

เอกสารผลการสอบเทียบ เครื่องมือตรวจวัด





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 & Evltest Supply Instrument

TSP High Volume Sampler Calibration

Verification Report No.
SO2300167-E001 -TSP 01

<input type="checkbox"/> PM	<input checked="" type="checkbox"/> Onsite
Site: จุดที่ 1 หมู่ที่ 4 ตำบลดิสัง	
UTM : 47P 707013 1644301	
Date: 20 Oct 23	
Technical: Amonthep K.	
Approval: Wisan R.	
Sampler: ETSP#25	
Recorder: ECRDCPR4169240	

CONDITIONS

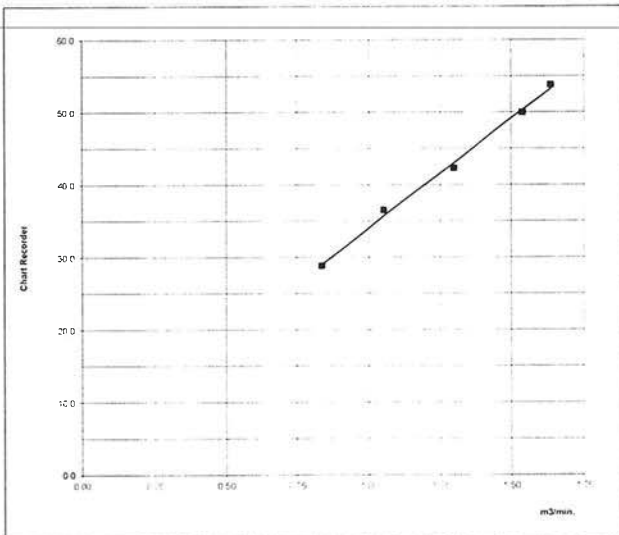
Barometric Press. (hPa): 951.0	Corrected Pressure (mm Hg): 713.3
Temperature (deg C): 30.0	Temperature (deg K): 303.0
Average Press. (hPa): 1013.0	Corrected Avg.Press. (mm Hg): 759.8
Average Temp. (deg C): 30.0	Average Temp. (deg K): 303.0

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	11.73	1.633	56.0	53.80	Slope = 30.2683
2	10.38	1.538	52.0	49.96	Intercept = 3.8117
3	7.33	1.295	44.0	42.27	Corr. coeff.= 0.9979
4	4.82	1.054	38.0	36.51	# of Observations: 5
5	2.99	0.834	30.0	28.82	Range of Chart at 1.1 - 1.7 m3/min. 39 57



Calibrated by :

Approved by :

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Environmental responsibility with accuracy measurement

FE-MNT-29 Rev 00-07/08/63



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ผู้จัดการฝ่ายควบคุมคุณภาพ



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Environmental responsibility with accuracy measurement

TSP High Volume Sampler Calibration

Verification Report No.
SO2300167-E001 -TSP 02

☐ PM ☒ Onsite

Site: จุดที่ 2 หมู่ที่ 1 ตำบลสีลัง

UTM : 47P 705303 1642328

Sampler: ETSP#27

Recorder: ECRANG15315224

Date: 20 Oct 23

Technical: Amonthep K.

Approval: Wisan R.

CONDITIONS

Barometric Press. (hPa): 951.0

Temperature (deg C): 30.0

Average Press. (hPa): 1013.0

Average Temp. (deg C): 30.0

Corrected Pressure (mm Hg): 713.3

Temperature (deg K): 303.0

Corrected Avg. Press. (mm Hg): 759.8

Average Temp. (deg K): 303.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 759

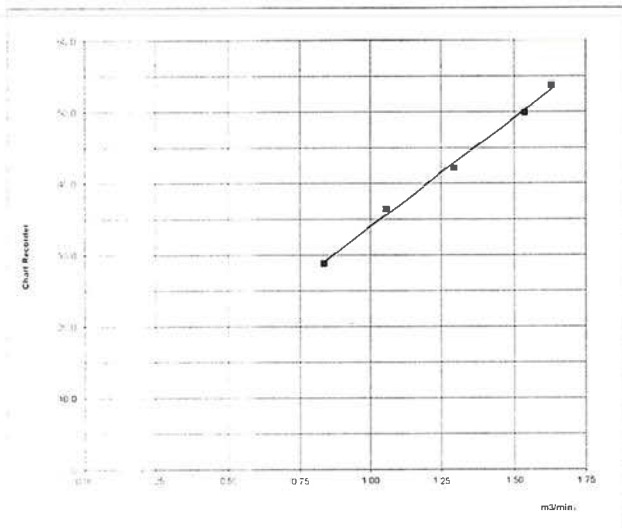
Qstd Slope: 2.03736

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	12.22	1.667	52.0	49.96	Slope = 30.5848
2	9.14	1.444	46.0	44.20	Intercept = -0.8665
3	7.47	1.307	40.0	38.43	Corr. coeff. = 0.9980
4	4.77	1.048	32.0	30.74	# of Observations: 5
5	2.98	0.832	26.0	24.98	Range of Chart 35
					at 1.1 - 1.7 m3/min. 53



Calibrated by :

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Envilab & Newdata Group Instruments

PM10 High Volume Sampler Calibration

Verification Report No.
SO2300167-E001 -PM 01

☒ PM ☐ Onsite

Site: จุดที่ 1 หมู่ที่ 4 ตำบลดัดล่าง
UTM : 47P 707013 1644301
Sampler: EPM#26
Recorder: ECRDS01618124

Date: 20 Oct 23
Technical: Amonthep K.
Approval: Wisan R.

CONDITIONS

Barometric Press. (hPa): 951.0 Corrected Pressure (mm Hg): 713.3
Temperature (deg C): 30.0 Temperature (deg K): 303.0
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
Model: TE-5025A
Serial#: 759

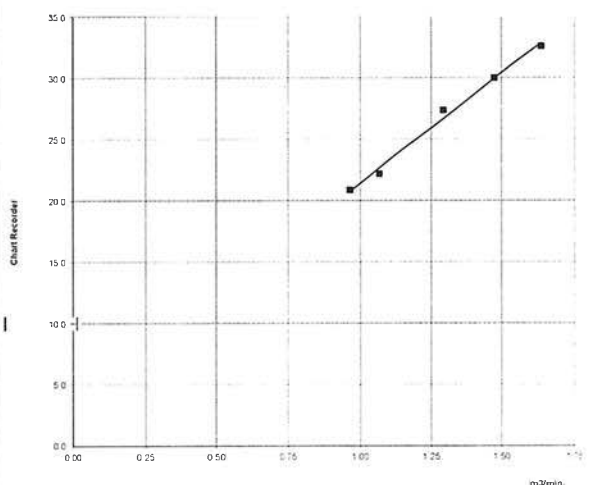
Slope: 1.27576
Intercept: -0.02337
Date Certified: 18 Jan 23

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.00	1.634	50.0	32.59
2	8.11	1.473	46.0	29.98
3	6.21	1.291	42.0	27.37
4	4.23	1.069	34.0	22.16
5	3.43	0.964	32.0	20.86

LINEAR REGRESSION

Slope = 18.0414
Intercept = 3.3833
Corr. coeff. = 0.9959
SFR = 1.204
SSP = 38.51
of Observations: 5
Range of Chart 36
at SFR $\pm 10\%$ 41



Calibrated by :

Approved by :

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



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PM10 High Volume Sampler Calibration

Verification Report No.
SO2300167-E001 -PM 02

☒ PM ☐ Onsite

Site: จุดที่ 2 หมู่ที่ 1 ตำบลดัดลัง
UTM : 47P 705303 1642328
Sampler: EPM#28
Recorder: ECRDS01618125

Date: 20 Oct 23
Technical: Amonthep K.
Approval: Wisan R.

CONDITIONS

Barometric Press. (hPa): 945.7
Temperature (deg C): 32.0
Average Press. (hPa): 1013.0
Average Temp. (deg C): 30.0
Corrected Pressure (mm Hg): 709.3
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

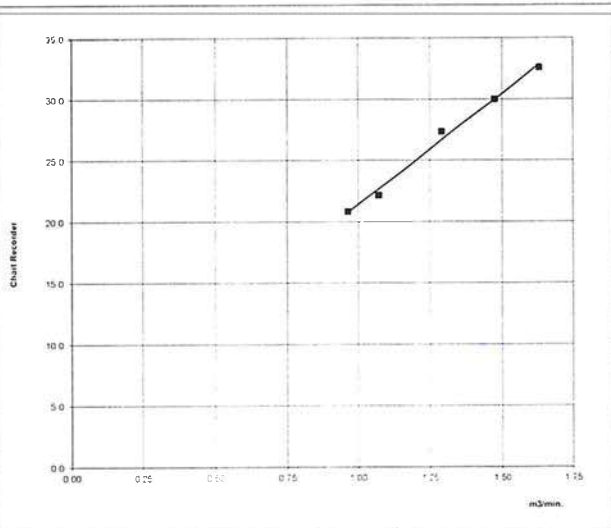
Slope: 1.27576
Intercept: -0.02337
Date Certified: 18 Jan 23

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	11.73	1.779	56.0	36.72
2	10.38	1.674	52.0	34.10
3	7.33	1.410	44.0	28.85
4	4.82	1.147	38.0	24.92
5	2.99	0.907	30.0	19.67

LINEAR REGRESSION

Slope = 18.9535
Intercept = 2.6328
Corr. coeff. = 0.9979
SFR = 1.218
SSP = 39.23
of Observations: 5
Range of Chart at SFR $\pm 10\%$ 37 42



Calibrated by :

Approved by :

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

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



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



Envilab & Envilab Supply Instruments

Verification Test Report

Report No.:

SO2300167-E001 -SLM 01

☐ PM

☒ Onsite UTM :

47P 706109 1644133

Calibrated Date: 20 October 2023

Site : จุดที่ 1 บริเวณริมรั้วโครงการด้านทิศตะวันออก

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 46

Serial : 2123

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:

Approve By:

Date:

20 October 2023

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Envilab & Mexilis Supply Instrument

Verification Test Report

Report No.:

SO2300167-E001 -SLM 02

☐ PM ☒ Onsite UTM : 47P 706191 1643665

Calibrated Date: 20 October 2023

Site : จุดที่ 2 บริเวณริมรั้วโครงการด้านทิศใต้

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 46

Serial : 2129

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:

Approve By:

Date:

20 October 2023

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



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Verification Test Report

Report No.:

SO2300167-E001 -SLM 03

☐ PM ☒ Onsite UTM : 47P 707022 1644341

Calibrated Date: 20 October 2023

Site : จุดที่ 3 หมู่ที่ 4 ตำบลดีลัง

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 45

Serial : 0012

Environment: Temperature 32 °C Humidity 65 %RH

Reference Standard: Acoustic Calibrator Class 1 Model 4230, Briel&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	93.60	-0.18	93.78

Calibrated By:

Date:

Approve By:

Date:

20 October 2023

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Envilab & Paredas Supply Instrument

Verification Test Report

Report No.:

SO2300167-E001 -SLM 04

☐ PM ☒ Onsite UTM : 47P 705290 1642307

Calibrated Date: 20 October 2023

Site : จุดที่ 4 หมู่ที่ 1 ตำบลดีลัง

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 45

Serial : 0016

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	93.67	-0.11	93.78

Calibrated By:

Date:

Approve By:

Date:

20 October 2023

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Certificate of Calibration

Method 5 Pre-Test Calibration - Liters (L)

UUT Meter Console Information

Model #: XC-572-V
Serial #: A2001003
DGM Model #: SK25EX
DGM Serial #: 00005796

Calibration Conditions

Bar. Pressure (mm Hg): 758.3
Ambient Temperature (°C): 24.4
Relative Humidity (%): 40
Altitude (m): 1.83
Bar. Pressure Corr. (mm Hg): 758.2

Factors/Conversions

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

Reference Equipment

Calibration Meter Model: DGM-200H
Cal. Date: 03-Jun-22
Serial No.: 0000026
Gamma: 1.0000

UUT Meter (DGM)

Run Time (seconds)	Orifice ΔH (mm H ₂ O)	Volume			Meter Temperature (°C)		Meter Pressure (mm H ₂ O)	Reference Meter (WTM)		
		Initial (L)	Final (L)	Total (L)	Initial	Final		Initial	Final	Total
Θ	P _{m(g)}	V _{mi}	V _{mf}	V _m	t _{mi}	t _{mf}	P _w	V _{wi}	V _{wf}	V _w
840.00	13.00	558671.6	558826.6	155.0	24.0	25.0	0.3	0.00	161.61	161.61
630.00	25.00	558826.6	558990.4	163.8	25.0	26.0	0.5	0.00	167.48	167.48
450.00	50.00	558990.4	559157.0	166.6	26.0	26.0	0.6	0.00	169.53	169.53
390.00	80.00	559157.0	559339.6	182.6	27.0	27.0	2.0	0.00	185.73	185.73
300.00	120.00	559339.6	559511.4	171.8	27.0	28.0	2.4	0.00	177.09	177.09

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 @
159.16	11.37	152.48	11.4	1.0438	0.0133	44.7	0.091
165.03	15.72	160.78	15.7	1.0264	-0.0042	44.9	0.314
167.09	22.28	163.65	22.3	1.0210	-0.0096	44.8	0.164
183.69	28.26	179.29	28.3	1.0245	-0.0060	44.8	0.199
175.32	35.06	169.05	35.1	1.0370	0.0065	43.8	-0.768
				1.0306	= Y Avg.	44.6	= ΔH @ Avg.

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 ΔH₀, orifice pressure differential that equates to 0.0212m³/min at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2 inches (5.1mm) H₂O.

Pass/Fail Judgment : **Pass**

Calibrate By: *Pattanyan P*

Approved By: *Pattanyan P*

Date: 28 Feb 23

The instruments listed and described on this certificate have been calibrated against standards traceable to the National Institute of Standards and Technology (NIST) and in reference to EPA Method 5, Section 10.3.1.



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รับรองสำเนาถูกต้อง
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Nomenclature

- P_o - Barometric Pressure
- DGM - Dry Gas Meter
- K₁ - Constant based on standard temp and press
- ϕ - Run time, in minutes
- P_m - ΔH (Meter Pressure, gauge)
- V_m - Volume collected by test meter, corrected for STP
- Q_{meas} - 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

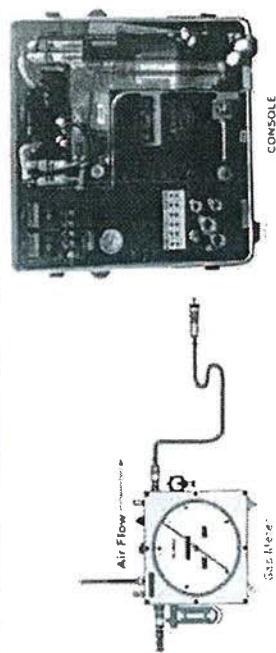
$$V_{m(std)} = V \cdot K_1 \cdot \frac{V_w \cdot (P_{bar} + \frac{P_{m(std)}}{13.6})}{T_w}$$

$$K_1 = \frac{T_{std}}{P_{std}} \cdot \frac{V_{m(std)}}{V - \frac{V_{m(std)}}{V_w + P_{std}}} \cdot \frac{V_{m(std)}}{(\phi)}$$

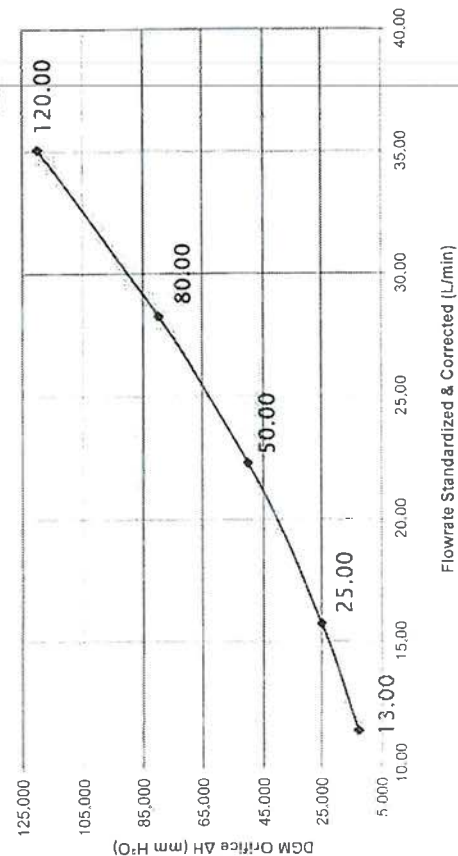
$$Q_{m(std)} = \frac{V_{m(std)}}{\phi}$$

$$\Delta H_{ref} = \frac{P_{m(std)} \cdot 0.0011696 \cdot (P_{bar} + \frac{P_{m(std)}}{13.6})}{T_w} \cdot \left(\frac{T_w + \phi}{V_w + P_{std}} \right)^2$$

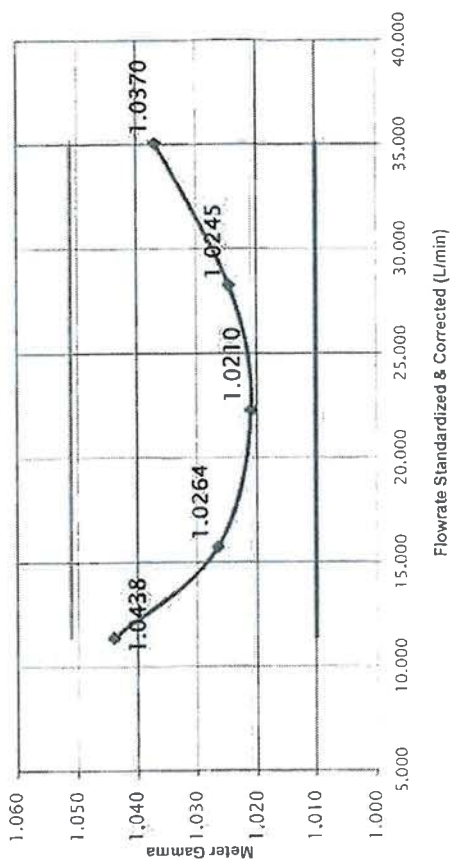
Calibration Train



Meter Pressure vs. Flowrate



Meter Gamma vs. Flowrate





Certificate of Calibration

Method 5 Console Sensor Calibration - Metric Units

Console Information

Model #: XC-572-V
Serial #: A2001003
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 758.3
Humidity (%): 40
Tamb (°C): 24.4
Elevation (m): 1.8
Corr. Pbar (mm. Hg): 758.2

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
		Aux	Stack	Probe	Oven	Filter	Exit	
#	°C	°C	°C	°C	°C	°C	°C	Pass/Fail
1	-18	-17	-17	-17	-17	-17	-17	PASS
2	38	38	37	38	38	37	37	PASS
3	93	93	93	94	93	93	94	PASS
4	149	150	150	149	149	149	149	PASS
5	260	260	259	259	259	259	259	PASS
6	371	370	371	372	370	370	370	PASS
7	482	481	481	483	481	481	481	PASS
8	593	592	592	594	592	592	592	PASS
9	816	815	816	816	817	816	816	PASS
10	1038	1038	1039	1039	1039	1039	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
Ice Water	1	0.1	0	0.04%
Ambient ³	2	24.4	24	0.08%

Maximum² 0.08%

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 :

Pattanan P.

Approved By:

VA

Date: 28 Feb 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 $\pm 1.5\%$ 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

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ผู้จัดการฝ่ายควบคุมคุณภาพ



neediss Console Sensor Calibration Data Sheet

Console Information

Model #: XC-572-V
Serial #: A2001003
Units: Metric
Type: English

Calibration Conditions

Pbar (mm. Hg): 758.3
Humidity (%): 40.0
Tamb (°C): 24.4
Corr. Pbar (mm. Hg): 758.2

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 Status ⁶
#	in. Hg	in. Hg	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
	Reference	Positive (+) Pitot	Negative (-) Pitot	
#	mm H ₂ O	mm H ₂ O	mm H ₂ O	Pass/Fail
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
	Reference	Positive (+) Pitot	Negative (-) Pitot	
#	mm H ₂ O	mm H ₂ O	mm H ₂ O	Pass/Fail
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: Pattanasorn P. Approved By: PH Date: 28 Feb 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 ±11.5% 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 H9 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)
- 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.



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Console Sensor Audit QA Sheet

Meter Console Information (UUT)

Model #: XC-572-V
 Serial #: A2001003
 Units: Metric

Calibration Conditions

Pbar (mm. Hg): 758.3
 Humidity (%): 40
 Amb. Temp. (°C): 24.4
 Altitude (m): 1.8
 Corrected Pbar (mm. Hg): 758.2

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
		Aux	Stack	Probe	Oven	Filter	Exit	
	°C	°C	°C	°C	°C	°C	°C	Pass/Fail
Room	24.4	24	25	24	24	25	25	PASS
Ice Water	0.1	0	0	0	0	1	1	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 By: Pattananan P.Approved By: VADate: 28 Feb 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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neediss Sampling Probe and Pitot Validation

Samplig System Equipment Information

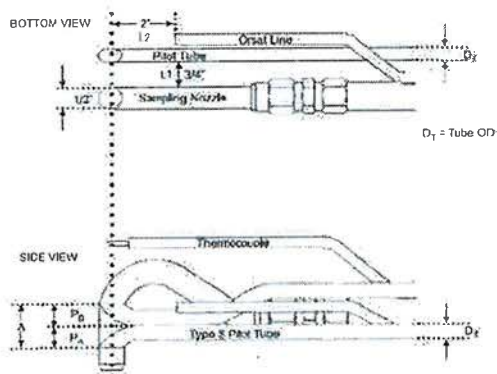
Probe Sheat	Apex 1 in. , 5 ft.
Probe Number	1912458
Pitot tube Number	A8778
Pitot tube Type	S Type 3/8 Inc.
Validation method	Standard Probe 1 in. and 1/2 in. Sampling Nozzle

Valibration Conditions and Equipment

Digital Calipers	CD-15APX
Reference No.	A22070181
Digital Inclonometer	BASELINE
Reference No.	FEL 12-1057
Temperature	24.4 °C±3
Barometric Pressure	758.3 mm Hg

Sampling Probe Validation with Tune up

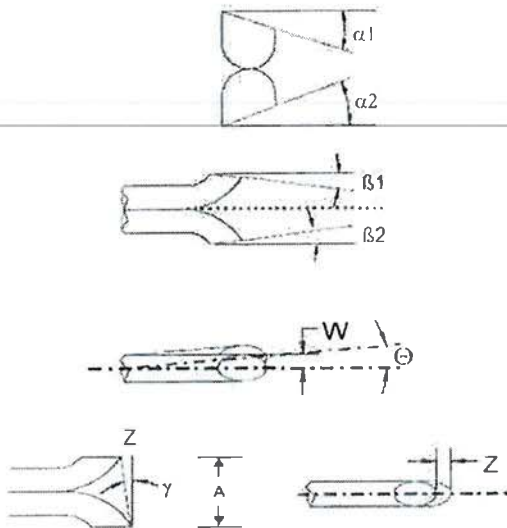
☒ Measure and Alinment with 1/2" Sampling Nozzle(12.7 mm)



Measured	Standard Range
$L_1 = 1.90 \text{ cm.}$	(1.905 cm. or 3/4 in.)
$L_2 = 5.03 \text{ cm.}$	(5.08 cm. or 2.0 in.)
$D_T = 0.955 \text{ cm.}$	(3/8 in.)
$A = 2.08 \text{ cm.}$	(2.1 $D_T \leq A \leq 3D_T$)
$A/2D_T = 1.091 \text{ cm.}$	(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
$\alpha_1 = 3.00^\circ$	$\leq 10^\circ$
$\beta_1 = 1.10^\circ$	$\leq 5^\circ$
P_A Size	
$\alpha_2 = 2.20^\circ$	$\leq 10^\circ$
$\beta_2 = -2.00^\circ$	$\leq 5^\circ$

Engles measurement	Calculated Result	Standard Range
$W = -1.10^\circ$	-0.040 cm.	$W < 0.08 \text{ cm (1/32 in.)}$
$Z = 1.10^\circ$	0.040 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: Pattana P.

Approved By: Vh

Date: 28 Feb 23

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Nozzle Validation

Samplig System Equipment Information

Console Model	XC-572-V
Console Number	A2001003
DGM Model	SK25EX
DGM Number	00005796

Validation Conditions

Digital Calipers	CD-15APX
Reference No	A22070181
Temperatute	24.8 °C±3
Barometric Pressure	758.2 mm Hg

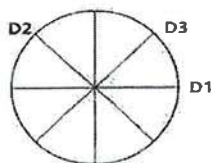
Validation Data					Results	
Nozzle ID	Nozzle Diameter				Different	(D ₁ + D ₂ + D ₃) / 3
Sizes		D ₁	D ₂	D ₃	ΔD	Davg
	mm	mm	mm	mm	mm	mm
NS-5	3.96	3.97	3.97	3.97	0.000	3.970
NS-7	5.30	5.00	4.97	4.96	0.021	4.977
NS-9	7.13	7.10	7.10	7.11	0.006	7.103
NS-11	8.71	8.47	8.47	8.53	0.035	8.490
NS-13	10.31	10.31	10.29	10.30	0.010	10.300
NS-15	11.88	11.80	11.79	11.79	0.006	11.793
NS-17	13.48	13.48	13.49	13.49	0.006	13.487

Where :

D₁, D₂, D₃ = There difference nozzle diameters , mm ; diameter must be within 0.025 mm

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

D avg = (D₁ + D₂ + D₃) / 3



Validation By:

Pattanyon P.

Approved By:

[Signature]

Date:

28 Feb 23



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Certificate of Calibration

Method 5 Pre-Test Console Pulse Calibration - Liters (L)

UUT Meter Console Information

Model #: XD-502-MV
Serial #: 1810007
DGM Model #: SK-25-EX
DGM Serial #: 20183536

Calibration Conditions

Bar, Pressure (mb): 1018
Ambient Temperature(°C): 24.9
Relative Humidity (%): 71%
Altitude (m): 1.8
Bar, Pressure Corr. (mm Hg): 763.4

Factors/Conversions

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

Reference Equipment

Calibration Meter Model: DGM-200H
Cal Date: 3 Jun 22
Serial #: 0000026
Gamma: 1.0000

UUT Meter (DGM)

Run Time (seconds)	Orifice, ΔH (mm H ₂ O)	Pulse Count			Meter Temperature (°C)			Meter Pressure (in H ₂ O)	Volume (L)			Outlet Temperature (°C)		
		Initial	Final	Total	Initial	Final	t _{mf}		Initial	Final	Total	Initial	Final	t _{mf}
Θ	P _{m(g)}	C _{init}	C _{final}	C _{total}	t _{mi}	t _{mf}	t _{mf}	P _w	V _{wi}	V _{wf}	V _w	t _{wi}	t _{wf}	t _{mf}
280.73	120.00	0	96510	96510	25.0	25.0	25.0	-14.0	0.0	178.1	178.1	25.0	25.0	25.0
340.88	80.00	0	96253	96253	25.0	25.0	25.0	-10.0	0.0	175.4	175.4	25.0	25.0	25.0
430.89	50.00	0	94831	94831	25.0	26.0	26.0	-7.0	0.0	171.6	171.6	25.0	25.0	25.0
600.99	25.00	0	89890	89890	26.0	26.0	26.0	-4.0	0.0	162.3	162.3	25.0	25.0	25.0
760.00	13.00	0	80487	80487	26.0	27.0	27.0	-2.0	0.0	144.6	144.6	25.0	25.0	25.0

Reference Meter

Standardized Data

Reference Meter			Test Meter		Volume Conversion		Correction Factor		Results	
Std. Volume	Std. Flow Rate	Totalizer	Scaling Fac.	Std. Vol.	Value	Variation	0.0212 SCMM	Variance		
V _{W,Std} (L)	Q _{W,Std} (L/min)	Counts _(std)	Y _{sc}	V _{m,Std} (L)	Y	ΔY	ΔH@	ΔΔH@		
169.847	36.301	96419	1.76E-03	171.3	0.9915	-0.0085	38.3	-2.896		
168.971	29.741	95796	1.76E-03	170.2	0.9928	-0.0072	38.6	-2.531		
166.614	23.200	93953	1.77E-03	166.9	0.9982	-0.0018	40.1	-1.066		
158.702	15.844	88696	1.79E-03	157.6	1.0071	0.0071	43.5	2.292		
142.142	11.222	79194	1.79E-03	140.7	1.0103	0.0103	45.4	4.201		
			1.78E-03	= Avg.	1.0000	= Y Avg.	41.18	ΔH@ Avg.		

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 0.0212m³/min at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.2 inches (5.1 mm) H₂O.

Pass/Fail Result: **Pass**

Console Input Value: **1.7766** Mean

Calibrate By:

Approved By:

Date: 17 Jan 23

The instruments listed and described on this certificate are the property of National Institute of Standards and Technology (NIST) and in reference to EPA Method 5, Section 10.3.1.



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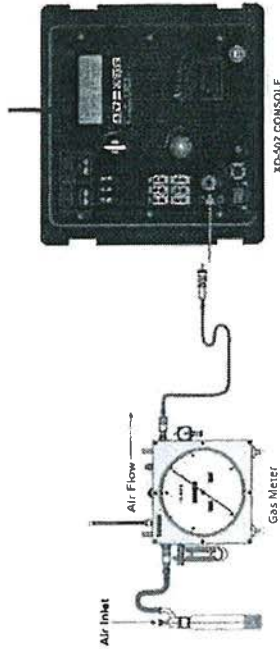
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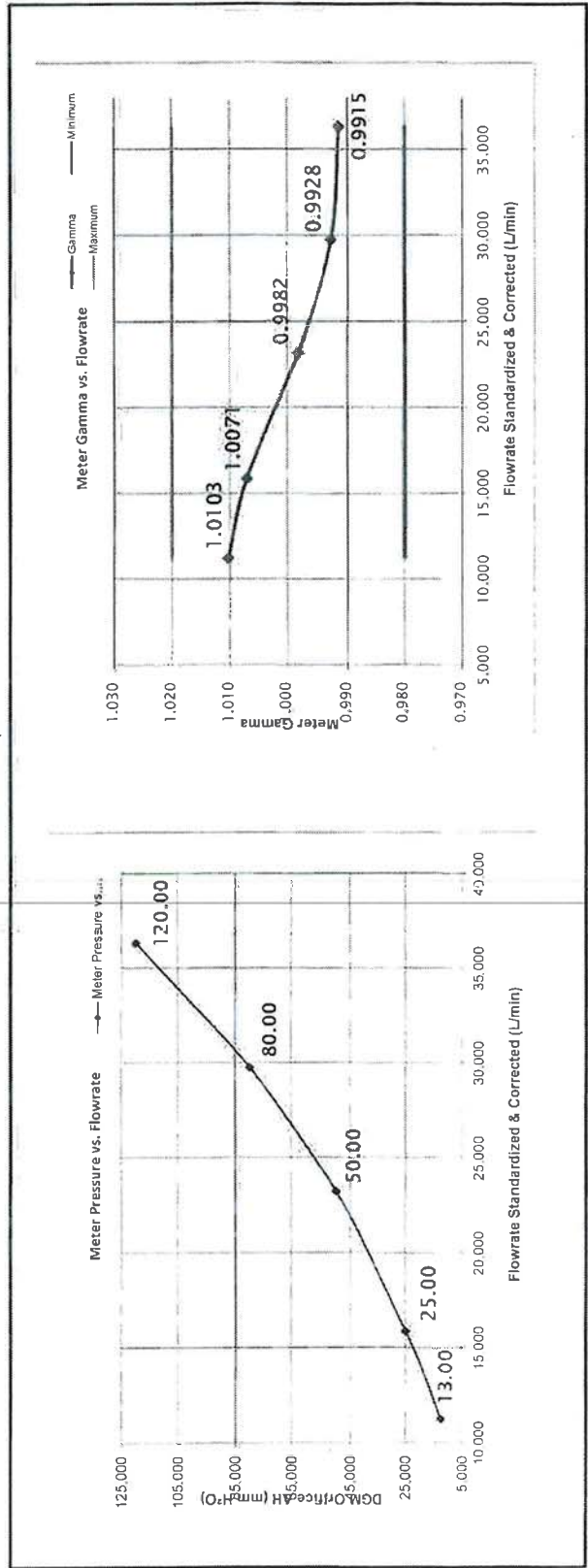
Certificate of Calibration - Supplemental

METHOD 5 PRE-TEST CONSOLE CALIBRATION

Nomenclature	Equations	Calibration Train
P_b - Barometric Pressure		
DGM - Dry Gas Meter		
K_1 - Constant based on standard temp and press		
θ - Run time, in minutes		
P_m - ΔH (Meter Pressure, gauge)		
V_m - Volume collected by test meter, corrected for STP	$V_{m(std)} = Y * K_1 * \frac{V_{m(sc)} * (P_{bar} + \frac{P_{m(std)}}{13.6})}{T_m}$	
$Q_{m(std)}$ - Calculated flow rate of test meter	$Q_{m(std)} = K_1 * \frac{\dot{V}_{m(std)}}{T_m}$	
K' - Critical orifice coefficient	$Q_{m(std)} = \frac{V_{m(std)}}{\theta}$	
P_w - Measured pressure of reference meter	$K' = \frac{V_{m(std)}}{P_{m(std)}}$	
t_w - Temperature measured in reference meter		
t_m - Temperature measured in test meter		
Y - Ratio of volume collected from test meter and orifice		
sc - Scaling Factor		
$Counts_{std}$ - Number of pulse counts, standardized	$Counts_{std} = \frac{P_{m(std)} * 0.001156 * (P_{bar} + \frac{P_{m(std)}}{13.6})}{T_m} * \left(\frac{T_w * \theta}{V_w * P_w} \right)^2$	
$Counts_{raw}$ - Number of raw pulse counts of a calibration run		



Calibration Graphs



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Certificate of Calibration

Method 5 Console Temperature Calibration - Metric Units

Console Information

Model #: XD-502-MV
Serial #: 1810007
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 763.50
Humidity (%): 71%
Tamb (°C): 24.9
Elevation (m): 1.8
Corr. Pbar (mm. Hg): 763.41

Reference Devices

TC Calibrator Model: CC-VTR-SH Reference #: 91109269
Pressure Calibrator Model: 718 30G Reference #: 9543013
Barometer Model: 736930 Reference #: EBARODIALSPE01

Temperature Sensors Calibration Data

Reference Point ¹	Reference Temp.	Test Thermocouple Calibrations						Reference Point Status ²
		Aux	Stack	Probe	Oven	Filter	Exit	
#	°C	°C	°C	°C	°C	°C	°C	Pass/Fail
1	-18	-18	-18	-18	-18	-18	-18	PASS
2	38	38	38	38	38	38	38	PASS
3	93	93	93	93	93	93	93	PASS
4	149	149	149	149	149	149	149	PASS
5	260	259	260	260	260	260	260	PASS
6	371	371	371	371	371	371	371	PASS
7	482	482	482	482	482	482	482	PASS
8	593	592	593	593	593	593	593	PASS
9	816	815	816	816	816	816	816	PASS
10	1038	1037	1038	1038	1038	1038	1038	PASS

TC Measure Overall Audit Status

PASS

NIST Reference Temperature Probe ID: 12702001

Ref Point	Theoretical Temp.	DGM Thermocouple Sensor Reading	ΔT_{theo}^4
#	°C	°C	°C
1	0.1	0	0.04%
2	24.9	25	0.02%

Maximum²

0.04%

Status

PASS

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

Vacuum Gauge Calibration Data

Console Vacuum Calibration			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status ³
#	mm. Hg	mm. Hg	Pass/Fail
1	50.1	50.0	PASS
2	100.0	101.0	PASS

Dual Inclined/Vertical Manometer

Reference Pressure	Pressure audit with Console System testing for Inclined Range of 0-26 and Vertical Range of 26-150mm H ₂ O			
	ΔH Loop (Backside)		Δp Loop (Frontside)	
mm H ₂ O	mm H ₂ O	Pass/Fail	mm H ₂ O	Pass/Fail
0.0	0.0	PASS	0.0	PASS
50.0	50.4	PASS	50.3	PASS
70.0	70.5	PASS	70.6	PASS
80.0	80.1	PASS	80.5	PASS
90.0	90.6	PASS	90.1	PASS
100.0	100.3	PASS	100.4	PASS
110.0	110.3	PASS	110.2	PASS
120.0	120.5	PASS	120.5	PASS
130.0	130.3	PASS	130.2	PASS
140.0	140.0	PASS	140.2	PASS
150.0	150.2	PASS	150.5	PASS

ΔH Overall Audit Status

PASS

Δp Overall Audit Status

PASS

Calibrate By:

Pattanasan P.

Approved By:

[Signature]

Date:

17 Jan 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 $\pm 1.5\%$ 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 the video, it is a standard based on input from the top of this sheet under "Calibration Conditions".

⁴ Absolute temperature difference and other formulas are calculated based on data input from 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 pressure 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.



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Console Sensor Audit QA Sheet

Meter Console Information (UUT)

Model #: XD-502-MV
Serial #: 1810007
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 763.50
Humidity (%): 71%
Amb. Temp. (°C): 24.9
Altitude (m): 1.8
Corrected Pbar (mm. Hg): 763.50

Reference Devices

TC Calibrator Model: CC-VTR-SH
TC Calibrator Reference #: 91109269
Barometer Model: 736930
Barometer Serial #: EBARODIALSPE01

Audit Data

Reference Point	Reference Temp.	Console Thermocouple Audit						Reference Point Status ¹
		Aux	Stack	Probe	Oven	Filter	Exit	
#	°C	°C	°C	°C	°C	°C	°C	Pass/Fail
1	100	100	100	100	100	100	100	PASS

Console Barometric Audit			
Reference Point	Reference Bar. Press.	Console Bar. Press.	Reference Point Status ²
#	mm. Hg	mm. Hg	Pass/Fail
1	763.50	763.20	PASS

Console Vacuum Audit			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status ³
#	mm. Hg	mm. Hg	Pass/Fail
1	110.00	114.00	PASS

Calibrate By: Pattanasan P. Approved By: [Signature] Date: 17 Jan 23

Notes

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

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)



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neediss Sampling Probe and Pitot Validation

Samplig System Equipment Information

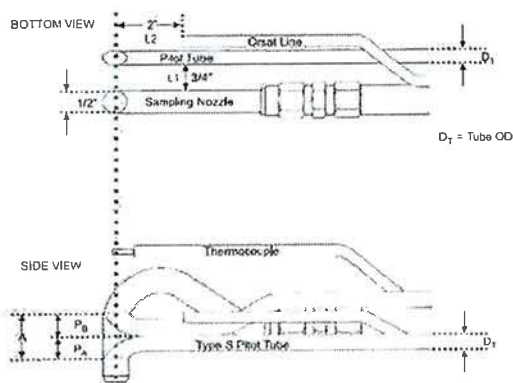
Probe Sheat:	Apex 1 in., 3 ft.
Probe Number:	1809992
Pitot tube Number:	A3601
Pitot tube Type:	S Type 3/8 Inc.
Validation method:	Standard Probe 1 in. and 1/2 in. Sampling Nozzle

Validation Conditions and Equipment

Digital Calipers:	ET123456
Reference No:	A22070181
Digital Inclinator:	BASELINE
Reference No:	12-1057
Temperature:	24.0 °C±3
Barometric Pressure:	763.6 mm Hg

Sampling Probe Validation with Tune up

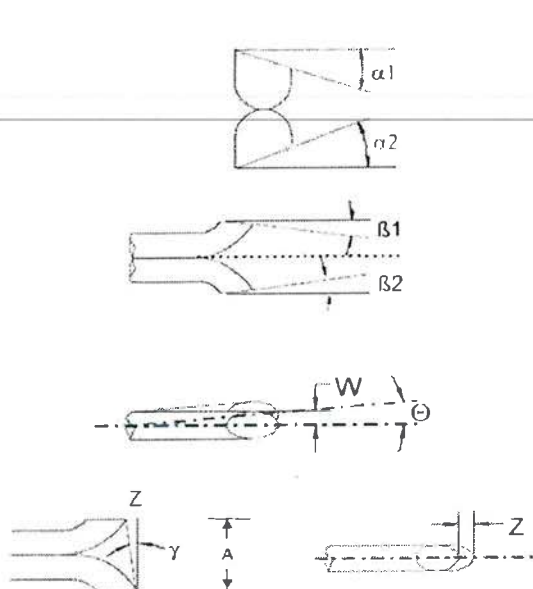
☒ Measure and Alinment with 1/2" Sampling Nozzle(12.7 mm)



Measured	Standard Range
$L_1 = 2.43 \text{ cm.}$	(1.905 cm. or 3/4 in.)
$L_2 = 4.60 \text{ cm.}$	(5.08 cm. or 2.0 in.)
$D_T = 0.955 \text{ cm.}$	(3/8 in.)
$A = 2.13 \text{ cm.}$	(2.1 $D_T \leq A \leq 3D_T$)
$A/2D_T = 1.117 \text{ cm.}$	(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
$\alpha_1 = 1.70^\circ$	$\leq 10^\circ$
$\beta_1 = -0.70^\circ$	$\leq 5^\circ$
P_A Size	
$\alpha_2 = -0.30^\circ$	$\leq 10^\circ$
$\beta_2 = 1.00^\circ$	$\leq 5^\circ$

Engles measurement	Calculated Result	Standard Range
$W = 1.10^\circ$	0.041 cm.	$W < 0.08 \text{ cm (1/32 in.)}$
$Z = -1.20^\circ$	-0.045 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: Pattanasaporn P. Approved By: PK Date: 17 Jan 23

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รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ

neediss Nozzle Validation

Samplig System Equipment Information

Console Model Number XD-502-MV
 Console Serial Number 1810007
 DGM Model Number SK-25-EX
 DGM Serial Number 20193964

Valibration Conditions

Digital Calipers CD-15APX
 Reference No A22070181
 Temperatute 25.0 °C±3
 Barometric Pressure 763.6 mm Hg

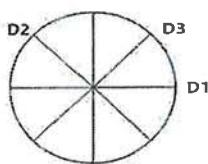
Calibration Data					Results	
Nozzle ID	Nozzle Diameter				Different	(D ₁ + D ₂ + D ₃) / 3
Sizes		D ₁	D ₂	D ₃	ΔD	Davg
	mm	mm	mm	mm	mm	mm
4	3.17	3.18	3.17	3.17	0.006	3.173
6	4.77	4.56	4.56	4.56	0.000	4.560
8	6.35	6.37	6.37	6.44	0.040	6.393
10	7.92	7.99	7.99	8.01	0.012	7.997
12	9.52	9.35	9.36	9.37	0.010	9.360
14	11.09	10.85	10.85	10.86	0.006	10.853
16	12.70	12.17	12.16	12.17	0.006	12.167

Where :

D₁, D₂, D₃ = There difference nozzle diamiters , mm ; diameter must be within 0.025 mm

Δ D = Maximum difference between any two diameters, must be ≤ 0,100 mm

D avg = (D₁ + D₂ + D₃) / 3



Validation By;

Pattanasem P.

Approved By;

[Signature]

Date:

17 Jan 23

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Envilab Co.,Ltd.

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



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:	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

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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Tel: 02-802-3780-2 Fax: 02-802-3788 E-mail: neediss@neediss.com



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 : Pattana P.

Approve By : [Signature]

Date: 30 Mar 23

Date: 30 Mar 23

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Verification Test Report

Page:1/2

Instruments Information

Analyzer Type:	Flue Gas Analyser	Manufacturer:	Dr.Fodisch
Model:	MGA11	S/N:	314198

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 25.7 °C

Humidity: 40 %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	101	0.5	0.5	101
Hight	200.9	200	-0.9	-0.4	200

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	102	2.3	2.3	101
Hight	197.2	203	5.8	2.9	203

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	102.0	2.2	2.2	102
Hight	197.2	203.0	5.8	2.9	203

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

Page:2/2

Instruments Information

Analyzer Type:	Flue Gas Analyser	Manufacturer:	Dr.Fodisch
Model:	MGA11	S/N:	314198

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 25.7 °C Humidity: 40 %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	643	48.5	8.2	643

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	2.4	0.2	9.1	2.4
Hight	10.22	10.3	0.1	0.8	10.3

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 : Pattampon P.Approve By : [Signature]

Date: 23 Feb 23

Date: 23 Feb 23

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Envilab Co.,Ltd.

CAL

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. : 66-200066-2

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 : Akaradath Thippichai

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 :

(Surachai Promthong)

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	-0.0001	0.00020
150	-0.0001	0.00038
200	-0.0002	0.00038

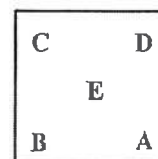
This result of calibration was found accurate as shown on date and place of calibration only.

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

- o0o -

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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 : Chortip Samchusri

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 :

(Bunjerd Masri)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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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 (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
25.01	25.0	0.0	0.46

Result of Calibration : Without Adjustment

Function : Humidity measurement

Reference Temperature @ 25 °C

Standard Humidity (%R.H.)	UUC Reading (%R.H.)	Correction (%R.H.)	Uncertainty (± %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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B

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

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Certificate of Calibration

Certificate No. : 66-200035-1

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

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

Equipment : Electronic Balance

Manufacturer : Sartorius

Model : SECURA224-1S

Serial No. : 0034803270

ID No. : ELABBALANCEN04

Capacity : 220 g

Resolution : 0.0001 g

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

Ambient Temperature : (23.4 to 23.7) °C

Relative Humidity : (61.4 to 62.8) %

Air Pressure : 1011.0 mbar

Date of Received : 02 February 2023

Date of Calibration : 02 February 2023

Date of Issue : 04 February 2023

Calibrated by : Akaradath Thippichai

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 :

(Surachai Promthong)

Laboratory Manager

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. : 66-200035-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty \pm (g)
0.01	0.0001	0.00011
0.1	0.0001	0.00011
1	0.0000	0.00011
2	0.0001	0.00011
5	0.0000	0.00012
10	0.0000	0.00011
20	0.0000	0.00013
50	0.0001	0.00014
100	0.0000	0.00020
200	-0.0001	0.00038

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

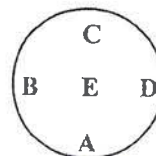
This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.11$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 50 g

A B C D E

-0.0001 0.0001 0.0000 -0.0001 0.0000 g



Repeatability

Load test : 200 g

Stdev. : 0.00000 g

- o0o -



SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6610008

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Instruments Information

Page: 1/2

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

Calibration System

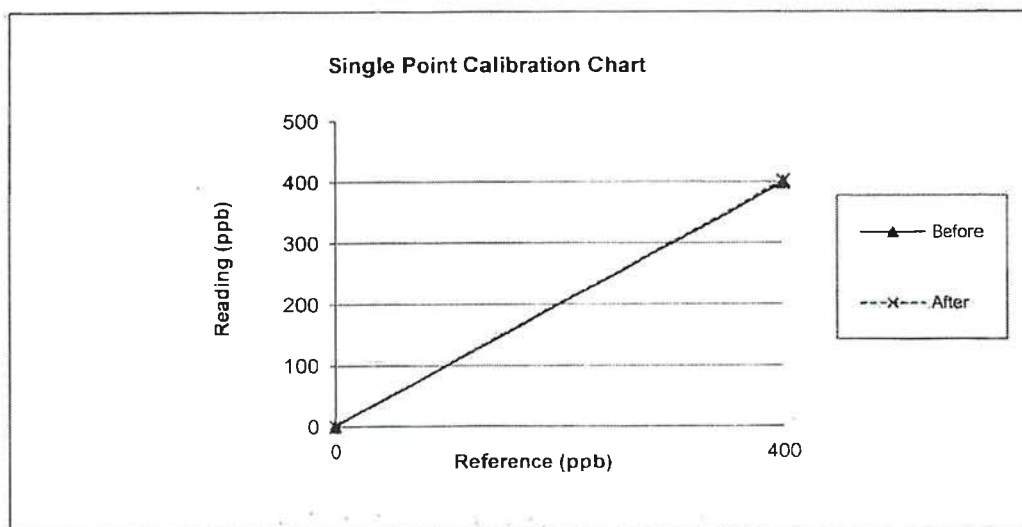
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31, 2026 EB0160267

Environment: Temperature 23.9 °C

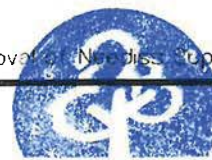
Humidity: 65 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.4	0.4	400.0	399.0	-0.1
After	0.0	0.1	0.1	400.0	402.0	0.2



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Neediss Supply Instrument Co., Ltd.536 ซอยบางแค 7 แขวงบางแค เขตบางแค กรุงเทพฯ 10160 536 Sai Bangkokae 7 Bangkokae Bangkokae Bangkok
Tel. 02-802-3980-2 Fax. 02-802-3988 E:info@neediss.com**SO2 Analyzer Verification Test Report**

Calibration Report No.: AP-S6610008

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Normal range	Unit	Before	After	Note
Date	1-Oct-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	
NGPS	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	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	0.4	0.1	
Span Gas (400 PPB)	400	ppb	399.0	402.0	± 5% of Range

Calibrate By :

Sirirat Poonlak

Date:

1-Oct-23

Approve By :

Sarawut Keawsrinal

Date:

1-Oct-23

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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.: AP-S6610006

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Instruments Information

Page:1/2

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

Calibration System

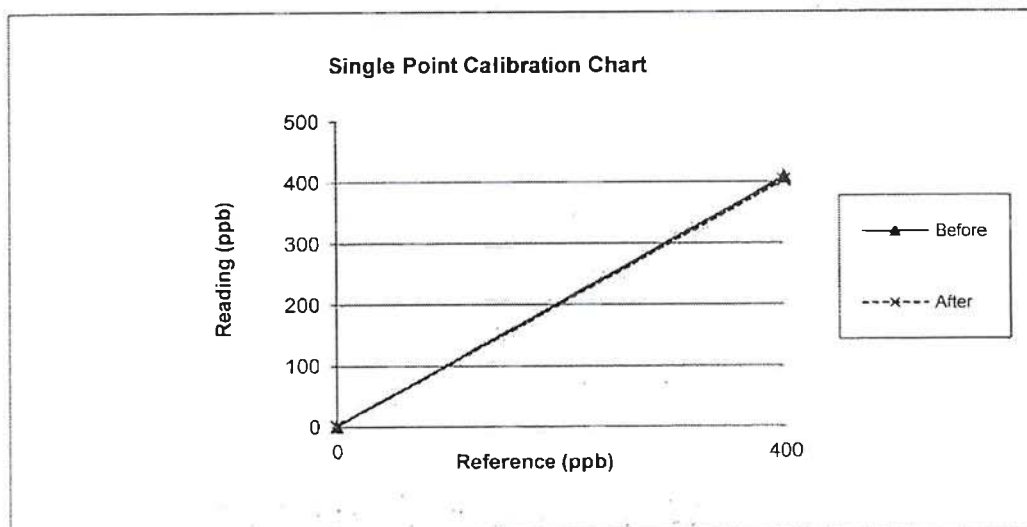
Calibrator Unit	Standard Gas
Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644	NOx Conc 45.50 PPM NO Conc 45.50 PPM SO2 Conc 45.59 PPM CO Conc 4500 PPM Expire Date: Mar 31,2026 EB0160267

Environment: Temperature 23.8 °C

Humidity: 67 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	0.7	0.7	400.0	408.0	1.0
After	0.0	0.4	0.4	400.0	403.0	0.4



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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.: AP-S6610006

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Now
Date	1-Oct-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	-	-	
RCCELL TEMP	50 (+/- 1)	Degree C	50	50	
BOX TEMP	20-40	Degree C	34.1	32.7	
PMT TEMP	7 (+/-1)	Degree C	8.0	8.0	
UV lamp	1000-4900	mV	4034.0	4034.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR. Light (Zero Gas)	<100	PPB	29	29	
Dark PMT	(-50) - (+200)	mV	44.7	44.7	
Dark lamp	(-50) - (+200)	mV	5.1	5.1	
SAMP PRES	20-30 contant	IN-Hg-A	28.1	27.8	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2004	2020	
SO2 Conc	1000 (+/- 250)	PPB	1002	1010	
SO2 Slope	1 (+/- 0.3)	-	0.920	0.866	
SO2 Offset	< 250	mV	65	130.1	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.6	0.2	
Final Test					
Zero Gas (0.00 PPB)	0	ppb	0.7	0.4	
Span Gas (400 PPB)	400	ppb	408.0	403.0	± 5% of Range

Calibrate By :

Sirirat Pooniak

Date:

1-Oct-23

Approve By :

Sarawat Keawsrinual

Date:

1-Oct-23

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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N66010010

Page:1/1

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: T200	Manufacturer API S/N: ENOAIT20000108
---	---

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 23.9 °C

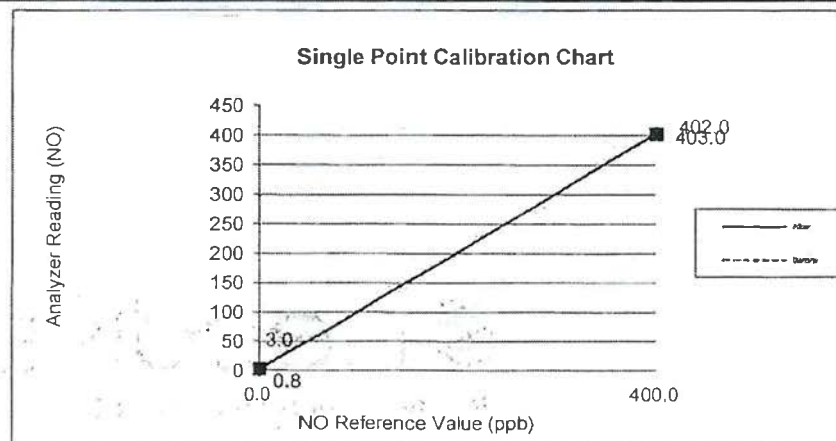
Humidity: 62 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.5	0.0	2.5	397.0	400.0	-0.4
NO ₂	0.5	0.0	0.5	5.0	0.0	0.6
NOx	3.0	0.0	3.0	402.0	400.0	0.2

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.4	0.0	0.4	400.0	400.0	0.0
NO ₂	0.4	0.0	0.4	3.0	0.0	0.4
NOx	0.8	0.0	0.8	403.0	400.0	0.4



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N66010010

Page:1/1

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Page:2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-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	
Span and Cal Values					
Zero Value	NO	0	ppb	2.5	0.4
	NOx	0	ppb	3.0	0.8
Span Value	NO	400	ppb	397.0	400.0
	NOx	400	ppb	402.0	403.0

Calibrate By :

Sirir Poonlak

Sirirat Poonlak

Date:

1-Oct-23

Approve By :

Sarawat Keawsrinal

Sarawat Keawsrinal

Date:

1-Oct-23



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



NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610007

Page: 1/1

Calibrated Date: 1-Oct-23

☒ PM ☐ Onsite

Instruments Information

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

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 23.6 °C

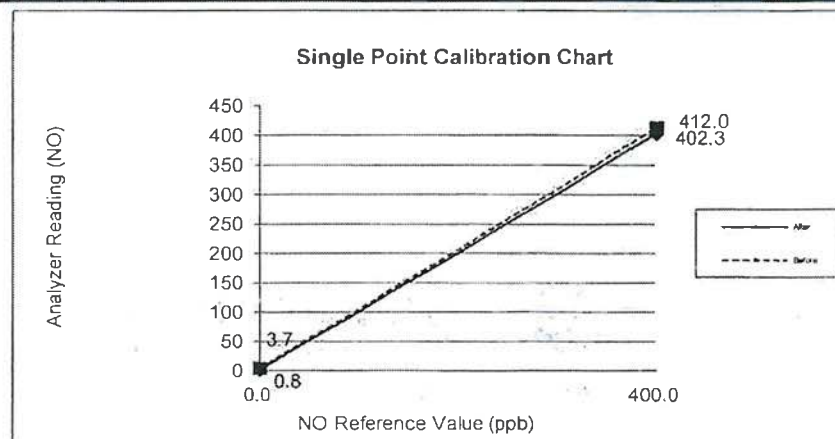
Humidity: 63 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.4	0.0	2.4	408.6	400.0	1.1
NO ₂	1.3	0.0	1.3	3.4	0.0	0.4
NOx	3.7	0.0	3.7	412.0	400.0	1.5

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.5	0.0	0.5	400.0	400.0	0.0
NO ₂	0.3	0.0	0.3	2.3	0.0	0.3
NOx	0.8	0.0	0.8	402.3	400.0	0.3



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6610007

Page: 1/1

Calibrated Date: 1-Oct-23

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Page: 2/2

Test Function Value	Nominal range	Unit	Before	After	Note
Date	1-Oct-23				
Time	13:30:00 AM				
Range	0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	500 +/- 50	cc/min	505	480	
Ozone Flow	60-90	cc/min	79	72	
PMT Detector	0-5000	mV	26.2	29.3	
AZERO	-20-150	mV	56.0	55.0	
HVPS	400-900 constant	V	755	755	
DCPS	2500 +/- 200	mV	-	-	
RCELL TEMP	50 +/- 1	Dreegee C	50	50	
BOX TEMP	20-35	Dreegee C	30.2	32.0	
PMT TEMP	7 +/- 1	Dreegee C	7.2	7.2	
IZS TEMP	50 +/- 4	Dreegee C	-	-	
MOLY Temp	315 +/- 5	Dreegee C	315.0	315.0	
RCEL PRES	4-10 contant	IN-Hg-A	4	5	
SAMP PRES	20-30 contant	IN-Hg-A	29	29	
NO Slope	1 +/- 0.3		0.890	1.118	
Nox Slope	1 +/- 0.3		0.911	1.046	
NO Offset	-10 to + 150	mV	12.9	2.2	
NOx Offset	-10 to + 150	mV	-2.4	9.1	
Span and Cal Values					
Zero Value	NO	0	ppb	2.4	0.5
	NOx	0	ppb	3.7	0.8
Span Value	NO	400	ppb	408.6	400.0
	NOx	400	ppb	412.0	402.3

Calibrate By :

Sirirat Poonlak

Sirirat Poonlak

Date:

1-Oct-23

Approve By :

Sarawat Keawsrinual

Sarawat Keawsrinual

Date:

1-Oct-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, SO2, BALN	Certification Date:	Feb 19, 2021

Expiration Date: Feb 19, 2024

Certification performed in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (May 2012)" document EPA 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
SIMFENS IJI TRAMAT 6 N1KD579	NDIR	Jan 27, 2021
Nicolet iS50 FTIR AUP2010245 NO	FTIR	Feb 11, 2021
Nicolet iS50 FTIR AUP2010245 NO2	FTIR	Jan 21, 2021
Nicolet iS50 FTIR AUP2010245 SO2	FTIR	Jan 21, 2021

Triad Data Available Upon Request

NOTES:

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



Michael A. Markus
Approved for Release



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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 : Uthen Kankawi

Approved by :

Malee

Approved Signatory

- (/) Malee Butkruea
() Saithip Meangmai
() Warakorn Lerngagtrakul

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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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

Malu



Envilab Co.,Ltd.

รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



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-

Malu.



รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ

ข้อเสนอแนะ/วิธีการควบคุมและการป้องกันเกี่ยวกับระดับเสียง

ปัจจัยที่ก่อให้เกิดปัญหาเสียงดังในบริเวณการทำงาน เกิดขึ้นได้จากหลายๆปัจจัย ได้แก่ ขนาดชนิด จำนวนของเครื่องจักร วัตถุดิบที่ใช้ในการผลิต ลักษณะของอาคารโครงสร้างของพื้น/ผนัง และเกิดจาก กระบวนการ หรือวิธีการทำงานของพนักงาน

เสียงดังที่เกิดจากปัจจัยด้านเครื่องจักร เช่น เครื่องปั่นด้าย เครื่องทอผ้า ปั่นลม และมอเตอร์ หรือ อุปกรณ์ที่เป็นส่วนประกอบของเครื่องจักร เช่น มู่เล่ย์สายพานเยื้องศูนย์ สายพานหย่อน จะทำให้เกิดเสียงดัง จากการเสียดสีระหว่างสายพานกับร่องสายพาน น็อตยึดส่วนประกอบของอุปกรณ์หรือโครงสร้างหลวม เมื่อเครื่องจักรทำงาน ทำให้เกิดการกระทบกันของโลหะ ก่อให้เกิดเสียงดัง และลูกปืนแตกชำรุดก็จะก่อให้เกิดเสียงดังขณะที่ตลับลูกปืนหมุน เป็นต้น

เสียงดังที่เกิดจากกระบวนการหรือวิธีการทำงานของพนักงาน เช่น การโยนชิ้นงานโลหะลงภาชนะ หรือที่กองเก็บ การเคาะ/ตอก เพื่อตัดหรือเคาะแต่งชิ้น โดยไม่มีมาตรการช่วยลดระดับเสียงที่เกิดจากการเคาะ หรือการนำแรงดันลมจากท่อหรือสายลม/ปืนลมมาเป่าตัวพนักงาน เป็นต้น

การควบคุมและป้องกันอันตรายจากเสียงดัง มีหลักการสำคัญ 3 ประการ คือ

- การควบคุมเสียงที่แหล่งกำเนิด ซึ่งควรพิจารณาเป็นลำดับแรก เช่น การออกแบบเครื่องจักร เครื่องมือให้ทำงานเงียบ การออกแบบจัดผังการทำงานเพื่อลดการสัมผัสเสียง การจัดที่ครอบปิดเครื่องจักรการติดตั้งในตำแหน่งให้มั่นคงและการใช้อุปกรณ์ป้องกันการสั่นสะเทือน หรือการติดตั้งวัสดุดูดซับเสียงที่แหล่งกำเนิด เช่น Silencers, Muffler, Vibration Isolators, Damper Treatments เป็นต้น

- การบำรุงรักษาอย่างเป็นระบบและสม่ำเสมอการควบคุมที่ทางผ่าน เป็นการควบคุมเพื่อต้องการลดระดับเสียงที่จะมาถึงหูของผู้ปฏิบัติงาน สามารถทำได้โดยการเพิ่มระยะทางระหว่างแหล่งกำเนิดและบริเวณที่มีผู้ปฏิบัติงานอยู่ การปิดกันห้องหรือทำฉากกำบังกันทางเดินเสียง การติดตั้งวัสดุดูดซับเสียงที่เพดานหรือฝ้าผนัง

- การควบคุมเสียงที่ผู้ที่ปฏิบัติงาน เป็นการควบคุมโดยผู้ปฏิบัติงานสัมผัสเสียงดังให้น้อยที่สุด โดยอาจหมุนเวียนคนทำงาน การจัดทำเป็นห้องควบคุม การทดสอบสมรรถภาพการได้ยิน การใช้ที่อุดหูหรือที่ครอบหู บางครั้งอาจต้องสวมใส่ทั้งที่อุดหูและที่ครอบพร้อมกัน



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 2 October, 2023

Certification No. 340/23

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger CM-1

Serial No. : 130129 ID No. : NWSDCMS1200129

Customer : Neediss Supply Instrument Co., Ltd.
536 Soi Bangkhae 7, Bangkhae, Bangkhae,
Bangkok 10160, Thailand.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.7 hPa

NATIONAL STANDARD WIND TUNNEL : Thermal Anemometer 642 S/N 91563

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

N.I.S.T. Test Reference Number 731/241460 : Standard Velocity at 20 - 30 m/sec

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

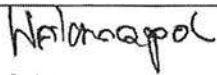
Serial Number 110730029 (sensor 120629586)

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

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

: Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015

Calibrated by : 

Mr. Watcharapol Subwat

Mechanical Engineer

Signed :

Mr. Pisoot Pomsut



รับรองสำเนาถูกต้อง

Envilab Co., Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

The Result of Calibration

Sensor model

NWSDCMS1200129

Certification No. 340/23

2 October, 2023

Serial No. 1198

Page : 2 of 6

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure inches H2O	Vacumm inches H2O	Velocity m/sec	Velocity m/sec	Correction m/sec
1.00	-	-	-	1.0	0.00
3.02	-	-	-	2.9	0.12
5.00	-	-	-	5.0	0.00
7.04	-	-	-	6.9	0.14
9.02	-	-	-	9.0	0.02
11.01	-	-	-	11.0	0.01
13.01	-	-	-	13.0	0.01
15.01	-	-	-	15.0	0.01
17.02	-	-	-	17.0	0.02
20.02	-	-	-	20.0	0.02

Wind Aloft Plotting Board.	
US.DEPARTMENT OF COMMERCE WEATHER BUREAU	
WIND DIRETION	TESTED WIND DIRECTION
0	0
90	91
180	180
270	272

Calibrated by :

Watcharapol

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau



รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

The Result of Calibration

Sensor Pressure Model TPH-1 C

Serial No. 6235

Certification No. 340/23

2 October, 2023

Page : 3 of 6

Standard Barometer	Tested Barometer	Correction
Pressure	Pressure	
1005.63	1005.30	0.33
1006.25	1005.90	0.35
1006.22	1005.90	0.32
1006.54	1006.20	0.34
1006.88	1006.50	0.38
1007.36	1007.00	0.36
1007.58	1007.20	0.38
1007.52	1007.20	0.32
1005.60	1005.30	0.30
1005.84	1005.50	0.34
1006.28	1005.90	0.38
1006.60	1006.30	0.30
1007.07	1006.70	0.37
1007.26	1006.90	0.36
1007.38	1007.00	0.38
1005.50	1005.20	0.30
1005.83	1005.50	0.33
1006.55	1006.20	0.35
1007.31	1007.00	0.31
1007.01	1006.70	0.31

Average

0.34

Calibrated by :

Watcharapol Subwat

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau



Envilab Co., Ltd.

รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804,0-2399-0469

The Result of Calibration

Sensor Temperature Model TPH-1 C

Certification No. 340/23

2 October, 2023

Serial No. 6235

Page : 4 of 6

Standard Temp. °C	Temperature Sensor Reading	
	Reading °C	Correction °C
45.2	45.2	0.0
31.1	31.1	0.0
15.8	15.9	-0.1

Calibrated by :

Watchapol

Mr. Watchapol Subwat

Mechanical Engineer

Calibration & Test Section
Meteorological Instruments Bureau



Envilab Co.,Ltd.

รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



THAI METEOROLOGICAL DEPARTMENT

4353 Sukhumvit, Bangna, Bangkok 10260 Tel. 081-454-2804, 0-2399-0469

The Result of Calibration

Sensor Humidity Model TPH-1 C

Certification No. 340/23

2 October, 2023

Serial No. 6235

Page : 5 of 6

Standard Humidity % R.H.	Relative Humidity Sensor Reading	
	Reading	Correction
	% R.H.	% R.H.
86.2	85.6	0.6
62.4	62.1	0.3
45.6	45.4	0.2

Calibrated by :

Wdcharapol

Mr. Watcharapol Subwat

Mechanical Engineer



Envilab Co., Ltd.

รับรองสำเนาถูกต้อง

ผู้จัดการฝ่ายควบคุมคุณภาพ



Date of Issue 2 October, 2023

Certification No. 340/23

Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ Davis Instruments แบบ TIPPING BUCKET Product No. 7342.026 Mfg. Code. NWSDCMS1200129 ทำการสอบเทียบกับแก้ววัดฝนแบบแก้วดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No. 71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm/TIP)



ลงชื่อ.....*วิธร ทรัพย์วัฒน์*.....

(นายวิธรพล ทรัพย์วัฒน์)

วิศวกรชำนาญการ



รับรองสำเนาถูกต้อง
ผู้อำนวยการฝ่ายควบคุมคุณภาพ



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 :

Ambient Environment

Description : Sound Level Calibrator

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

Manufacturer : Bruel & Kjaer

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

Model : 4230

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

Serial No. : 1351075

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

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

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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

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2 1121-30 ex. 112
Fax. (66) 0 2 1121-30 ex. 112
E-mail : mtc@tistr.or.th



รับรองสำเนาถูกต้อง
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 :


(Mr. Weerachai Deechaiyae)

Approved by :


(Mr. Prawate Kluaypa)
Director

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.

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

Certificate of Calibration

Certificate No. : 66-420026-1

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

540,540/1 Soi Bangkhae7, Bangkhae, Bangkok 10160

Equipment : pH Meter with electrode

pH meter

Manufacturer : Horiba

Model : F-74BW-G

Range : N/A pH

Resolution : 0.001 pH

Serial No. : B41J0001

ID No. : ELABPHHB74BW01

Electrode

Model : 9615S

Serial No. : 9X1K0003

Environment : On site calibration was carried out at the Laboratory, Envilab Co., Ltd.

Ambient Temperature : (23.8 to 24.8)° C

Relative Humidity : (54 to 57) %

Date of Received : 23 March 2023

Date of Calibration : 23 March 2023

Date of Issue : 24 March 2023

Calibrated by : Bunjerd Masri

Calibration Method : In-house method CAL-M4201 direct measurement by using standard voltage calibrator and using certified reference material (CRM)

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

1. Multiproduct Calibrator

ID No.	Cert. No.	Due Date	Traceability
400005	SG-E-00473/64	27 Aug 2023	National Institute of Metrology Thailand (NIMT)

2. Standard Buffer Solution

pH	Cert. No.	Lot No.	Exp. Date	Traceability
4.008	61270213	879344	13 Mar 2025	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025
6.986	61267169	879345	13 Mar 2024	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025
10.010	61260481	879346	13 Mar 2024	CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025

Approved by :

(Bunjerd Masri)

Supervisor

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 Calibratech Co.,Ltd.

Certificate of Calibration

Certificate No. : 66-420026-1

Page : 2 of 2

Result of Calibration :

UUC Condition As-Received : Good

Function : Electrical measurement

pH meter

Performing standard curve by Multiproduct Calibrator at pH (4,7,10)

Adjustment Curve at nominal pH	Applied Voltage (mV)	Nominal Value (pH)	UUC Reading		Correction (mV)	Uncertainty (± mV)
			(pH)	(mV)		
4, 7, 10	177.4800	4	4.00	177.5	0.0	0.12
	0.0000	7	7.00	0.0	0.0	0.086
	-177.4800	10	10.00	-177.6	0.1	0.12

Function : pH meter with electrode

Performing a three - buffer standard curve using buffer nominal pH (4,7,10)

Adjustment Curve at nominal pH	Standard Buffer (pH)	UUC Reading (pH)	Correction (pH)	Uncertainty (± pH)
4, 7, 10	4.008	4.006	0.002	0.0084
	6.986	7.000	-0.014	0.0094
	10.010	10.008	0.002	0.014

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 measurment 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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B



QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkhae, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com



CERTIFICATE No : 23T3852

REFERENCE No : 68967-3

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : REFRIGERATOR
MANUFACTURER : THERMO SCIENTIFIC
MODEL : PLR221
SERIAL No : 2210M319042801
ID No : ELABREFRIGEN02
CONDITION AS RECEIVED : USED ITEM
SUBMITTED BY : ENVILAB CO.,LTD.
540, 540/1 SOI BANGKHAE 7, BANGKHAE,
BANGKHAE, BANGKOK 10160

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 03-May-23

APPROVED BY : PONGSAK J.

ISSUED DATE : 04-May-23

RECEIVED DATE : 03-May-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
QUALITY CALIBRATION CO., LTD.



Envilab Co.,Ltd.

F-C

รับรองสถานภาพถูกต้อง

ผู้จัดการฝ่ายควบคุมคุณภาพ



CERTIFICATE No : 23T3852

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : REFRIGERATOR
MANUFACTURER : THERMO SCIENTIFIC
MODEL : PLR221
ID No : ELABREFRIGEN02 S/N : 2210M319042801
RECEIVED DATE : 03-May-23 CALIBRATION DATE : 03-May-23
AMBIENT TEMPERATURE : 31 °C ± 1 °C RELATIVE HUMIDITY : 57 %RH ± 10 %RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED ACCORDING TO TLAS G-20 BY COMPARISON WITH CALIBRATED THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON NINE POINTS AND LOCATED ONE THERMOCOUPLE IN EACH OF THE EIGHT CORNERS OF THE CHAMBER AND WAS AWAY FROM THE EACH WALL OF 5 cm TO 10 cm. AND PLACED THE NINTH THERMOCOUPLE WITHIN 2.5 cm. OF THE GEOMETRIC CENTER OF THE CHAMBER. THE UNIFORMITY WAS MEASURED BETWEEN REFERENCE PROBE AND OTHER PROBES AT THE SAME TIME.

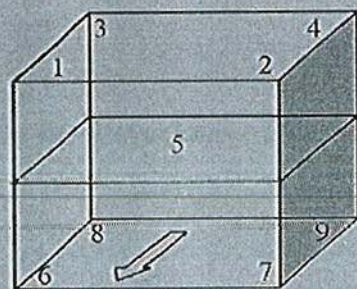
2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH TC TYPE K	HYDRA 2635A	8009008	22T7511	10-Jul-23

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT - NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT

FRONT

GENERAL INFORMATION

Overall Ambient Temperature around the Chamber (°C) variation : 2

Overall Line Voltage (V) variation : 0

Instrument Condition : Normal

CHAMBER PERFORMANCE

Controller Temperature (°C)	Indicating Temperature (°C)	Temperature Stability (±°C)	Temperature Uniformity (°C)	Overall Variation (°C)
4	4	1.59	2.96	5.39

TEMPERATURE MEASUREMENT ACCURACY TEST

Controller Temp (°C)	Indicating Temp (°C)	Measured Temperature (°C) at Spread Locations									Uncertainty (±°C)
		#1	#2	#3	#4	Ref. 5	#6	#7	#8	#9	
4	4	5.31	6.22	4.95	5.15	3.77	3.48	3.77	4.37	3.88	2.2

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 5 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



F-G010

Envilab Co.,Ltd.

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ผู้จัดการฝ่ายควบคุมคุณภาพ

Certificate of Calibration

Certificate No. : 66-400546-3

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

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

Equipment : Air Chamber (Oven)

Manufacturer : Binder

Model : ED 53

Range : N/A °C

Resolution : 0.1 °C

Serial No. : 13-02277

ID No. : ELABHAOVEN2277

Environment : On site calibration was carried out at the Laboratory, Envilab Co., Ltd.

Ambient Temperature : (30.5 to 32.0) °C

Relative Humidity : (50 to 55) %

Line Voltage : (224.0 to 226.0) V

Date of Received : 03 October 2023

Date of Calibration : 03 October 2023

Date of Issue : 06 October 2023

Calibrated by : Permpon Chanpu

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Digital Thermometer with Thermocouple probe

ID No.	Cert. No.	Due Date	Traceability
400029 & 400030	66-400227-1	24 Oct 2023	National Institute of Metrology Thailand (NIMT)

Approved by :



(Surachai Promthong)

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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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. : 66-400546-3

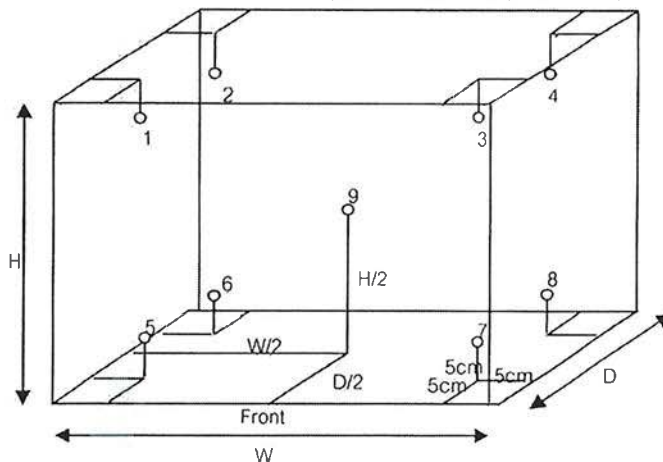
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.40 m

D = 0.33 m

H = 0.40 m

Capacity = 0.05 m³

Test Point (° C)	Setting Temperature (° C)	Indicating Temperature (° C)	Measured Temperature (° C) @ Sensor No.									Uncertainty (± ° C)
			1	2	3	4	5	6	7	8	9	
85.0	85.0	85.0	85.7	85.8	85.3	85.6	84.9	84.7	84.5	84.3	85.0	0.73
104.0	104.0	104.0	104.7	105.1	104.3	104.6	104.4	104.2	104.1	103.7	104.6	0.74
180.0	183.0	183.0	180.8	181.6	180.7	181.6	179.9	181.2	179.2	179.7	179.7	1.1

Test Point (° C)	Setting Temperature (° C)	Indicating Temperature (° C)	Measured Uniformity (° C)	Measured Stability (° C)	Overall Variation (° C)
85.0	85.0	85.0	1.1	0.2	1.9
104.0	104.0	104.0	1.1	0.2	1.8
180.0	183.0	183.0	2.2	0.4	2.9

Remark The uncertainty is not combine uniformity of the air chamber

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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Certificate of Calibration

Certificate No. : 66-400156-2

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

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

Equipment : Air Chamber (Oven)

Manufacturer : Memmert

Model : UF 75

Range : N/A °C

Resolution : 0.1 °C

Serial No. : B319.0600

ID No. : ELABHAOVEN0600

Environment : On site calibration was carried out at the Laboratory, Envilab Co., Ltd.

Ambient Temperature : (30.0 to 30.8) °C

Relative Humidity : (60 to 65) %

Line Voltage : (224.2 to 225.2) V

Date of Received : 23 March 2023

Date of Calibration : 23 March 2023

Date of Issue : 25 March 2023

Calibrated by : Penpon Chanpu

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Digital Thermometer with Thermocouple probe

ID No.	Cert. No.	Due Date	Traceability
400029 & 400030	65-400548-1	26 Apr 2023	National Institute of Metrology Thailand (NIMT)

Approved by :

(Bunjerd Masri)

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. :66-400156-2

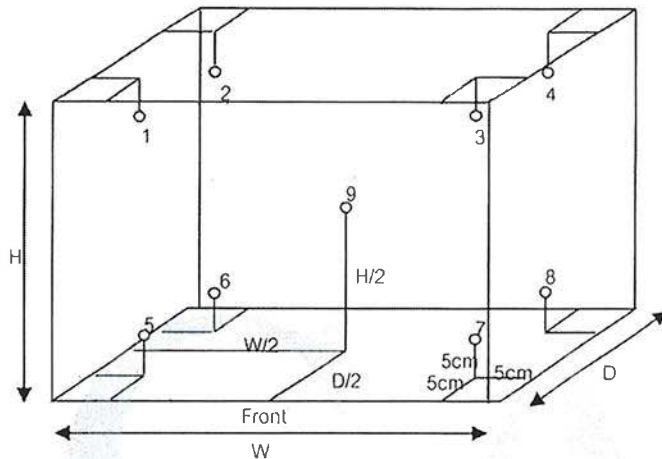
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.40 m

D = 0.33 m

H = 0.56 m

Capacity = 0.07 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
104.0	103.5	103.5	104.3	104.3	104.3	104.2	104.3	104.1	103.7	104.0	104.3	0.70
110.0	109.5	109.5	110.3	110.3	110.3	110.3	110.3	110.1	109.7	110.0	110.3	0.71
180.0	179.0	179.0	179.4	180.1	180.3	180.1	180.6	179.9	179.2	179.6	180.4	0.95

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
104.0	103.5	103.5	0.7	0.1	0.8
110.0	109.5	109.5	0.8	0.1	1.0
180.0	179.0	179.0	1.4	0.2	1.5

Remark The uncertainty is not combine uniformity of the air chamber

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%

- o0o -

B

Certificate of Calibration

Certificate No. : 66-400056-1

Page : 1 of 2

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

Equipment : Water Bath
Manufacturer : Memmert Model : WNB29
Range : N/A °C Resolution : 0.1 °C
Serial No. : L617.0156 ID No. : ELABWBWNB29N01

Environment : On site calibration was carried out at the Laboratory, Envilab Co., Ltd.

Ambient Temperature : (22.5 to 23.0) °C

Relative Humidity : (45 to 50) %

Line Voltage : (224.0 to 225.0) V

Date of Received : 02 February 2023

Date of Calibration : 02 February 2023

Date of Issue : 04 February 2023

Calibrated by : Permpon Chanpu

Calibration Method : This instrument was calibrated by In-house method CAL-M4006 based on ASTM E715-80

The temperature scale used was based on ITS-90

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

Standard Digital Thermometer with RTD probe

ID No.	Cert. No.	Due Date	Traceability
400029 & 400031	65-400549-1	22 Apr 2023	National Institute of Metrology Thailand (NIMT)

Approved by :



(Bunjerd Masri)

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

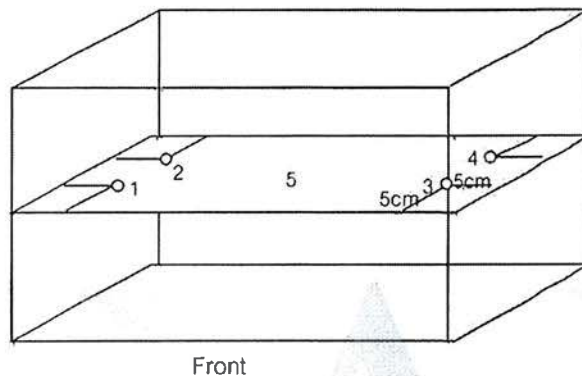
Certificate No. : 66-400056-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement



Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor					Uncertainty (± °C)	Measured Uniformity (°C)	Measured Stability (°C)
			No.							
			1	2	3	4	5			
95.0	95.0	95.0	95.41	95.41	95.68	95.62	95.57	0.22	0.33	0.10

Remark The uncertainty is not combine uniformity of the water bath

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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Certificate of Calibration

Certificate No. : 66-400546-1

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

540, 540/1 Soi Bangkhac, Bangkok 10160

Equipment : Air Chamber (Incubator)

Manufacturer : M-LAB

Model : BIC-140

Range : N/A °C

Resolution : 0.1 °C

Serial No. : 100613-1

ID No. : ELABBODC140N01

Environment : On site calibration was carried out at the Laboratory, Envilab Co., Ltd.

Ambient Temperature : (25.0 to 26.0) °C

Relative Humidity : (50 to 55) %

Line Voltage : (224.0 to 225.0) V

Date of Received : 03 October 2023

Date of Calibration : 03 October 2023

Date of Issue : 06 October 2023

Calibrated by : Permpon Chanpu

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Digital Thermometer with RTD Probe

<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>	<u>Traceability</u>
400029 & 400048	66-400454-1	05 Feb 2024	National Institute of Metrology Thailand (NIMT)

Approved by :

(Surachai Promthong)

Laboratory Manager

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. : 66-400546-1

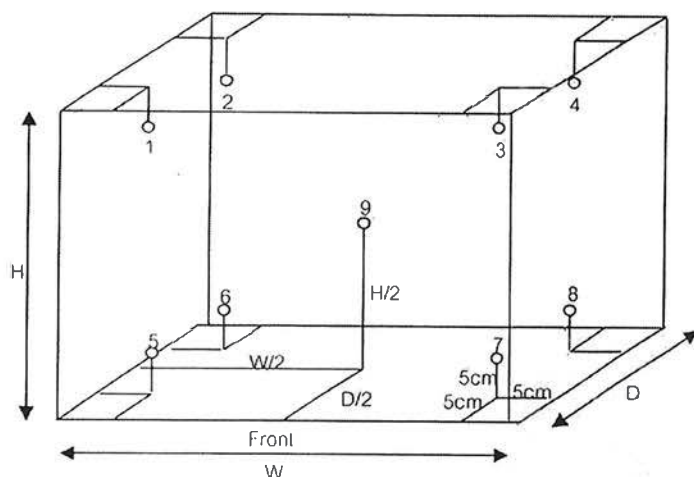
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.38 m

D = 0.35 m

H = 1.15 m

Capacity = 0.15 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
20.0	20.0	20.0	20.18	19.98	20.08	19.97	20.39	20.36	20.20	20.18	20.28	0.30

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
20.0	20.0	20.0	0.35	0.03	0.47

Remark The uncertainty is not combine uniformity of the air chamber

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%

- o0o -

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NSG-TISI-TIS17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 66-400101-1

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

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

Equipment : Air Chamber (Incubator)

Manufacturer : Memmert

Model : IF 110

Range : N/A °C

Resolution : 0.1 °C

Serial No. : D419.0525

ID No. : ELABINCUBATOR1

Environment : On site calibration was carried out at the Laboratory, Envilab Co., Ltd.

Ambient Temperature : (24.0 to 24.6) °C

Relative Humidity : (55 to 60) %

Line Voltage : (224.5 to 226.0) V

Date of Received : 21 February 2023

Date of Calibration : 21 February 2023

Date of Issue : 21 February 2023

Calibrated by : Bunjerd Masri

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS 90

Reference Standard Instruments : This certification is traceable to the International System of Units
Standard Digital Thermometer with RTD Probe

ID No.

Cert. No.

Due Date

Traceability

400046 & 400042

66-400066-1

02 Aug 2023

National Institute of Metrology Thailand (NIMT)

Approved by :

(Bunjerd Masri)

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. :66-400101-1

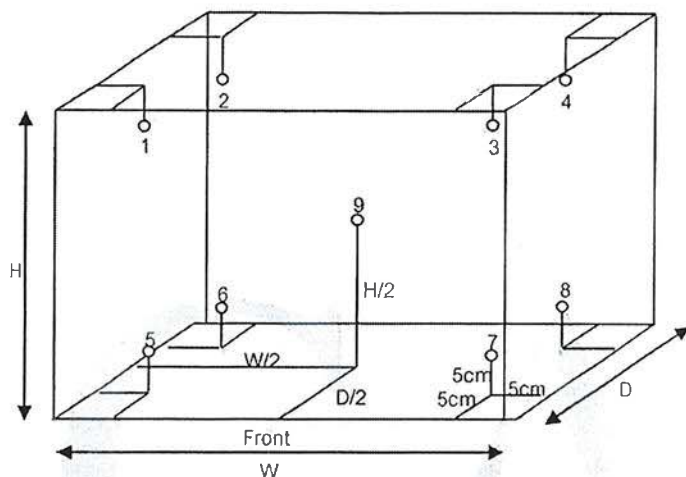
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

This instrument was setting air ventilation at position 0 (close)



Inside of Chamber

W = 0.56 m

D = 0.48 m

H = 0.40 m

Capacity = 0.11 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
35.0	35.0	35.0	35.01	35.09	35.15	35.13	35.16	35.11	34.98	35.03	35.12	0.30
37.0	37.0	37.0	37.04	37.11	37.17	37.16	37.18	37.14	36.99	37.04	37.14	0.30

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
35.0	35.0	35.0	0.16	0.02	0.2
37.0	37.0	37.0	0.18	0.03	0.2

Remark The uncertainty is not combine uniformity of the air chamber

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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QUALITY CALIBRATION CO.,LTD.

235 Petchkasem 63/2 Road, Laksong, Bangkac, Bangkok 10160

Tel (662) 421-5402, (662) 444-0152-3, Fax (662) 809-4584

www.qcalibration.com

CERTIFICATE No : 23T3851

REFERENCE No : 68967-2

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : COD TESTER
MANUFACTURER : HANNA
MODEL : HI839800
SERIAL No : 6480043101
ID No : ELABH183980002
SUBMITTED BY : ENVILAB CO.,LTD.
540, 540/1 SOI BANGKHAE 7, BANGKHAE,
BANGKHAE, BANGKOK 10160

CALIBRATED BY : CHAICHARN CH.

CALIBRATION DATE : 30-Aug-23

APPROVED BY : PRASERT D.

ISSUED DATE : 30-Aug-23

RECEIVED DATE : 24-Aug-23

THIS CERTIFICATE MAY NOT BE REPRODUCED OTHER THAN IN FULL EXCEPT WITH THE PRIOR WRITTEN APPROVAL OF
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F-G010

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CERTIFICATE No : 23T3851

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : COD TESTER
MANUFACTURER : HANNA
ID NUMBER : ELABH183980002
RECEIVED DATE : 24-Aug-23
AMBIENT TEMPERATURE : 31°C ± 1°C
MODEL : H1839800
SERIAL NUMBER : 6480043101
CALIBRATION DATE : 30-Aug-23
RELATIVE HUMIDITY : 55% RH ± 10% RH

CONDITION OF THIS RESULTS OF CALIBRATION

1. THIS INSTRUMENT WAS CALIBRATED BY DIRECT MEASUREMENT METHOD WITH CALIBRATED THERMOCOUPLE TYPE K UNDER NO LOAD CONDITION. THE THERMOCOUPLES WERE PLACED ON POINTS AND LOCATED AS THE PICTURE.

2. REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No	CERTIFICATE No	DUE DATE
1) DATA LOGGER WITH TC TYPE K	HYDRA 2635A	7903007	23T6639	10-Jul-24

3. THIS RESULT WAS FOUND ACCURATE AS SHOWN ON DATE AND PLACE OF CALIBRATION ONLY.

4. THIS RESULT EXCLUDE LONG TERM STABILITY OF THE UNIT UNDER CALIBRATION.

5. THIS CERTIFICATE IS TRACEABLE TO THE INTERNATIONAL SYSTEM OF UNIT MAINTAINED AT:-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH QUALITY CALIBRATION CO.,LTD.

RESULT OF CALIBRATION :- WITHOUT ADJUSTMENT



TEMPERATURE MEASUREMENT ACCURACY TEST

Controller temperature (°C)		150.0
Indicating Temperature		150.0
Measured Temperature (°C) at Spread Locations	1	150.2
	2	150.4
	3	150.3
	4	150.3
	5	150.3
	6	150.5
	7	150.3
	8	150.5
	9	150.4
	10	150.4
	11	150.5
	12	150.4
	13	150.4
	14	150.3
	15	150.4
	16	150.4
	17	150.5
	18	150.5
	19	150.4
	20	150.5
	21	150.3
	22	150.4
	23	150.5
	24	150.4
	25	150.3
Uncertainty of Measurement(± °C)		1.2

NOTE 1 : THE UNCERTAINTY OF MEASUREMENT EXCLUDED TEMPERATURE UNIFORMITY OF THE CHAMBER.

NOTE 2 : LOCATION 10 WAS REFERENCE LOCATION.

NOTE 3 : THIS CALIBRATION WAS CARRIED OUT AT THE CUSTOMER'S PLACE AT LABORATORY AREA.

THE REPORTED UNCERTAINTY OF MEASUREMENT WAS BASED ON A STANDARD UNCERTAINTY MULTIPLIED BY A COVERAGE FACTOR k =2, PROVIDING A LEVEL OF CONFIDENCE APPROXIMATELY 95%.

END OF CALIBRATION REPORT



G010

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EnviLab Co., Ltd.

ผู้จัดการฝ่ายควบคุมคุณภาพ



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 FAX. 0-2719-9484

Cert.No.: 23TW79

Page.: 1 of 2

Certificate of Testing

Equipment :	DO Meter
Manufacturer :	Hanna
Model :	HI9146-04
Serial No. :	G00007931
ID No. :	ELABDOHI914601
Received Date :	17 March 2023
Test Date :	20 March 2023
Reference :	2303-0651DN-1
Submitted by :	Envilab Co.,Ltd (Head office) 540, 540/1 Soi Bangkhao 7, Bangkhao, Bangkhao, Bangkok 10160
Laboratory Condition :	Temperature (25 ± 5) °C Humidity (50 ± 20) %
Test Procedure :	In - house method : CP-CH9 by Comparison Technique with Azide Modification Method
Tested by :	Walalak Sirithean
Approved by :	 Approved Signatory
<input checked="" type="checkbox"/> Malee Butkruea	
<input type="checkbox"/> Saithip Meangmai	
<input type="checkbox"/> Warakorn Lernagtrakul	
Issue Date :	23 March 2023



B 03

รับรองสำเนาถูกต้อง

Envilab Co.,Ltd.

ผู้จัดการฝ่ายควบคุมคุณภาพ



Cert.No.: 23TW79

Page.: 2 of 2

Condition of this result of calibration

1. Reference Standard Instruments :

This certification is traceable to the International System of Unit through the reference standards laboratory of Industrial Calibration Center, Technology Promotion Association (Thailand-Japan).

<u>Instruments</u>	<u>Serial No.</u>	<u>ID No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
1) Burette	-	130BU10	21CG1389	25 Mar 2023
2) Balance	1126143764	140RC004	22MM50	20 Sep 2023

2. Standard Material :-

<u>Material</u>	<u>Manufacturer</u>	<u>Lot.No.</u>	<u>Assay</u>
Sodium Thiosulfate pentahydrate	Merck	AM1763316	100.2%

Result : Dissolved Oxygen Meter Adjustment With Air 100 %

Dissolved Oxygen Probe No.: KC1A01TAF

Titration Method (Azide Modification Method)	DO Meter Reading	Standard Deviation
(mg/L)	(mg/L)	(mg/L)
8.14	8.16	0.0084

This report was certified only for the instrument we tested. It is allowable to use for study the system efficiency, The environmental impact control and present to organization it may concerned. Intend to use for advertising and referral purpose is prohibited. This report may not be reproduced other in full, without written approval of the laboratory

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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. : 66-300140-5

Page : 1 of 2

Submitted by : Envilab Co.,Ltd.

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

Equipment : Cylinder

Manufacturer : PYREX

Class : A

Capacity : 500 ml Graduation : 5 ml

ID No. : C-WW-006/21

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

Relative Humidity : (50 ± 15) %

Air Pressure : 1009.9 mbar.

Date of Received : 15 March 2023

Date of Calibration : 20 March 2023

Date of Issue : 20 March 2023

Calibrated by : Areerat Sombun

Calibration Method : In-house method CAL-M3001 based on ASTM E 542-01

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

Electronic Balance

ID No.	Cert. No.	Due Date	Traceability
241002	65-200370-1	02 Jun 2023	National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Wipa Tovadee)

Supervisor

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. : 66-300140-5

Page : 2 of 2

Result of Calibration : This result of true Volume is referred to standard temperature at 20 °C

UUC Condition As-Received : Good

Nominal Volume (ml)	Measuring Volume (ml)
250	250.53
500	499.90

Uncertainty of measurement with in \pm 0.12 ml

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 $k = 2.00$,
providing a level of confidence of approximately 95%

- o0o -

D.

CAL

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NSC-TISI-TIS 17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 66-300140-3

Page : 1 of 2

Submitted by : Envilab Co.,Ltd.

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

Equipment : Cylinder

Manufacturer : PYREX

Class : A

Capacity : 100 ml

Graduation : 1 ml

ID No. : C-WW-002/22

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

Relative Humidity : (50 ± 15) %

Air Pressure : 1009.9 mbar.

Date of Received : 15 March 2023

Date of Calibration : 20 March 2023

Date of Issue : 20 March 2023

Calibrated by : Areerat Sombun

Calibration Method : In-house method CAL-M3001 based on ASTM E 542-01

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

Electronic Balance

<u>ID No.</u>	<u>Cert. No.</u>	<u>Due Date</u>	<u>Traceability</u>
241002	65-200370-1	02 Jun 2023	National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Wipa Tovadee)

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. : 66-300140-3

Page : 2 of 2

Result of Calibration : This result of true Volume is referred to standard temperature at 20 °C

UUC Condition As-Received : Good

Nominal Volume (ml)	Measuring Volume (ml)
50	49.82
100	99.84

Uncertainty of measurement with in \pm 0.063 ml

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 $k = 2.00$,
providing a level of confidence of approximately 95%

- o0o -

D.





AIRFLOW CALIBRATION CO.,LTD.

CERTIFICATION OF TEST REPORT

Equipment : Biological Safety Cabinet (Class II)
Manufacturer : Heal Force
Model : Hfsafe 1200LC
Serial Number : EX042012LC5497
Identification Number : ELABMICROBSC01
Report Number : B223337
Issued Date : 9 March 2023
Job Number : B223337
Page : 1 of 7 Pages

Customer : ENVILAB CO.,LTD. (HEAD OFFICE)
540, 540/1 Soi Bangkhac 7, Bangkhac, Bangkhac, Bang 10160

Environment Condition : Temperature: 24.9 °C \pm 0.8 °C
Humidity: 51.9 %RH \pm 0.6 %RH
Voltage: 221.5 VAC \pm 0.3 VAC

Test Place : ENVILAB CO.,LTD. (HEAD OFFICE) Laboratory Floor 3

Test By : Mr.Achira Kaewpaitoon

Test Date : 1 March 2023

Due Date : 1 March 2024

Test Procedure : EN 12469: 2000 Biotechnology performance criteria for microbiological safety cabinet
AS 1807.23: 2000 Determination of intensity of radiation from germicidal ultraviolet lamp

Traceability : Velocity test is traceable to TAT Certificate Number :TTH-0-59155
Leak test of HEPA filter is traceable to NIST Certificate Number :ST673/0922
Illumination test is traceable to TIC Certificate Number :E-2302026
Ultraviolet Radiation test is traceable to EEI Certificate Number :CO20220115EA
Sound test is traceable to SP Certificate Number :SPR22030177-1

This calibration certificate documents the traceability to national standards, which realize the unit of measurement according to the International System of Units (SI).

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Mr. Watcharin Tavara

Authorized Signatory

AIR FM - SV - 08 : 01 Sep 2021

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Tel : 0 2152 8350 , 0 2152 8348 , 0 2152 8070 , 08 4360 2558 , 09 2265 3175 Fax : 0 2152 8348

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Primary Test Results

1. Downflow Velocity Test

Test equipment used

- Thermo anemometer ● Brand: Testo ● Model: 425
- Serial number: 3101751 ● Calibration due: 31-Oct-2023

Instruction: Work opening in normal positions. With the anemometer inside the MSC, make air velocity measurements in horizontal plane 50 mm to 100 mm above the top edge of the front aperture. Make measurements over a period of at least 1 min in each position. Measure in 2 rows along a line 1/4 of the depth of the working space forward of the rear wall and along a line the same distance behind the

Downflow Velocity Unit: m/s

Back

0.36	0.35	0.36	0.37
0.37	0.37	0.36	0.37

Front

Characteristic of downflow velocities

Specification	Mean	Maximum	Minimum	±20 % of Mean
• Mean downflow velocity to achieve product protection : 0.25 m/s - 0.50 m/s. All measurements should be within ±20 % of mean values.	0.37	0.37	0.35	0.29 - 0.44

Result Summary : Pass



AIRFLOW CALIBRATION CO.,LTD.

Continuation of the Certificate of Test Report Number : B223337

Page 3 of 7 Pages

2. Inflow Velocity Test

Test equipment used

- Thermo anemometer
- Brand: Testo
- Model: 425
- Serial number: 3101751
- Calibration due: 31-Oct-2023

Exhaust Measurement

Instruction: The alternative procedure to determine inflow velocity uses a thermoanemometer in a constricted window access opening of 3 inches (76mm) with the armrest removed. Inflow air velocity is measured in the center of the constricted opening 1-1/2 inches (38mm) blow the top of the work access opening on the following specified grid. Use the correction factor table to calculate the inflow velocity.

Inflow Velocity Unit: m/s

1.39	1.35	1.37	1.38	1.37	1.39	1.38	1.39	1.35	1.38	1.38
------	------	------	------	------	------	------	------	------	------	------

Characteristic of air velocities in the work opening

Specification	Mean inflow (m/s)
• Mean Inflow velocity to achieve product protection : ≥ 0.40 m/s.	0.53

Result Summary : Pass

Adjustments Required

Fan speed



No Change

Damper



No Change

51/104 M80/9, Ladsawai, Lamlukka Phatunthani 12150 Thailand

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http://www.airflowcalibration.com E-mail : hm.airflow@gmail.com , nop.airflow@gmail.com

AIR FM - SV - 08 : 01 Sep 2021



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Continuation of the Certificate of Test Report Number : B223337

Page 4 of 7 Pages

3. Leak Test of HEPA Filters

Test equipment used

- Aerosol Photometer ● Brand: ATI ● Model: 2H
- Serial number: 20627 ● Calibration due: 23-Sep-2023

Test equipment used:

- Aerosol Generator ● Brand: ATI ● Model: 6C
- Serial number: 20554 ● Calibration date: -

Instruction: The aerosol through the "Challenge" valve to the backside of HEPA filter and maximum local penetration: 0.01 % of upstream concentration. (PAO test substitute for DOP test)

Characteristic of PAO test

Concentration on the upstream side of main HEPA filter	22	µg/l
Downstream aerosol and the ratio of concentration in percentage of main HEPA filter	0.001	%
Downstream aerosol and the ratio of concentration in percentage of exhaust HEPA filter	0.001	%

Main HEPA Filter

Leak position

☐ : 10 cm. x 10 cm. X : Media leak position G : Gasket leak position M : Maximum leak position





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Continuation of the Certificate of Test Report Number : B223337

Page 5 of 7 Pages

Exhaust HEPA Filter

Leak position

☐ : 10 cm x 10 cm X : Media leak position G : Gasket leak position M : Maximum leak position

Result Summary : Pass

4. Airflow Patterns

Test equipment used

Smoke Generator

Instruction : The purpose of the test is to verify that no smoke escapes from the working space to the room, and that smoke will be drawn into the working space from the room.

Pass the smoke in an easy movement along the front opening outside the cabinet. The smoke must be drawn into the cabinet without visible turbulence.

Test the laminarity of the downflow and along the side and back wall. No smoke must come out in the room and only small Turbulence must be observed.

Result Summary :

Downflow Pattern Test

Pass

View Screen Retention Test

Pass

Work Opening Edge Retention Test

Pass

Sash/Window Seal Test

Pass

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Continuation of the Certificate of Test Report Number : B223337

Page 6 of 7 Pages

5. Site Installation

5.1 Sash Alarm	Pass
5.2 Interlocks	N/A
5.3 Exhaust System Alarm	Pass

6. Soap Solution

Instruction: Comprising 25g/l soft soap in tepid distilled water prepared in grease free vessel.

Result Summary : Absence of soap bubbles.

Pass

Secondary Test Results

7. Illumination Test

Instruction: Take readings at approximately 300 mm centres across the full front width of the work floor surface, starting approximately 150 mm in from each side.

Test equipment used

- Lux meter
- Brand: Digicon
- Model: LX-73
- Serial number: T.034913
- Calibration due: 9-Feb-2024

Illumination Unit: Lux

Back

1050	1214	1225	1025
797	910	867	847

Front

Lighting should be adequate for safe working within the cabinet. Illumination measured at the work surface should be at least 750 lux.

Result Summary : Pass

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AIR FM - SV - 08 : 01 Sep 2021



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Continuation of the Certificate of Test Report Number : B223337

Page 7 of 7 Pages

8. Ultraviolet Radiation Test

Instruction: Take readings at approximately 300 mm centres across the full front width of the work floor surface, starting approximately 150 mm in from each side.

Test equipment used

- UVC Light Meter
- Brand: SPER SCIENTIFIC
- Model: 850010
- Serial number: 0908314302
- Calibration due: 1-Sep-2023

Ultraviolet Radiation Unit: mW/m^2

Back

2020	2420	2720	1970
1990	2680	2230	2130

Front

Ultraviolet radiation where UV lamps are fitted, the intensity of radiation at a wave length of 254 nm shall be not less than 400 mW/m^2 when measured at the work floor surface.

Result Summary : Pass

9. Sound levels Test

Instruction: Sound levels in a cabinet should be low enough not to distract a worker. When tested in accordance with EN ISO 3744 using a sound level meter situated 1.0 m from the centre of the front aperture of the cabinet, or 1.0 m from any part of the installation within the laboratory, the A-weighted sound pressure level generated by the cabinet should not exceed 65 dB when the A-weighted sound pressure level of the background is less than 55 dB. If the background noise exceeds 55 dB then the corrected cabinet A-weighted sound pressure level should not exceed 65 dB.

Test equipment used

- Sound Meter
- Brand: Daiichi
- Model: SL332
- Serial number: 130108517
- Calibration due: 14-Mar-2023

* Sound pressure level of the background: 49.6 dBA

* Sound levels: 60.4 dBA

Result Summary : Pass

End of Certificate of Test Report

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AIR FM - SV - 08 : 01 Sep 2021



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Certificate of Calibration

Certificate No. : 66-400056-2

Page : 1 of 2

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

Equipment : Autoclave
Manufacturer : Tomy **Model :** SX-500
Range : N/A °C **Resolution** 1 °C
Serial No. : 55133094 **ID No. :** N/A

Environment : On site calibration was carried out at the Laboratory,
Ambient Temperature : (26.0 to 28.0) °C
Relative Humidity : (50 to 55) %
Line Voltage : (224.0 to 225.0) V

Date of Received : 02 February 2023

Date of Calibration : 02 February 2023

Date of Issue : 04 February 2023

Calibrated by : Permpon Chanpu

Calibration Method : This instrument was calibrated by In-house method CAL-M4007 based on
BS 2646 Part5 : 1993

The temperature scale used was based on ITS-90

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

Standard Temperature Data Logger with RTD pt 100

ID No.	Cert. No.	Due Date	Traceability
400039	66-400026-1	19 Jul 2023	National Institute of Metrology Thailand (NIMT)
400040	66-400026-2	19 Jul 2023	National Institute of Metrology Thailand (NIMT)
400041	66-400026-3	19 Jul 2023	National Institute of Metrology Thailand (NIMT)

Approved by :

(Bunjerd Marsi)

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

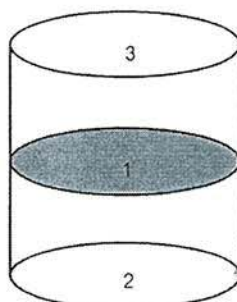
Certificate No. 66-400056-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement



Front

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.			Uncertainty (± °C)	Measured Uniformity (°C)	Measured Stability (°C)	Sterilizing Time (minute)	Pressure Gauge Reading (MPa)
			1	2	3					
121	121	121	121.8	121.4	121.3	0.82	1.0	0.3	15	0.11

Remark

1. UUC : Unit Under Calibration
2. Pressure Gauge reading are out of accreditation's scope.

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%

- o0o -

CAL

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NSC-TISI-TIS 17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 66-300030-2

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

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

Equipment : Piston Pipette

Manufacturer : sartorius

Model : N/A

Serial No. : 4538900217

ID No. : N/A

Capacity : 100 µl to 1000 µl

Resolution: 5 µl

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

Relative Humidity : (50 ± 15) %

Air Pressure : (1013.7 to 1013.9) mbar.

Date of Received : 18 January 2023

Date of Calibration : 24 January 2023

Date of Issue : 24 January 2023

Calibrated by : Wipa Tovadee

Calibration Method : In-house method CAL-M3002 base on ISO 8655-6 : 2002-09-15

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

Electronic Balance

ID No.	Cert. No.	Due Date	Traceability
241003	65-200370-2	02 Jun 2023	National Institute of Metrology (Thailand) (NIMT)

Approved by :

(Wipa Tovadee)

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. : 66-300030-2

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Test Volume (μ l)	Measuring Volume at 20 °C (μ l)	Systematic error (e_s %)	Coefl. of Variation (CV %)	Uncertainty ($\pm \mu$ l)
100	99.92	0.01	0.05	0.69
500	500.09	0.01	0.02	0.69
1000	1000.17	0.02	0.01	0.69

e_s : Systematic error (%)

CV : Coefficient of variation (%)

UUC Calibrated by : White Tip

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 $k = 2.00$,

providing a level of confidence of approximately 95%

- o0o -

D.

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.



รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ

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" checkboxes 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 8015 A		M417490002
2. G 8410 A		AU11393768
3. G 8491-80002		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 Dismountable Fully Dismountable Other
Injector Diameter	2.4mm 1.8mm 1.4mm 0.8mm 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. N/A
- ☒ 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.
- ☒ 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 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



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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*
At 214 nm SRBP	1577.1	3582.6	2548.2	6124.3
Min 257 nm SRBR	9943.3	16143.3	10764.1	39073.2
At 396 nm SRP	7.0	16.3	4.3	25.7
K 766 nm SBR	0.2	67.3	4.7	73.6

* 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	VAC
Mains Current	0.082	A	0.098	A
Instrument Temperature	23.5	°C	23.1	°C
RF Air Flow (sensor speed)	13.0	Hz	19.0	Hz
Plasma Exhaust Temperature	No measurement		36.4	°C
Water Flow Oscillator	No measurement		1.31	L/min
Water Flow Detector	1.04	L/min	1.06	L/min
Water Inlet Temperature	16.9	°C	16.7	°C
Polychromator Temperature	35.0	°C	35.0	°C
CCD Temperature	-39.6	°C	-39.4	°C
Thermal Stabilizer	53.0	°C	35.0	°C
Argon Supply Pressure	619.13	kPa	350.32	kPa
Purge Gas Supply Pressure*1	616.63	kPa	597.43	kPa
Option Gas Supply Pressure*1	-	kPa	-	kPa
Nebulizer Flow	No measurement		0.70	L/min
Nebulizer Back Pressure	No measurement		243.17	kPa
Plasma Gas Flow	No measurement		11.98	L/min
Auxiliary Gas Flow	No measurement		1.00	L/min
RF Power	No measurement		1193.1	W
RF Supply Current	No measurement		8.190	A
RF Supply Voltage	No measurement		194.557	V

*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
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:

Kanyakorn S.

Service Engineer Signature:

Kanyakorn S.

Total number of pages in this document:

14

Date Service Completed:

31 May 2023

Customer Name:

เจริญ

Customer Signature:

เจริญ

Report Summary

Instrument Model

Instrument ID

Instrument Serial Number

Software Version

Firmware Version

Tested By

Test Started On

Test Completed On

Agilent 5100/5110 VDV ICP-OES

G8011A/G8015A

MY17490002

7.4.0.10280

3562

Kanyakorn S.

5/31/2023 12:22:01 PM

5/31/2023 12:26:21 PM

Result Summary

Subsystem Communications Test

Air Flow Test

Water Flow Test

Gas Flows Test

RF Generator Test

Camera Test

Optics Test

Advanced Valve System Test

Resolution Test

Sensitivity Test

Precision Test

Pass

Skipped

Skipped

Skipped

Skipped

Skipped

Pass

Skipped

Pass

Pass

Pass

Subsystem Communications Test

Pass

Optics Test

Radial

Intensity

Wavelength

Axial

2923418

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	23661.0	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		
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
0.70	0.71	280.77	2.00	2.00
				93.84
Makeup Target Flow	Actual Flow	Back Pressure	Plasma Target Flow	Actual Flow
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	



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



Envilab & Evltest Supply Instruments

Verification Test Report

Report No.:

SO2300167-E001 -PU 01

Calibrated Date: 21-Oct-23

Equipment: Air Sampling Pump

Manufacturer: SKC

Model: 224 PC-3

Serial or ID No. 16765

Environment: Temperature 26 °C Humidity 60 %RH

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

Serial No. 164578

Date of Calibration : 4 May 2023

Result of Test			
Reference Flow (ml/min)	Test No.	Reading (ml/min)	Average (ml/min)
2000	1	1999.4	2000.2
	2	2000.3	
	3	2000.8	
	4	1999.6	
	5	2000.7	

Calibrated By:

Date:

Approve By:

Date:

21-Oct-23

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



Envilab & Evltest Supply Instruments

Verification Test Report

Report No.:

SO2300167-E001 -PU 02

Calibrated Date: 21-Oct-23

Equipment: Air Sampling Pump

Manufacturer: SKC

Model: 224 PC-3

Serial or ID No. 16766

Environment: Temperature 26 °C Humidity 60 %RH

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

Serial No. 164578

Date of Calibration : 4 May 2023

Result of Test

Reference Flow (ml/min)	Test No.	Reading (ml/min)	Average (ml/min)
1700	1	1699.7	1700.5
	2	1700.7	
	3	1700.8	
	4	1700.9	
	5	1700.3	

Calibrated By:

Date:

Approve By:

Date:

21-Oct-23

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Envilab & Evltesting Supply Instruments

Verification Test Report

Report No.:

SO2300167-E001 -PU 03

Calibrated Date: 21-Oct-23

Equipment: Air Sampling Pump

Manufacturer: SKC

Model: 224 PC-3

Serial or ID No. 16769

Environment: Temperature 26 °C Humidity 60 %RH

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

Serial No. 164578

Date of Calibration : 4 May 2023

Result of Test

Reference Flow (ml/min)	Test No.	Reading (ml/min)	Average (ml/min)
2000	1	2000.9	2000.4
	2	2000.5	
	3	2000.6	
	4	1999.7	
	5	2000.3	

Calibrated By:

Date:

Approve By:

Date:

21-Oct-23

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



Envilab & Associated Supply Instrument

Verification Test Report

Report No.:

SO2300167-E001 -SLM 01

☒ PM ☐ Onsite UTM : 47P 1514458 N 654247 E

Calibrated Date: 21/10/2023

Site : บริษัท เอ็นไวแล็บ จำกัด

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1811

Environment: Temperature 26 °C Humidity 60 %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:

Approve By:

Date:

21/10/2023

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Envilab Co., Ltd. 540,540/1 Soi Bangkhoe 7 Bangkhoe 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.:

SO2300167-E001 -SLM 02

☒ PM ☐ Onsite UTM : 47P 1514458 N 654247 E

Calibrated Date: 21/10/2023

Site : บริษัท เอ็นไวแล็บ จำกัด

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1821

Environment: Temperature 26 °C Humidity 60 %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	93.70	-0.08	93.78

Calibrated By:

Date:

Approve By:

Date:

21/10/2023

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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



Verification Test Report

Report No.:

SO2300167-E001 -SLM 03

☒ PM ☐ Onsite UTM : 47P 1514458 N 654247 E

Calibrated Date: 21/10/2023

Site : บริษัท เอ็นไวแล็บ จำกัด

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1812

Environment: Temperature 26 °C Humidity 60 %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	93.30	-0.24	93.78

Calibrated By:

(Panumas Songkaew)

Date:

21/10/2023

Approve By:

(Wisan Ritthikamon)

Date:

21/10/2023

This report shall not be reproduced except in full, without the written approval of Envilab Co., Ltd.





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 : Mr. Jirasak Pumbut

Approved by :

Calibration Officer

(Mr. Prayoon Topart)

Authorized Signatory



5 rev.0

Envilab Co., Ltd.

รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



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

Certificate Number : SPR23040182-7

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 : PN1811
ID. Number : N/A

Environmental Conditions

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

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

Location of Calibration : In-Lab

Calibration Procedure : SP-CPE-04-01

Received Date : 19 Apr 2023

Calibration Date : 20 Apr 2023

Recommend Due Date : 20 Apr 2024

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 : Mr. Prayoon Topart

Calibration Officer

Approved by :

(Mr. Nirut Loha)

Authorized Signatory



04-15 rev.0



รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



Calibration Report

Page : 2 of 3

Certificate Number : SPR23040182-7

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

Page : 3 of 3

Certificate No. : SPR23040182-7

Range : 20 to 140 dB

Function : @1kHz

Unit : dB

Select A	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

Unit : dB

Select C	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

Unit : dB

Select Z	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 -



รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ

-FM-04-15 REV.1



Certificate of Calibration

Certificate Number : SPR23040182-8

Page : 1 of 3

Customer : Envilab Co., Ltd.,

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

Equipment Name : Sound Level Meter

Manufacturer : Pulsar

Model : 44

Serial Number : PN1812

ID. Number : N/A

Environmental Conditions

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

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

Location of Calibration : In-Lab

Calibration Procedure : SP-CPE-04-01

Received Date : 19 Apr 2023

Calibration Date : 20 Apr 2023

Recommend Due Date : 20 Apr 2024

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 : Mr. Prayoon Topart

Calibration Officer

Approved by :

(Mr. Nirut Loha)

Authorized Signatory



Envilab Co., Ltd.

รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ

-15 rev.0



Calibration Report

Certificate Number : SPR23040182-8

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. : SPR23040182-8

Page : 3 of 3

Range : 20 to 140 dB

Function : @1kHz

Unit : dB

Select A 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

Unit : dB

Select C 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

Unit : dB

Select Z 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.

รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ

1-04-15 REV.0

CERTIFICATE OF CALIBRATION

ISSUED BY **Pulsar Instruments Plc**

DATE OF ISSUE **29 June 2023**

CERTIFICATE NUMBER **194449**



Pulsar Instruments Plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2

Approved signatory

T. Goodrich

Electronically signed:

T. A. Goodrich

Sound Level Meter : IEC 61672-3:2013

Instrument information

Manufacturer: **Pulsar Instruments Plc**

Notes:

Model: **Model 44**

Serial number: **PN1821**

Class: **2**

Firmware version: **2.6.0.328**

Test summary

Date of calibration: **29 June 2023**

The calibration was performed respecting the requirements of ISO/IEC 17025:2017.

Periodic tests were performed in accordance with procedures from IEC 61672-3:2013.

The sound level meter submitted for testing successfully completed the class 2 periodic tests of IEC 61672-3:2013, for the environmental conditions under which the tests were performed.

However, no general statement or conclusion can be made about conformance of the sound level meter to the full specifications of IEC 61672-1:2013 because (a) evidence was not publicly available, from an independent testing organisation responsible for pattern approvals, to determine that the model of sound level meter fully conformed to the class 2 specifications in IEC 61672-1:2013 or correction data for acoustical test of frequency weighting were not provided in the Instruction Manual and (b) because the periodic tests of IEC 61672-3:2013 cover only a limited subset of the specifications in IEC 61672-1:2013.

Notes

This certificate provides traceability of measurement to the SI system of units and/or to units of measurement realised at the National Physical Laboratory or other recognised national metrology institutes. This certificate may not be reproduced other than in full, except with the prior written approval of the issuing laboratory. The results within this certificate relate only to the items calibrated. The reported expanded uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a coverage probability of approximately 95%.



Envilab Co., Ltd.

รับรองสำเนาถูกต้อง

ผู้จัดการฝ่ายควบคุมคุณภาพ

CERTIFICATE OF CALIBRATION

ISSUED BY Pulsar Instruments Plc

DATE OF ISSUE 28 June 2023 CERTIFICATE NUMBER 194448



Pulsar Instruments Plc
Acoustic House
Bridlington Road
Hunmanby
North Yorkshire
YO14 0PH
United Kingdom

Page 1 of 2

Test engineer:

D. Swalwell

Electronically signed:

A handwritten signature in black ink, appearing to be 'D. Swalwell', written over a horizontal line.

Microphone

Microphone capsule

Manufacturer: Pulsar Instruments

Model: PM2

Serial Number: 022540E

Calibration procedure

Date of calibration: 28 June 2023

Open circuit: 50.3 mV/Pa

Sensitivity at 1 kHz: -26.0 dB rel 1 V/Pa

The microphone capsule detailed above has been calibrated to the published data as described in the operating manual of the associated sound level meter (where applicable).

The frequency response was measured using an electrostatic actuator in accordance with BS EN 61094-6:2005 with the free-field response derived via standard correction data traceable to a National Measurement Institute.

The absolute sensitivity at 1 kHz was measured using an acoustic calibrator conforming to IEC 60942:2003 Class 1.

Environmental conditions

Pressure: 100.70 kPa

Temperature: 21.0 °C

Humidity: 69.0 %



รับรองสาเหตุดังกล่าว

ผู้จัดการฝ่ายควบคุมคุณภาพ



Service Report

Instrument Manufacturer: Pulsar Instruments Plc

Job Reference Number: 84203

Instrument Type: Model 44

Serial Number: PN1821

Customer Name: Neediss Supply Instrument Co., Ltd.

Customer Address: 536, Soi Bangkhae 7

Bangkhae

Thailand

10160

Issue	Action	Result	Engineer
Recal & repair LCD problem and microphone failure. Keypad top right key failure, incorrect pre amp s/n programmed 1768. Actually fitted s/n 1899.	Reprogrammed correct pre amp s/n. New PM2 microphone s/n 022540E fitted. Replaced "blotchy" display. Replaced the keypad.	Recal ok tag	Terry Goodrich

Engineer:

T. A. Goodrich

Date: 29 June 2023

We hope that you are satisfied with the service you have received from Pulsar Instruments plc.
If you have any concerns, would like further information or have any feedback do not hesitate to contact us.

Pulsar Instrument Plc, Acoustic House, Bridlington Road, Hunmanby, YO14 0PH

Telephone: +44 (0) 1723 518011 Fax: +44 (0) 1723 518043

Email: sales@pulsarinstruments.com



Envilab Co., Ltd.

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 : Akaradath Thippichai

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 :

(Surachai Promthong)

Laboratory Manager

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 Calibratech Co., Ltd.

CAL-F0031-03



รับรองสำเนาถูกต้อง

Envilab Co.,Ltd.

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

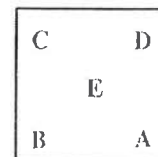
This result of calibration was found accurate as shown on date and place of calibration only.

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

- ๐0๐ -

CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhaprachasan 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. : 66-410024-1

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 : Chortip Samchusri

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 :

(Bunjerd Masri)

Supervisor

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 Calibratech Co., Ltd.

CAL-F0031-03



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ผู้จัดการฝ่ายควบคุมคุณภาพ

CAL

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 : 2 of 2

UUC Condition As-Received : Good

Result of Calibration : Without Adjustment

Function : Temperature measurement

Reference Humidity @ 50 %R.H.

Standard Temperature (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
25.01	25.0	0.0	0.46

Result of Calibration : Without Adjustment

Function : Humidity measurement

Reference Temperature @ 25 °C

Standard Humidity (%R.H.)	UUC Reading (%R.H.)	Correction (%R.H.)	Uncertainty (± %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%

- 0(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 :

Ambient Environment

Description : Sound Level Calibrator

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

Manufacturer : Bruel & Kjaer

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

Model : 4230

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

Serial No. : 1351075

Standards used : 1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.

2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.

3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.

4. Digital Multimeter Agilent 34401A S/N MY44005560.

5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.

6. Audio Analyzer Keithley 2015-P S/N 4106495.

7. Condenser Microphone Bruel&Kjaer 4180 S/N 2889871.

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

Repeating 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

Head Office

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Website: www.tistr.or.th

Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,

Amphoe Muang, Changwat Samutprakan 10280, Thailand

Tel. (66) 0 2323 1672-80 ext. 115, 116

Fax. (66) 0 2323 9165

E mail : mtc@tistr.or.th

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,

Thailand

Tel. (66) 0 2577 0000 : 30 ext. 5

Fax. (66) 0 2577 0000

E mail : mtc@tistr.or.th



รับรองสำเนาถูกต้อง

Envilab Co.,Ltd.

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 :

(Mr. Weerachai Deechaiyae)

Approved by :

(Mr. Prawate Kluaypa)
Director

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.

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

Head Office
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Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
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รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



Request No. 22-66 / 0323

MTC No. PSL-H 0147 / 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 : MCE030018
Manufacturer : METROSONICS
Date of Request : 9 February 2023
Date of Calibration : 22 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 :

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchai Singhapiwat)

Director

Photometry and Temperature Standards Laboratory

Ref. No : 2012266020900611002

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 0147 / 66

Description of Unit Under Calibration :

Customer : Envilab Co.,Ltd.
Address : 540, 540/1 Soi Bangkhac7, Bangkhac, Bangkok, 10160
Item : Thermo-Hygrometer (Area Heat Stress Monitor)
Serial Number : MCE030018
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

Request No. 22-66 / 0323

MTC No. PSL-H 0147 / 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)
20.1	20.2	-0.1	0.50
30.0	29.7	0.3	0.50
40.0	39.5	0.5	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)
20.1	20.2	-0.1	0.50
30.0	29.8	0.2	0.50
40.0	39.6	0.4	0.50

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Request No. 22-66 / 0323

MTC No. PSL-H 0147 / 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	20.5	-0.5	0.50
30.0	29.3	0.7	0.50
40.0	39.3	0.7	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...

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Envilab Co.,Ltd.

รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



Request No. 22-66 / 0323

MTC No. PSL-H 0146 / 66

Certificate of Calibration

Customer : Envilab Co.,Ltd.
540, 540/1 Soi Bangkhæ7, Bangkhæ, Bangkok, 10160
Item : Thermo-Hygrometer (Area Heat Stress Monitor)
Model /Type : hs-32
Serial Number : MCE030016
Manufacturer : METROSONICS
Date of Request : 9 February 2023
Date of Calibration : 22 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 :

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchar Singhapiwat)

Director

Photometry and Temperature Standards Laboratory

Ref. No : 2012266020900611001

Issued Date : 8 March 2023

Page 1 of 4

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รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



Request No. 22-66 / 0323

MTC No. PSL-H 0146 / 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 : MCE030016
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

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

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รับรองสถานะผู้ทดสอบ
ผู้จัดการฝ่ายควบคุมคุณภาพ



Request No. 22-66 / 0323

MTC No. PSL-H 0146 / 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)
20.1	22.8	-2.7	0.50
30.0	32.0	-2.0	0.50
40.0	41.3	-1.3	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)
20.1	22.8	-2.7	0.50
30.0	32.0	-2.0	0.50
40.0	41.3	-1.3	0.50

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รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ
Envilab Co.,Ltd.



Request No. 22-66 / 0323

MTC No. PSL-H 0146 / 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	23.0	-3.0	0.50
30.0	31.6	-1.6	0.50
40.0	41.0	-1.0	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...



Request No. 22-66 / 0323

MTC No. PSL-H 0149 / 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 : MCG010014

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 :

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchai Singhapiwat)

Director

Photometry and Temperature Standards Laboratory

Ref. No : 2012266020900611004

Issued Date : 8 March 2023

Page 1 of 4

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รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



Request No. 22-66 / 0323

MTC No. PSL-H 0149 / 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 : MCG010014
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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รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ

Request No. 22-66 / 0323

MTC No. PSL-H 0149 / 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	20.2	-0.3	0.50
30.0	30.0	0.0	0.50
40.1	39.8	0.3	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	20.1	-0.2	0.50
30.0	30.0	0.0	0.50
40.1	39.9	0.2	0.50



Request No. 22-66 / 0323

MTC No. PSL-H 0149 / 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	20.4	-0.4	0.50
30.0	30.0	0.0	0.50
40.1	39.6	0.5	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...

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

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รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ



INTERNATIONAL TESTING SERVICE CO., LTD

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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 INSTEK.
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

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รับรองสำเนาถูกต้อง
ผู้จัดการฝ่ายควบคุมคุณภาพ

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E-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**Approved on behalf of
International Testing Service Co., Ltd**
(Mr. Yuttana Tholueng)
(Mr. Pichit Vivat-Anant)
Managing Director

Page 2 of 2

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Envilab Co., Ltd.

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ผู้จัดการฝ่ายควบคุมคุณภาพ