min	74	77	
PMT Detector	0-5000	mV	51	26	
AZERO	-20-150	mV	53.3	33.3	
HVPS	400-900 constant	V	821	821	
DCPS	2500 +/- 200	mV	2556	2556	
RCELL TEMP	50±/ 1	Dreegee C	50	50	
BOX TEMP	20-35	Dreegee C	30.2	32.8	
PMT TEMP	7 ±/1	Dreegee C	7.5	7.5	
IZS TEMP	50±/ 4	Dreegee C	-	-	
MOLY Temp	315 ±/ 5	Dreegee C	315.0	314.5	
RCEL 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 ±/ 0.3		0.820	0.822	
Nox Slope	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	
Zero Value	NO	0	ppb	1.0	0.1
	NOx	0	ppb	3.5	0.6
Span Value	NO	400	ppb	390.3	398.1
	NOx	400	ppb	395.0	401.5

Calibrate By : _____

Approve By : _____

Date: _____

1-Nov-23

Date: _____

1-Nov-23

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6611006

Page:1/1

Calibrated Date: 1-Nov-23

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 200E	Manufacturer API S/N: ENOAI200E03407
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Calibration System

Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	Nox conc 46.50 PPM NO Conc 46.50 PPM SO2 Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.7 °C

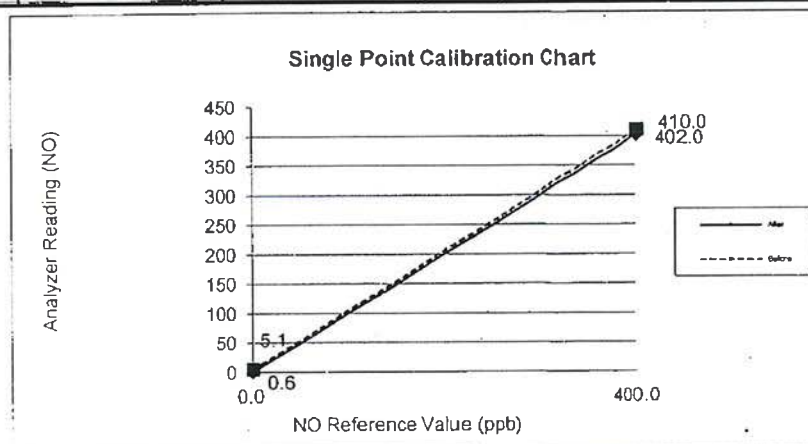
Humidity: 74 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.0	0.0	3.0	408.0	400.0	1.0
NO ₂	2.1	0.0	2.1	2.0	0.0	0.2
NOx	5.1	0.0	5.1	410.0	400.0	1.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.2	0.0	0.2	400.0	400.0	0.0
NO ₂	0.4	0.0	0.4	2.0	0.0	0.2
NOx	0.6	0.0	0.6	402.0	400.0	0.2



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6611006

Page:1/1

Calibrated Date: 1-Nov-23



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Onsite

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Date	1-Nov-23				
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	-	-	
RCELL TEMP	50 +/- 1	Dreegee C	50	50	
BOX TEMP	20-35	Dreegee C	33.7	32.9	
PMT TEMP	7 +/- 1	Dreegee C	7.1	7.1	
IZS TEMP	50 +/- 4	Dreegee C	-	-	
MOLY Temp	315 +/- 5	Dreegee C	314.4	315.0	
RCEL PRES	4-10 contant	IN-Hg-A	10	10	
SAMP PRES	20-30 contant	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	
Zero Value	NO	0	ppb	3.0	0.2
	NOx	0	ppb	5.1	0.6
Span Value	NO	400	ppb	408.0	400.0
	NOx	400	ppb	410.0	402.0

Calibrate By : _____

Approve By : _____

Date:

1-Nov-23

Date:

1-Nov-23



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6611001

Page:1/1

Calibrated Date: 1-Nov-23

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO ₂ /NO _x Analyzer Model: 200E	Manufacturer API S/N: ENOAI200E00579
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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 _x Conc 46.50 PPM NO Conc 46.50 PPM SO ₂ Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 24.7 °C

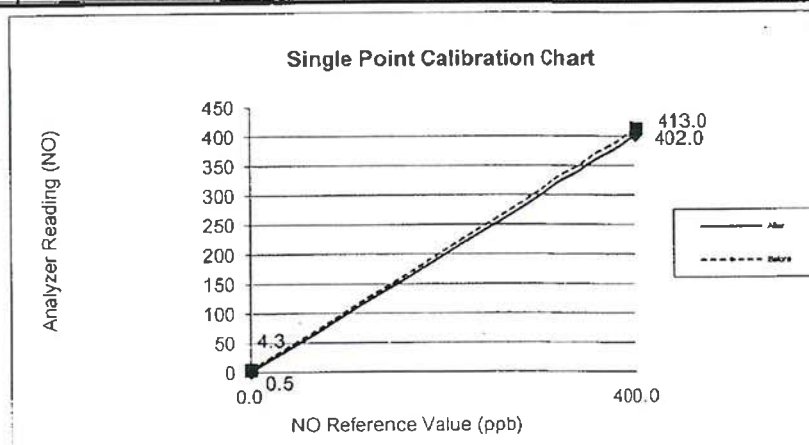
Humidity: 72 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	3.2	0.0	3.2	410.0	400.0	1.2
NO ₂	1.1	0.0	1.1	3.0	0.0	0.4
NO _x	4.3	0.0	4.3	413.0	400.0	1.6

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.3	0.0	0.3	400.0	400.0	0.0
NO ₂	0.2	0.0	0.2	2.0	0.0	0.2
NO _x	0.5	0.0	0.5	402.0	400.0	0.2



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ผู้จัดสอบ: [Redacted]



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6611001

Page:1/1

Calibrated Date: 1-Nov-23



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Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Unit
Date	1-Nov-23				
Time	13:25				
Range	0.00 - 500.00 PPB	PPB	500.0	500.0	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	474.0	441.0	
Ozone Flow	60-90	cc/min	76.0	76.0	
PMT Detector	0-5000	mV	24.5	62.2	
AZERO	-20-150	mV	8.6	67.5	
HVPS	400-900 constant	V	839.0	836.0	
DCPS	2500 +/- 200	mV	-	-	
RCELL TEMP	50 +/- 1	Dreegee C	50.0	50.0	
BOX TEMP	20-35	Dreegee C	34.5	30.5	
PMT TEMP	7 +/- 1	Dreegee C	7.0	7.1	
IZS TEMP	50 +/- 4	Dreegee C	-	-	
MOLY Temp	315 +/- 5	Dreegee 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		1.256	1.032	
Nox Slope	1 +/- 0.3		1.232	1.048	
NO Offset	-10 to + 150	mV	4.50	6.90	
NOx Offset	-10 to + 150	mV	-5.00	-1.50	
Zero and Span Value					
Zero Value	NO	0	ppb	3.2	0.3
	NOx	0	ppb	4.3	0.5
Span Value	NO	400	ppb	410.0	400.0
	NOx	400	ppb	413.0	402.0

Calibrate By : _____

Approve By : _____

Date:

1-Nov-23

Date:

1-Nov-23

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA Protocol

Part Number:	E04NI99E15A00V3	Reference Number:	160-402021734-1
Cylinder Number:	EB0140762	Cylinder Volume:	144.4 Cubic Feet
Laboratory:	124 - Plumsteadville - PA	Cylinder Pressure:	2015 PSIG
PGVP Number:	A12021	Valve Outlet:	660
Gas Code:	CO, NO, NOX, SO ₂ , BALN	Certification Date:	Feb 19, 2021

Expiration Date: Feb 19, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 600/R-12/531, 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	12386	D685025	9.91 PPM AIR/NITROGEN DIOXIDE	2.0%	Feb 20, 2020
GMIS	124206889	CC323707	4.028 PPM NITROGEN DIOXIDE/NITROGEN	2.1%	Aug 15, 2021
NTRM	0141709	KAL003190	49.67 PPM SULFUR DIOXIDE/NITROGEN	+/- 1.0%	Jun 20, 2022
NTRM	08012341	KAL004716	4857 PPM CARBON MONOXIDE/NITROGEN	+/- 0.6%	Jun 07, 2024

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

ANALYTICAL EQUIPMENT		
Instrument/Make/Model	Analytical Principle	Last Multipoint Calibration
SIEMENS ULTRAMAT 6 N1KD579	NDIR	Jan 27, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AUP2010245 NO ₂	FTIR	Jan 21, 2021
Nicolet iS50 FTIR AUP2010245 SO ₂	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

Page 1 of 160-402021734-1



รับรองสาขาถูกต้อง
ผู้รับรอง: [Signature]
Airgas Ltd.



Certificate of Calibration

Certificate Number : SPR23040182-2

Page : 1 of 3

Customer : Envilab Co., Ltd.

540, 540/1 Soi Bangkhae 7, Bangkhae, Bangkhae Bangkok 10160

Equipment Name : Sound Level Meter

Manufacturer : Pulsar

Model : 44

Serial Number : PN1805

ID. Number : N/A

Environmental Conditions

Ambient Temperature : $23^{\circ}\text{C} \pm 3^{\circ}\text{C}$

Received Date : 19 Apr 2023

Relative Humidity : $50\% \pm 15\%$

Calibration Date : 20 Apr 2023

Location of Calibration : In-Lab

Recommend Due Date : 20 Apr 2024

Calibration Procedure : SP-CPE-04-01

Date of Issue : 21 Apr 2023

Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by :



Calibration Officer

Approved by :



Authorized Signatory



SP-FM-04-15 rev.0

รับรองมาตรฐาน
การจัดการฝ่ายควบคุมคุณภาพ



Calibration Report

Certificate Number : SPR23040182-2

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 114/0166	17 Jan 2024

Traceability

This certification is traceable to the International System of Unit maintained at :
TISTR - Thailand Institute of Scientific and Technological Research





Result of Calibration

Certificate No. : SPR23040182-2

Page : 3 of 3

Range : 20 to 140 dB

Function : @1kHz

Select A Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	114.0	114.0	0.0	0.0	0.15

Select C Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	114.0	114.0	0.0	0.0	0.15

Select Z Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	114.0	114.0	0.0	0.0	0.15

Note:

The result of calibration was found accurate as show on date and place of calibration only.

This Certificate is not certified for any commercial transaction.

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2.00$, providing a level of confidence approximately 95%.

– End of Certificate –



Envilab Co.,Ltd.

ผู้จัดการฝ่ายควบคุมคุณภาพ

SP-FM-04-15 REV.0



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0381

MTC No. EEL. BP. 70/0366

CALIBRATION CERTIFICATE

Submitted by : Envilab Co.,Ltd.

Address : 540, 540/1 Soi Bangkhae 7, Bangkhae, Bangkok 10160.

Calibrated at : Electrical and Electronic Standards Laboratory, Industrial Metrology and Testing Service Centre.
: Soi 1C, Bangpoo Industrial Estate, Sukhumvit Rd., Muang, Samutprakan 10280.

Instrument Calibrated :

Description : Sound Level Calibrator

Manufacturer : Bruel & Kjaer

Model : 4230

Serial No. : 1351075

Ambient Environment

Temperature : $(23 \pm 3) ^\circ\text{C}$

Relative Humidity : $(50 \pm 15) \%$

Ambient Pressure : $(101.325 \pm 1.500) \text{ kPa}$

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 : 14 Mar. 2023

Date of Calibration : 16 Mar. 2023

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

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รับรองผลการสอบเทียบ
ผู้จัดการฝ่ายควบคุมคุณภาพ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0381

MTC No. EEL. BP. 70/0366

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.78	-0.22	± 0.10	± 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	999.0	-1.0	± 1.5	$\pm 1.0\%$

3. Total distortion

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

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 16 Mar. 2023

Date of Issue : 17 Mar. 2023

Ref : 2011266031401056001

End of Certificate

2 / 2

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

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รับรองผลการสอบเทียบ
ผู้จัดทำ : [Redacted]
ผู้ตรวจสอบ : [Redacted]



Certificate of Calibration

Certificate Number : SPR23050051-1

Page : 1 of 3

Customer : Envilab Co., Ltd.

540, 540/1 Soi Bangkhuae 7, Bangkhuae, Bangkhuae Bangkok 10160

Equipment Name : Primary Flow Meter (Drycal)

Manufacturer : MesaLabs

Model : Defender 520-H

Serial Number : 164578

ID. Number : N/A

Environmental Conditions

Ambient Temperature : $23^{\circ}\text{C} \pm 2^{\circ}\text{C}$

Received Date : 04 May 2023

Relative Humidity : $50\% \pm 15\%$

Calibration Date : 04 May 2023

Location of Calibration : In-Lab

Recommend Due Date : 04 May 2024

Calibration Procedure : SP-CPM-04-13

Date of Issue : 05 May 2023

Method of Calibration

This certifies that the above instrument was calibrated in compliance with the calibration system requirement of ISO/IEC 17025:2017 in accordance with reference procedure. Standards used to perform this calibration are certified by to NIST or equivalent, National metrology institute, Natural physical constants, consensus standards. The result reported herein apply only to the calibration of the item described above as received. Our decision rule is to contact the customer if the item pass and fail calibration when the results include the uncertainties and the customer must determine if the results meets their needs.

All calibrations are performed within manufacture's specifications. The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by



Calibration Officer

Approved by



Authorized Signatory



SP-FM-04-15 rev 0

รับรองสำเนาถูกต้อง

จัดการ

ภาพ



Calibration Report

Certificate Number : SPR23050051-1

Page : 2 of 3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Mass Flow Calibrator	AFC-COMplete-10	12532	AD2207-177-0001	17 Jul 2023
Standard Flow Meter	520-H	200353	MW-0071-22	25 Aug 2023

Traceability

This certification is traceable to the International System of Unit maintained at :

MIT - Miracle International Technology Co.,Ltd.

MesaLabs - Mesa Laboratories, Inc.NVLEP Lab Code 200661-0 (ISO17025)



รับรองมาตรฐานถูกต้อง

รพ่าย

4-15 rev.0



Result of Calibration

Certificate No. : SPR23050051-1

Page : 3 of 3

Range : 0 to 30 L/Min

Resolution : 0.0001 L/Min

Function : Air Flow Measurement

Unit : L/Min

Calibration Point	UUC Reading	Standard Reading	UUC Error	K Factor Value	Uncertainty (±)
5.0	4.9722	4.9752	-0.0030	1.00060	0.050
10.0	10.296	10.325	-0.029	1.00282	0.10
15.0	15.076	15.037	0.039	0.99741	0.20
20.0	20.331	20.274	0.057	0.99720	0.20

Note:

The result of calibration was found accurate as show on date and place of calibration only.
This Certificate is not certified for any commercial transaction.

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor $k = 2$, providing a level of confidence approximately 95 %

- End of Certificate -





Request No. 22-66 / 0323

MTC No. PSL-H 0150 / 66

Certificate of Calibration

Customer : Envilab Co.,Ltd.
540, 540/1 Soi Bangkhae7, Bangkhae, Bangkok, 10160
Item : Thermo-Hygrometer (Area Heat Stress Monitor)
Model /Type : hs-32
Serial Number : MCG080040
Manufacturer : METROSONICS
Date of Request : 9 February 2023
Date of Calibration : 24 February 2023

The certifies the above equipment was calibrated in accordance with the recognised International Standard ISO/IEC 17025:2017 and the operation according to procedure no. WI.CP.18.

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2$, which for a normal distribution corresponds to a coverage probability of approximately 95 %.

Calibrated by :

Approved

Photometry and Temperature Standards Laboratory

Ref. No : 2012266020900611005

Issued Date : 8 March 2023

Page 1 of 4

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FM.BL.MTC.002 Rev.4

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รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



Request No. 22-66 / 0323

MTC No. PSL-H 0150 / 66

Description of Unit Under Calibration :

Customer : Envilab Co.,Ltd.
Address : 540, 540/1 Soi Bangkhae7, Bangkhae, Bangkok, 10160
Item : Thermo-Hygrometer (Area Heat Stress Monitor)
Serial Number : MCG080040
Calibration Required : Temperature at (20, 30, 40) °C
Ambient Condition : Ambient temperature (23 ± 3) °C
Relative humidity (55 ± 20) %
Laboratory Address : Photometry and Temperature Standards Laboratory
Soi 1, Bangpoo Industrial Estate, Sukhumvit Rd., Samutprakan

Reference Standard :

Digital Thermometer with Sensor, Model : F250H, S/N : 9345 008 2331, Sensor RTD Probe No. RTD-01 and RTD-02 which was calibrated by Industrial Metrology and Testing Service Centre, Certificate No. PSL-T 0786/65.

The temperature scale in use of this laboratory is the International Temperature Scale of 1990.

Calibration Procedure :

The certifies the above equipment was calibrated according to procedure no. WI.CP.18.

Support Equipment :

Temperature & Humidity Controlled Chamber, Model : 9141-5110, S/N : 1205101

Adjustments : NONE

Page 2 of 4

P.T.

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FM.BL.MTC.002 Rev.4

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รับรองมาตรฐานห้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



Request No. 22-66 / 0323

MTC No. PSL-H 0150 / 66

Results of Calibration :- (/) Without Adjustment () After Adjustment

Table : Temperature Measurement @ Wet Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
19.9	20.4	-0.5	0.50
30.0	30.2	-0.2	0.50
40.1	40.2	-0.1	0.50

Table : Temperature Measurement @ Dry Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
19.9	20.2	-0.3	0.50
30.0	30.2	-0.2	0.50
40.1	40.1	0.0	0.50

Page 3 of 4

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รับรองผลการสอบเทียบ
ผู้จัดการฝ่ายควบคุมคุณภาพ



Request No. 22-66 / 0323

MTC No. PSL-H 0150 / 66

Results of Calibration :-

Table : Temperature Measurement @ Globe Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.0	20.2	-0.2	0.50
30.0	30.1	-0.1	0.50
40.1	40.0	0.1	0.50

- Note :**
1. This calibration was done without removing reservoir cover, white plates and blackened copper sphere of the instrument.
 2. The calibration data for instrument in this report is reported within the condition existing at the time of measurement only.

...end of certificate...

Page 4 of 4

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.

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รับรองมาตรฐานถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



INTERNATIONAL TESTING SERVICE CO., LTD

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Tel 0-2559-2095 Fax 0-2559-2096

E-mail : sale@itest-lab.com web site : www.itest-lab.com



NSC-TISI-TIS 17025
CALIBRATION 129

CALIBRATION CERTIFICATE

Issued date: 18 April 2023

Client Name : **ENVILAB CO., LTD.**

Address : 540,540/1 Soi Bangkhae 7, Bangkhae, Bangkhae, Bangkok 10160.

Request No : **C-2304 - 169**

Laboratory No.: **CAL- 169**

Date of Request: 12 April 2023.

Date of Calibration: 17 April 2023.

1. Unit Under Calibration (UUC) :

Nomenclature : Digital Lux Meter

Serial No.: 190600470

Maker : TENMARS

Model : TM-720

2. Place of Calibration: Photometry Standard Laboratory, INTERNATIONAL TESTING SERVICE CO., LTD.

3. Range of Calibration: 1 Range

4. Condition of Laboratory: Ambient temperature: $(25 \pm 2) ^\circ\text{C}$ and relative humidity $(60 \pm 20) \%$.

5. Reference Standard: Standard Tungsten Halogen Lamp, Serial No.: 504011, which was calibrated on 5 October 2022, can be traceable to International System of Unit (SI) through National Institute of Metrology (Thailand), Certificate No.: TP-1024-22.

6. Support Equipment:

1. Photometric bench, 6.3 meter long.
2. DC. power supply, Serial No.: EJ 19A 009, Model: GPR-25H 300, Maker: GW INSTRUK.
3. Digital Multimeter, Model: 34401A, S/N: MY44011212 and MY44011215.
4. Foot Candle / Lux Meter, Model: 407026, S/N: Q 558437, Maker: EXTECH.

7. Calibration Procedure:

The measurement was done in accordance with WI-CP-01. The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k = 2$, providing a level of confidence of approximately 95 %.

Page 1 of 2

The Results shown in this certification report refer only to the equipment(s) calibrated unless otherwise stated
This Calibration Certificate cannot be reproduced, except in full, without permission of company.



รับรองมาตรฐาน
ผู้จัดการฝ่ายควบคุมคุณภาพ

**INTERNATIONAL TESTING SERVICE CO., LTD**1213/388 Ladprao 94 Ladprao Rd. Wangtonglang Bangkok 10310
Tel 0-2559-2095 Fax 0-2559-2096E-mail : sale@itest-lab.com web site : www.itest-lab.comRequest No: **C-2304 - 169**

Serial No.: 190600470

Laboratory No.: **CAL - 169****Results :**

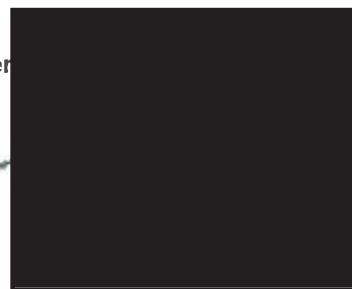
UUC Range	Standard (lx)	UUC Reading (lx)		Correction (lx)	Uncertainty of Measurement (\pm lx)
		Before adjust	After adjust		
Auto	0	0.0	0.0	0.0	0.1
	100	81.9	103.8	- 3.8	2.0 % of Reading
	500	393.2	506.9	- 6.9	
	1000	779.4	1003	- 3	
	1500	1160	1490	+ 10	
	2000	1531	1972	+ 28	

Note: 1. The results relate only to the items calibrated.
2. Zero adjust before used.

Calibration result approved by



Inter [Redacted] Ltd



Managing Director

Page 2 of 2

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Envilab Co., Ltd.

รับรองและออกใบ
ผู้จัดการฝ่ายควบคุมคุณภาพ

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Agilent 5100 5110 ICP-OES Preventive Maintenance

Agilent Preventive Maintenance provides factory recommended service for your analytical instruments to assure reliable operation and the accuracy of your results

Delivered by highly trained and certified service engineers using genuine Agilent parts and supplies, Agilent Preventive Maintenance provides what you need to reduce unplanned downtime and keep your systems operating at their peak performance.

This checklist is used as a guide for completing the preventive maintenance tasks. A signed copy of this checklist is provided for your records.



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Introduction

Customer Information

- Customers should provide all necessary operating supplies upon request of the engineer.
- A customer representative should be available to the engineer while performing the preventive maintenance procedures. Customers are responsible for regular maintenance and are encouraged to observe the service representative.
- Any parts not included in the Parts Lists section of this document are not part of the recommended Preventive Maintenance service nor are they included in the price of this service.
- If a system requires the use of extra or special procedures and/or parts for the maintenance service, then these must be ordered separately and charged as a repair, which may incur additional costs.
- For customers using HF applications, the instrument should be returned to its standard sample introduction system.

Important Customer Web Links

- To access Agilent University, visit <http://www.agilent.com/crosslab/university/> to learn about training options, which include online, classroom and onsite delivery. A training specialist can work directly with you to help determine your best options.
- To access the Agilent Resource Center web page, visit <https://www.agilent.com/en-us/agilentresources>. The following information topics are available:
 - Sample Prep and Containment
 - Chemical Standards
 - Analysis
 - Service and Support
 - Application Workflows
- The Agilent Community is an excellent place to get answers, collaborate with others about applications and Agilent products, and find in-depth documents and videos relevant to Agilent technologies. Visit <https://community.agilent.com/welcome>
- Videos about specific preparation requirements for your instrument can be found by searching the Agilent YouTube channel at <https://www.youtube.com/user/agilent>
- Need to place a service call? Flexible Repair Options | Agilent

Service Engineer's Responsibilities

- Contact the customer and ensure that all necessary supplies are available before the preventive maintenance visit.
- Only select those pages that relate to the system or module being serviced.
- Complete empty fields with the relevant information.
- Complete the relevant checkboxes in the checklist using either a "X" or tick mark "✓".
- Check "Service not applicable" check boxes to indicate services/tasks not delivered, as appropriate.
- Complete the Preventive Maintenance services in the most logical order relevant to the individual system service in the order of the tasks listed.
- Complete the Service Review section together with the customer.
- Complete the fields for page numbers at the foot of each selected page
- Add relevant page numbers to selected pages and complete the total number of pages field in the Service Completion section
- Ask the customer to sign the Service Verification section including the customer's and your signature.

Instrument Maintenance

System Information

- ☐ Check this box if an instrument configuration report is attached instead of completing the table.

Instrument System Name and ID
Instrument System Site and Location

5110 VDU ICP-OES
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List System Component	Product Numbers	List the Serial Numbers of each Component
1	G 8413 A	M717490002
2	G 8410 A	AU13393769
3	G 8441-80002	1309-05327
4		
5		
6		
7		
8		
9		

ICP-OES Configuration Table	Circle the type or write in the type if other
Nebulizer Type	SeaSpray/OneNeb Conical Other
Spray Chamber	Cyclonic Single Pass Cyclonic Double Pass Other
Torch	Radial Dual View Other
Torch Type	One Piece Semi Demountable Fully Demountable Other
Injector Diameter	2.4mm 1.8mm 1.4mm 1.0mm 0.8mm Other
Injector Material	Quartz Ceramic Other

Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components and implementation of Service Notes
- ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- ☐ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it via
- ☒ Ask the customer to remove any samples from the ICP-OES sample introduction area, auto sampler or around the ICP-OES.

Preventive Maintenance Procedures

Record Pre-PM Instrument performance

- ☒ Run Instrument Performance test.
- ☒ Record results in Instrument Performance Test Results Table – Pre-PM.

Clean and inspect ICP-OES system

- ☒ Look for any obvious external damage or problems.
- ☒ Inspect water cooling hoses, gas lines and power cord for excessive wear or damage.
- ☒ Perform a general internal inspection of the system for excessive dust accumulation, clean if necessary.
- ☒ Inspect sample introduction components and record any required maintenance in the Service Engineer Comments and notify the customer as the required actions required.
- ☒ Record the instrument operating conditions in the ICP-OES Status Results Table.
- ☒ Replace the polychromator purge filter.
- ☒ Replace the radial pre-optics window
- ☒ Replace the axial pre-optics window for SVDV and VDV instruments.
- ☒ Check exhaust flow for the correct positive extraction at the exhaust duct to insure they meet minimum specifications.
- ☒ Replace air inlet dust filter.
- ☒ Replace high capacity air inlet dust filter element if installed N1R
- ☒ Remove and clean instrument water inlet filter.

Agilent Water Recirculator

- ☐ Service not applicable
- ☒ Drain cooling fluid and remove any particles from the chiller reservoir
- ☒ Remove, clean and re-install water inlet metal mesh filter if present
- ☒ Re fill with Agilent Cool Clear cooling fluid
- ☒ Clean the cooling system Air filter and the condenser.

SPS 3 Auto Sampler

- ☒ Service not applicable
- ☐ Power cycle the autosampler and verify successful initialization.
- ☐ Inspect X and Z axis belts for wear. Replace is necessary.
- ☐ Clean X and Z axis slide shafts.
- ☐ Using customer's racks and the Agilent software move the sample probe to the 4 outermost corners and rinse port, ensure that the probe is approximately centered in the vial.

SPS 4 Auto sampler

- ☐ Service not applicable
- ☒ Clean the spill tray, rack location mat, end frames and chassis with a damp soft cloth and diluted mild detergent.
- ☒ Clean the auto sampler cover panels, if cover kit is installed, with domestic window cleaner.
- ☒ Check the X-axis and Z-axis drive belts for cracks, splits, damaged teeth, excessive fraying, color changes or degradation from fumes.
- ☒ Check the X-axis, Theta-axis and Z-axis EFC cables for cracks, incorrect positioning, damaged edges or damaged connectors.
- ☒ Pump Tubing Replacement. Replace peristaltic pump tubing. Replace all tubing that goes from the rinse station to the pump and from the pump to the waste/rinse bottles. *only checked, passed*
- ☒ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

AVS 4, 6, 7 Advanced Valve System

- ☒ Service not applicable
- ☐ Replace valve rotor seal
- ☐ Check fittings for signs of leaks
- ☐ Check tubing including autosampler tubing for kinks or excessive wear
- ☐ Check high flow pump for signs of leaks

ICP-OES adjustment

- ☒ Check position of Zn peak, adjust if required.
- ☒ Check Argon Ratio, adjust to specified value if required.
- ☒ Perform Detector Calibration.
- ☒ Perform Instrument Calibration.

Record Post-PM instrument performance

- ☒ Run Instrument Performance test
- ☒ Record results in Instrument Performance Test Results Table - Post-PM.
- ☒ For systems using ICP Expert version 7.3 and above, run the following instrument tests
 - ☒ Subsystem Communications Test
 - ☒ Air Flow
 - ☒ Water Flow
 - ☒ Gas Flows
 - ☒ RF Generator
 - ☒ Camera Test
 - ☒ Optics Test
 - ☒ Nebulizer Test

- ☒ Record the result in the Instrument Test Results Table

Restore Instrument

- ☐ For HF applications, ask the customer to reinstall their sample introduction system. N/A
- ☒ Leave system in an idle state: on and purging.
- ☒ Guidance: If the PM service is performed prior to a qualification service, then use the qualification procedure as a guide for final instrument set up and checkout.

Service Review

- ☒ Attach available reports/printouts of all tests to this documentation.
- ☒ Record the Preventive Maintenance service activity in the customer's records/logbook.
- ☒ Record the PM event in the Smart Alerts logbook, if applicable.
- ☒ Update/reset instrument maintenance counters as appropriate.
- ☒ Affix the PM sticker to the system or instrument logbook based on the customer's request.
- ☒ Complete the Service Engineer Comments section if there are additional comments.
- ☒ Review this service, parts replaced, and test results obtained with the customer.
- ☒ If the instrument firmware was updated, record the details of the change in the Service Engineer's Comments box. Systems in a compliant environment may need additional documentation.
- ☒ Complete the Signature Page with both Service Engineer and Customer signatures.

Test Results

Instrument Performance Test Results Table

Note: These measurements do not form part of any specification and are for reference only.

	Pre PM Sensitivity Check		Post PM Sensitivity Check	
	Radial	Axial*	Radial	Axial*
Zn 213.857 nm SRBR	1577.1	3532.6	2344.2	6129.9
Mn 257.610 nm SRBR	5945.3	16145.3	10714.1	39073.2
Al 336.152 nm SBR	7.0	16.3	8.5	25.7
K 766.491 nm SBR	0.2	67.3	4.7	83.6

* Axial result is not applicable for G8016AA, G8012AA Radial View instruments.

Instrument Test Results Table

Note: The Instrument Test results are for systems using ICP Expert version 7.3 and above only.

Instrument Test	Result
Subsystem Communications Test	Pass
Air Flow	Pass
Water Flow	Pass
Gas Flows	Pass
RF Generator	Pass
Camera Test	Pass
Optics Test	Pass
Nebulizer Test	Pass

ICP-OES Status Results Table

Note: These measurements do not form part of any specification and are for reference only.

Measurement	Standby Mode	Plasma On
Mains Voltage	219.371	VAC 217.464
Mains Current	0.042	A 0.048
Instrument Temperature	23.3	°C 23.1
RF Air Flow (sensor speed)	13.0	Hz 19.0
Plasma Exhaust Temperature	No measurement	°C
Water Flow Oscillator	No measurement	L/min 1.51
Water Flow Detector	1.09	L/min 1.06
Water Inlet Temperature	16.9	°C 16.7
Polychromator Temperature	35.0	°C 35.0
CCD Temperature	-39.6	°C -39.4
Thermal Stabilizer	35.0	°C 35.0
Argon Supply Pressure	619.13	kPa 600.32
Purge Gas Supply Pressure*1	616.63	kPa 597.43
Option Gas Supply Pressure*1	-	kPa -
Nebulizer Flow	No measurement	L/min 0.70
Nebulizer Back Pressure	No measurement	kPa 233.17
Plasma Gas Flow	No measurement	L/min 11.98
Auxiliary Gas Flow	No measurement	L/min 1.00
RF Power	No measurement	W 1193.1
RF Supply Current	No measurement	A 8.190
RF Supply Voltage	No measurement	V 194.557

*1 If option installed

Consumed PM Parts

Part Description	Part Number	Product or Model# where used	Quantity consumed
Axial Pre-Optic Window	G8010-68014	G8010A, G8011A, G8014A/G8015A	1
Radial Pre-Optic Window	G8010-68015	All	1
Agilent Cool Clear Coolant Fluid	5799-0037	Agilent Water Recirculator	1
Purge Gas Filter	G8010-60136	All	1
Air Inlet Filter	G8000-68002	All	1
High Capacity Air Filter	G8010-60189	Optional	1
Rotor seal for 6-7 port valve for AVS6/7	G8494-60002	G8494A/G8495	1
Rotor seal for 4 port valve for AVS4	G8493-60002	G8493A	1
Rins3 solution to rinse station 2.5mm id x 1m	G8410-80123	SPS 4	1
Barb connector 2.5mm-1.5mm ID	G8410-80124	SPS 4	1
PVC waste tubing 8mm od x 5mm id, 2m	G8410-80122	SPS 4	1
Additional Parts may be required from engineer's stock:			
X axis drive belt	5410047500	SPS 3	1
Z axis drive belt	5410047400	SPS 3	1
Peristaltic pump tubing, PVC Solvalflex 3 bridged,	3710049000	SPS 4	1

Consumed Parts Reference
(Purchased by customer, not included as part of PM)

☐ Section Not Applicable.

Part Description	Part Number	Product or Model# where used	Quantity consumed
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Signature Page

Service Engineer Comments (optional)

If there are any specific points you wish to note as part of performing the installation or other items of interest for the customer, please write in this box.

Service Verification

Service Request Number: 6006121636
Date Service Completed: 31 May 2023
Service Engineer Name: Kanworn S
Service Engineer Signature: Kanworn S
Customer Name: เจริญ
Customer Signature: เจริญ
Total number of pages in this document: 14

Report Summary		
Instrument Model	Agilent 5100/5110 VDV ICP-OES	
Instrument ID	G8011A/G8015A	
Instrument Serial Number	MY17490002	
Software Version	7.4.0.10280	
Firmware Version	3562	
Tested By	Kanyakorn S.	
Test Started On	5/31/2023 12:22:01 PM	
Test Completed On	5/31/2023 12:26:21 PM	
Result Summary		
Subsystem Communications Test	Pass	
Air Flow Test	Skipped	
Water Flow Test	Skipped	
Gas Flows Test	Skipped	
RF Generator Test	Skipped	
Carrera Test	Skipped	
Optics Test	Pass	
Advanced Valve System Test	Skipped	
Resolution Test	Pass	
Sensitivity Test	Pass	
Precision Test	Pass	
Subsystem Communications Test		
Pass		
Optics Test		
	Radial	Axial
Intensity	3397602	2923418
Wavelength	737.212	737.212
Pass		



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Resolution Test			
Element	Wavelength	Specification	Width
N	(174.213 nm)	≤ 9.40	6.72
As	(188.980 nm)	≤ 8.20	6.49
C	(193.027 nm)	≤ 11.50	8.01
Mo	(202.032 nm)	≤ 8.20	6.43
Cr	(206.158 nm)	≤ 13.40	8.50
Zn	(213.857 nm)	≤ 8.70	7.16
Pb	(220.353 nm)	≤ 9.50	7.51
Co	(228.615 nm)	≤ 17.20	11.32
Ba	(230.424 nm)	≤ 9.40	7.80
Mn	(257.610 nm)	≤ 13.30	9.78
Mn	(260.568 nm)	≤ 20.30	13.88
Cr	(267.716 nm)	≤ 11.00	9.09
Cu	(324.754 nm)	≤ 25.00	18.88
Cu	(327.395 nm)	≤ 14.20	12.41
Sr	(338.071 nm)	≤ 33.50	24.27
Ba	(455.403 nm)	≤ 44.00	34.07
Sr	(460.733 nm)	≤ 36.00	22.56
Ba	(493.408 nm)	≤ 36.00	27.79
Ba	(614.171 nm)	≤ 42.00	27.97
Ar	(675.283 nm)	≤ 74.00	62.41
K	(766.491 nm)	≤ 80.00	65.95

Sensitivity Test				Precision Test			
Radial				Radial			
Element Wavelength	Specification	Method	Ratio	Standard	Blank	Element Wavelength	Specification
As (188.980 nm)	≥ 46.0	SRBR	108.0	934.0	64.8	As (188.980 nm)	≤ 2.60
Se (196.026 nm)	≥ 41.0	SRBR	110.2	1159.4	93.6	Se (196.026 nm)	≤ 2.60
Zn (213.857 nm)	≥ 1421.0	SRBR	2348.2	23561.0	99.8	Zn (213.857 nm)	≤ 1.50
Pb (220.353 nm)	≥ 46.0	SRBR	98.7	1075.1	98.0	Pb (220.353 nm)	≤ 2.60
Mn (257.610 nm)	≥ 3518.0	SRBR	10768.1	218704.5	411.0	Mn (257.610 nm)	≤ 1.50
Al (396.152 nm)	≥ 3.4	SBR	8.5	40909.0	4325.8	Al (396.152 nm)	≤ 1.50
Ba (493.408 nm)	≥ 34.0	SBR	111.9	1356218.4	12367.4	Ba (493.408 nm)	≤ 1.50
K (766.491 nm)	≥ 1.8	SBR	4.7	108989.7	19076.8	K (766.491 nm)	≤ 1.50
Axial				Axial			
Element Wavelength	Specification	Method	Ratio	Standard	Blank	Element Wavelength	Specification
As (188.980 nm)	≥ 208.0	SRBR	267.6	3134.3	126.3	As (188.980 nm)	≤ 1.50
Se (196.026 nm)	≥ 159.0	SRBR	284.6	4158.5	194.0	Se (196.026 nm)	≤ 1.50
Zn (206.200 nm)	≥ 234.0	SRBR	495.4	1165.9	5.5	Zn (206.200 nm)	≤ 1.50
Zn (213.857 nm)	≥ 1743.0	SRBR	6129.9	92298.3	225.6	Zn (213.857 nm)	≤ 1.50
Cd (214.439 nm)	≥ 4227.0	SRBR	16998.9	48382.7	8.1	Cd (214.439 nm)	≤ 1.50
Pb (220.353 nm)	≥ 320.0	SRBR	416.4	6520.1	228.4	Pb (220.353 nm)	≤ 1.50
Mn (257.610 nm)	≥ 10625.0	SRBR	39073.2	1331904.8	1159.9	Mn (257.610 nm)	≤ 1.50
Cr (267.716 nm)	≥ 1048.0	SRBR	5986.5	203686.5	1144.7	Cr (267.716 nm)	≤ 1.50
Cu (324.754 nm)	≥ 19.0	SBR	77.1	389900.7	4991.6	Cu (324.754 nm)	≤ 1.50
Al (396.152 nm)	≥ 6.0	SBR	25.7	268775.7	10073.7	Al (396.152 nm)	≤ 1.50
Ba (493.408 nm)	≥ 60.0	SBR	293.9	8244793.3	27957.8	Ba (493.408 nm)	≤ 1.50
K (766.491 nm)	≥ 24.0	SBR	83.6	3030541.1	35817.8	K (766.491 nm)	≤ 1.50

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Ba (493.408 nm)	≥ 60.0	SBR	293.9	8244793.3	27957.8	Ba (493.408 nm)	≤ 1.50
K (766.491 nm)	≥ 24.0	SBR	83.6	3030541.1	35817.8	K (766.491 nm)	≤ 1.50



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Report Summary		
Instrument Model	Agilent 5100/5110 VDV ICP-OES	
Instrument ID	G8011A/G8015A	
Instrument Serial Number	MY17490002	
Software Version	7.4.0.10280	
Firmware Version	3562	
Tested By	Kanyakorn S.	
Test Started On	5/31/2023 12:34:17 PM	
Test Completed On	5/31/2023 12:46:55 PM	
Result Summary		
Subsystem Communications Test	Pass	
Air Flow Test	Pass	
Water Flow Test	Pass	
Gas Flows Test	Pass	
RF Generator Test	Pass	
Camera Test	Pass	
Optics Test	Skipped	
Advanced Valve System Test	Skipped	
Resolution Test	Skipped	
Sensitivity Test	Skipped	
Precision Test	Skipped	
Subsystem Communications Test		
Pass		
Air Flow Test		
30% Air Flow (relative speed)	75% Air Flow (relative speed)	
12.00	18.00	
Water Flow Test		
Pass		
RF Water Flow(L/min)	Camera Water Flow (L/min)	Water Inlet Temperature (°C)
1.45	1.06	16.78

Gas Flows Test			
Pass			
Nebulizer Target Flow	Actual Flow	Back Pressure	
0.70	0.71	280.77	
Auxiliary Target Flow	Actual Flow	Back Pressure	
2.00	2.00	93.84	
Makeup Target Flow	Actual Flow	Back Pressure	
2.00	1.99	95.26	
Plasma Target Flow	Actual Flow	Back Pressure	
18.00	17.94	23.27	
RF Generator Test			
Pass			
RF Power Supply Test	Passed		
RF Power Supply (V)	147.418		
RF Oscillator Test	Passed		
RF Oscillator Frequency (MHz)	25.961		
Work Coil Current (A)	45.326		
RF Power Supply Current (A)	2.000		
Camera Test			
Pass			
Integration Time (ms)	Standard Deviation	Status	
1000	5.120	Passed	
Array Test	0.015	Passed	
Linearity Test	0.122	Passed	