



TSP High Volume Sampler Calibration

Verification Report No.

SO2400210-E001 -TSP 01

☐ PM ☒ Onsite

Site: วัดพระหมวังษ์

UTM : 47P 705303 1642328

Sampler: ETSP#27

Recorder: ECRDS016431077

Date: 10 Jul 24

Technical: Amonthep Konklee

Approval: Wisan Ritthikamon

CONDITIONS

Barometric Press. (hPa): 980.0

Temperature (deg C): 36.0

Average Press. (hPa): 1020.0

Average Temp. (deg C): 32.0

Corrected Pressure (mm Hg): 735.1

Temperature (deg K): 309.0

Corrected Avg. Press. (mm Hg): 765.1

Average Temp. (deg K): 305.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 5411

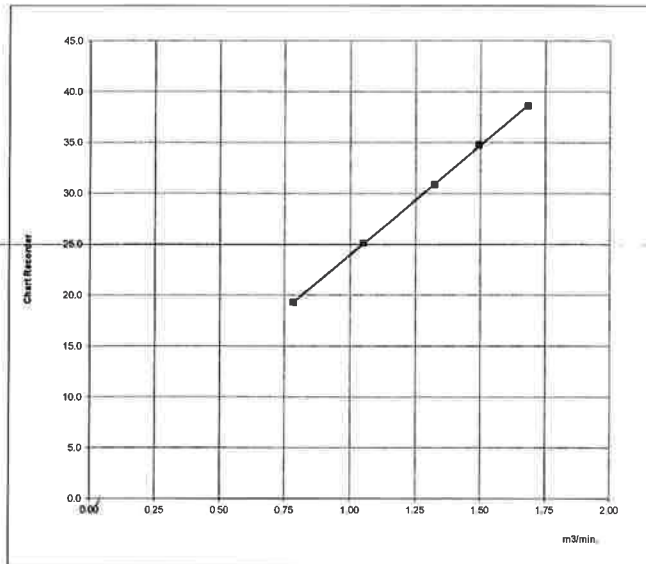
Qstd Slope: 2.02024

Qstd Intercept: -0.02667

Date Certified: 9 Feb 2024

CALIBRATIONS

| Plate or Test # | H2O (in) | Qstd (m3/min) | I (chart) | IC (corrected) | LINEAR REGRESSION | |
|-----------------|----------|---------------|-----------|----------------|----------------------|---------|
| 1 | 12.20 | 1.683 | 40.0 | 38.63 | Slope = | 21.5365 |
| 2 | 9.60 | 1.494 | 36.0 | 34.77 | Intercept = | 2.4663 |
| 3 | 7.50 | 1.322 | 32.0 | 30.91 | Corr. coeff.= | 0.9999 |
| 4 | 4.70 | 1.050 | 26.0 | 25.11 | # of Observations: | 5 |
| 5 | 2.60 | 0.784 | 20.0 | 19.32 | Range of Chart | 28 |
| | | | | | at 1.1 - 1.7 m3/min. | 40 |



Calibrated by :

Approved by :

Wisan Ritthikamon
10 July 2024

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Environmental responsibility with accuracy measurement



TSP High Volume Sampler Calibration

Verification Report No.

SO2400210-E001 -TSP 02

☐ PM ☒ Onsite

Site: วัดจันทรังษี

UTM : 47P 707013 1644301

Sampler: ETSP#26

Recorder: ECRDS016431078

Date: 10 Jul 24

Technical: Amonthep Konklee

Approval: Wisan Ritthikamon

CONDITIONS

Barometric Press. (hPa): 978.0

Temperature (deg C): 36.3

Average Press. (hPa): 1018.0

Average Temp. (deg C): 33.0

Corrected Pressure (mm Hg): 733.6

Temperature (deg K): 309.3

Corrected Avg.Press. (mm Hg): 763.6

Average Temp. (deg K): 306.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 5411

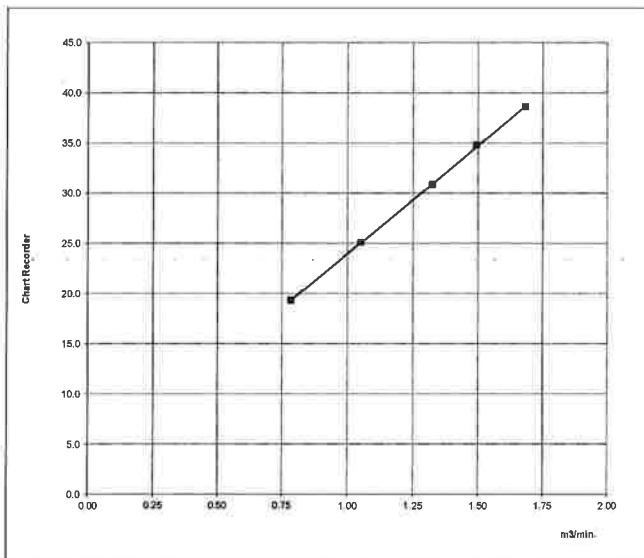
Qstd Slope: 2.02024

Qstd Intercept: -0.02667

Date Certified: 9 Feb 2024

CALIBRATIONS

| Plate or Test # | H2O (in) | Qstd (m3/min) | I (chart) | IC (corrected) | LINEAR REGRESSION | |
|-----------------|----------|---------------|-----------|----------------|----------------------|---------|
| 1 | 12.20 | 1.680 | 40.0 | 38.57 | Slope = | 14.6344 |
| 2 | 8.60 | 1.413 | 38.0 | 36.64 | Intercept = | 14.8306 |
| 3 | 6.40 | 1.221 | 34.0 | 32.79 | Corr. coeff.= | 0.9913 |
| 4 | 4.00 | 0.968 | 30.0 | 28.93 | # of Observations: | 5 |
| 5 | 2.20 | 0.721 | 26.0 | 25.07 | Range of Chart | 33 |
| | | | | | at 1.1 - 1.7 m3/min. | 41 |



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10 July 2024

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FE-MNT-29 Rev.02:05/07/67



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EnviLab & Needs Supply Instrument

PM10 High Volume Sampler Calibration

Verification Report No.

SO2400210-E001 -PM 01

PM

Onsite

Site: วัดพรหมรังษี

UTM : 47P 705303 1642328

Sampler: EPM10#47

Recorder: ECRDS016431074

Date: 10 Jul 24

Technical: Amonthep Konklee

Approval: Wisan Ritthikamon

CONDITIONS

Barometric Press. (hPa): 980.0

Temperature (deg C): 36.0

Average Press. (hPa): 1020.0

Average Temp. (deg C): 32.0

Corrected Pressure (mm Hg): 735.1

Temperature (deg K): 309.0

Corrected Avg. Press. (mm Hg): 765.1

Average Temp. (deg K): 305.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 5411

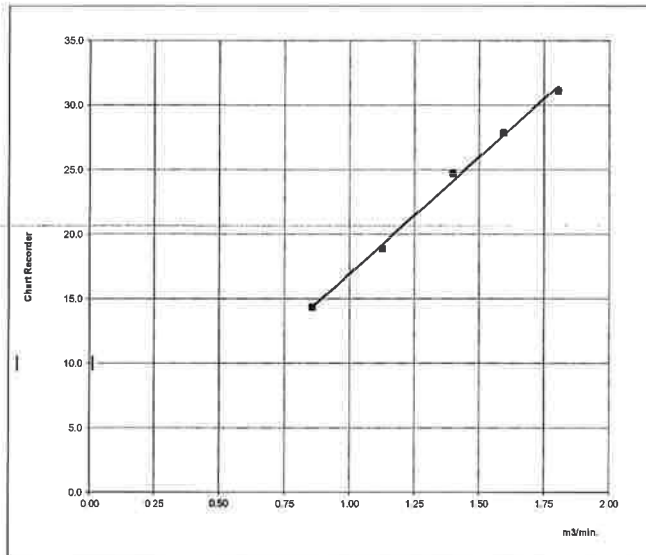
Qstd Slope: 1.2654

Qstd Intercept: -0.01667

Date Certified: 9 Feb 2024

CALIBRATIONS

| Plate or Test # | H2O (in) | Qa (m3/min) | I (chart) | IC (corrected) | LINEAR REGRESSION | |
|-----------------|----------|-------------|-----------|----------------|----------------------------------|----------|
| 1 | 12.20 | 1.803 | 48.0 | 31.12 | Slope = | 18.0757 |
| 2 | 9.50 | 1.592 | 43.0 | 27.88 | Intercept = | -1.1014 |
| 3 | 7.30 | 1.398 | 38.1 | 24.70 | Corr. coeff.= | 0.9984 |
| 4 | 4.70 | 1.124 | 29.1 | 18.87 | SFR = | 1.192 |
| 5 | 2.70 | 0.855 | 22.1 | 14.33 | SSP = | 31.52 |
| | | | | | # of Observations: | 5 |
| | | | | | Range of Chart at SFR $\pm 10\%$ | 29 34 |



Calibrated by

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Wisan Ritthikamon
10 July 2024

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FE-MNT-29 Rev.02.05/07/67



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Envilab & Needss Supply Instrument

PM10 High Volume Sampler Calibration

Verification Report No.

SO2400210-E001 -PM 02

☐ PM

☒ Onsite

Site: วัดจันทรังษี

UTM : 47P 707013 1644301

Sampler: EPM10#27

Recorder: ECRDS016431075

Date: 10 Jul 24

Technical: Amonthep Konklee

Approval: Wisan Ritthikamon

CONDITIONS

Barometric Press. (hPa): 978.0

Temperature (deg C): 36.3

Average Press. (hPa): 1018.0

Average Temp. (deg C): 33.0

Corrected Pressure (mm Hg): 733.6

Temperature (deg K): 309.3

Corrected Avg.Press. (mm Hg): 763.6

Average Temp. (deg K): 306.0

CALIBRATION ORIFICE

Brand: Tisch Environmental, Inc

Model: TE-5025A

Serial#: 5411

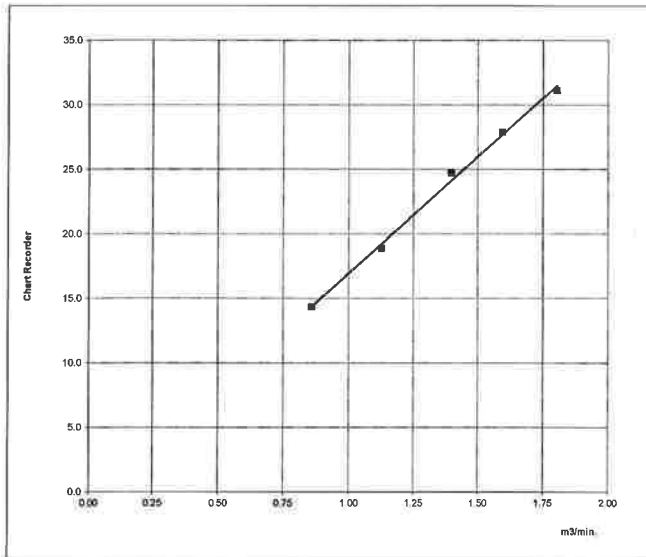
Qstd Slope: 1.2654

Qstd Intercept: -0.01667

Date Certified: 9 Feb 2024

CALIBRATIONS

| Plate or Test # | H2O (in) | Qa (m3/min) | I (chart) | IC (corrected) | LINEAR REGRESSION | |
|-----------------|----------|-------------|-----------|----------------|---|----------------------------------|
| 1 | 12.00 | 1.791 | 48.0 | 31.17 | Slope = 19.8117 Intercept = -3.7588 Corr. coeff. = 0.9972 SFR = 1.189 SSP = 30.49 # of Observations: 5 | Range of Chart at SFR $\pm 10\%$ |
| 2 | 9.50 | 1.595 | 43.0 | 27.92 | | |
| 3 | 7.30 | 1.400 | 38.0 | 24.67 | | |
| 4 | 4.70 | 1.126 | 29.0 | 18.83 | | |
| 5 | 2.80 | 0.872 | 20.0 | 12.99 | | |
| | | | | | 28 | 33 |



Calibrated by

Approved by

Wisan Ritthikamon
10 July 2024

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PM10 Cal. Rev.07 / Iss Date: Mar 27, 2020

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FE-MNT-29 Rev.02:05/07/67



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Envilab & Neediss Supply Instrument

Verification Test Report

Report No.:

SO2400210-E001 -SLM 04

☒ PM ☒ Onsite UTM : 47P 706109 1644133

Calibrated Date: 10 July 2024

Site : จุดที่ 1 บริเวณริมรั้วโครงการด่านทิศตะวันออก

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 45

Serial : 0024

Environment: Temperature 34 °C Humidity 54 %RH

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

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test

| Reference Standard (dB) | Instrument reading (dB) | Error (dB) | Adjust (dB) |
|----------------------------|----------------------------|---------------|----------------|
| 94.10 | 92.40 | -1.70 | 94.10 |

Calibrated By:

Date:

Approve By:

10 July 2024

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Envilab & Needless Supply Instrument

Verification Test Report

Report No.:

SO2400210-E001 -SLM 03

☒ PM ☐ Onsite UTM: 47P 706191 1643665

Calibrated Date: 10 July 2024

Site : จุดที่ 2 บริเวณริมรั้วโครงการด่านทิศใต้

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 45

Serial : 0027

Environment: Temperature 34 °C Humidity 54 %RH

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

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test

| Reference Standard (dB) | Instrument reading (dB) | Error (dB) | Adjust (dB) |
|----------------------------|----------------------------|---------------|----------------|
| 94.10 | 92.40 | -1.70 | 94.10 |

Calibrated By:

Date:

Approve By:

Date:

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



Envilab & Neediss Supply Instrument

Verification Test Report

Report No.:

SO2400210-E001 -SLM 01

☒ PM ☐ Onsite UTM : 47P 705290 1642307

Calibrated Date: 10 July 2024

Site : หมู่ที่ 1 ตำบลดีลัง

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 45

Serial : 0034

Environment: Temperature 34 °C Humidity 54 %RH

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

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test

| Reference Standard (dB) | Instrument reading (dB) | Error (dB) | Adjust (dB) |
|----------------------------|----------------------------|---------------|----------------|
| 94.10 | 92.40 | -1.70 | 94.10 |

Calibrated By:

Date:

Approve By:

Date:

10 July 2024

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



Envilab & Neediss Supply Instrument

Verification Test Report

Report No.:

SO2400210-E001 -SLM 02

☒ PM ☐ Onsite UTM: 47P 707022 1644341

Calibrated Date: 10 July 2024

Site : หมู่ที่ 4 ตำบลดัดสัง

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 45

Serial : 0013

Environment: Temperature 34 °C Humidity 54 %RH

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

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test

| Reference Standard (dB) | Instrument reading (dB) | Error (dB) | Adjust (dB) |
|----------------------------|----------------------------|---------------|----------------|
| 94.10 | 92.30 | -1.80 | 94.10 |

Calibrated By:

Date:

Approve By:

Date:

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Certificate of Calibration

Method 5 Pre-Test Calibration - Liters (L)

UUT Meter Console Information

Model #: XC-572-V
Serial #: 1001003
DGM Model #: GB/T6968-2011
DGM Serial #: L1500033221

Calibration Conditions

Bar. Pressure (mm Hg): 759.8
Ambient Temperature (°C): 24.2
Relative Humidity (%): 60.0
Altitude (m): 1.83
Bar. Pressure Corr. (mm Hg): 759.7

Factors/Conversions

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

Reference Equipment

Calibration Meter Model: DGM-200H
Cal. Due Date: 25-Jul-24
Serial No.: 0000026
Gamma: 1.0000

UUT Meter (DGM)

| Run Time (min:sec) | Office, ΔH (mm Hg) | Volume (L) | | Meter Temperature (°C) | | Meter Pressure (mm Hg) | Volume (L) | | Outlet Temperature (°C) | |
|--------------------|--------------------|-----------------|-----------------|------------------------|-----------------|------------------------|-----------------|----------------|-------------------------|----------------|
| | | Initial (L) | Final (L) | Initial | Final | | Initial | Final | Initial | Final |
| Θ | P _{m(g)} | V _{mi} | V _{mf} | T _{mi} | T _{mf} | P _w | V _{mf} | V _w | t _{mf} | t _w |
| 870.00 | 13.00 | 483737.2 | 483897.2 | 25.0 | 25.0 | 0.3 | 0.00 | 161.44 | 25.0 | 25.0 |
| 630.00 | 25.00 | 483897.2 | 484059.0 | 25.0 | 25.0 | 0.5 | 0.00 | 164.16 | 25.0 | 25.0 |
| 450.00 | 50.00 | 484059.0 | 484223.5 | 26.0 | 26.0 | 0.6 | 0.00 | 167.88 | 25.0 | 25.0 |
| 360.00 | 80.00 | 484223.5 | 484391.4 | 26.0 | 27.0 | 2.0 | 0.00 | 171.91 | 25.0 | 25.0 |
| 0 | 120.00 | 484391.4 | 484561.5 | 27.0 | 27.0 | 2.4 | 0.00 | 174.74 | 25.0 | 25.0 |

Reference Meter (WTM)

| Run Time (min:sec) | Office, ΔH (mm Hg) | Volume (L) | | Meter Temperature (°C) | | Meter Pressure (mm Hg) | Volume (L) | | Outlet Temperature (°C) | |
|--------------------|--------------------|-----------------|-----------------|------------------------|-----------------|------------------------|-----------------|----------------|-------------------------|----------------|
| | | Initial (L) | Final (L) | Initial | Final | | Initial | Final | Initial | Final |
| Θ | P _{m(g)} | V _{mi} | V _{mf} | T _{mi} | T _{mf} | P _w | V _{mf} | V _w | t _{mf} | t _w |
| 870.00 | 13.00 | 483737.2 | 483897.2 | 25.0 | 25.0 | 0.3 | 0.00 | 161.44 | 25.0 | 25.0 |
| 630.00 | 25.00 | 483897.2 | 484059.0 | 25.0 | 25.0 | 0.5 | 0.00 | 164.16 | 25.0 | 25.0 |
| 450.00 | 50.00 | 484059.0 | 484223.5 | 26.0 | 26.0 | 0.6 | 0.00 | 167.88 | 25.0 | 25.0 |
| 360.00 | 80.00 | 484223.5 | 484391.4 | 26.0 | 27.0 | 2.0 | 0.00 | 171.91 | 25.0 | 25.0 |
| 0 | 120.00 | 484391.4 | 484561.5 | 27.0 | 27.0 | 2.4 | 0.00 | 174.74 | 25.0 | 25.0 |

Standardized Data

| Sl. | Reference Meter (L) | | UUT Meter (L) | | Correction Factor | | ΔH@ (mm Hg) | |
|-----|---------------------|---------------------|---------------------|---------------------|-------------------|----------|-------------|------------|
| | Std. Flow | Std. Vol. | Std. Flow | Std. Vol. | Value | Variance | ΔH@ | Variance |
| 1 | Q _{w(Std)} | V _{m(Std)} | V _{w(Std)} | V _{m(Std)} | Y | ΔY | ΔH@ | ΔΔH@ |
| 8 | 10.95 | 157.44 | 11.0 | 157.44 | 1.0085 | -0.0109 | 48.2 | 1.935 |
| 3 | 15.38 | 159.40 | 15.4 | 159.40 | 1.0134 | -0.0060 | 47.1 | 0.802 |
| 3 | 22.03 | 161.91 | 22.0 | 161.91 | 1.0205 | 0.0011 | 45.9 | -0.385 |
| 8 | 28.30 | 165.46 | 28.3 | 165.46 | 1.0261 | 0.0068 | 44.9 | -1.407 |
| 5 | 34.55 | 167.99 | 34.5 | 167.99 | 1.0283 | 0.0090 | 45.3 | -0.944 |
| | | | | | 1.0194 | = Y Avg. | 46.3 | = 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, office 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**



NeediSS Supply Instrument Co., Ltd.



Certificate of Calibration - Supplemental

Nomenclature

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

Equations

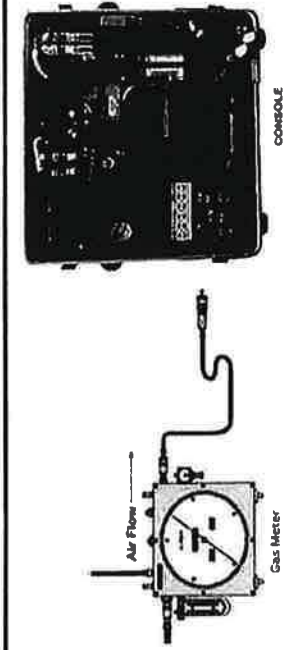
$$V_{w(std)} = Y * K_1 \frac{V_w * (P_{bar} + \frac{P_{init}}{13.6})}{T_w}$$

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

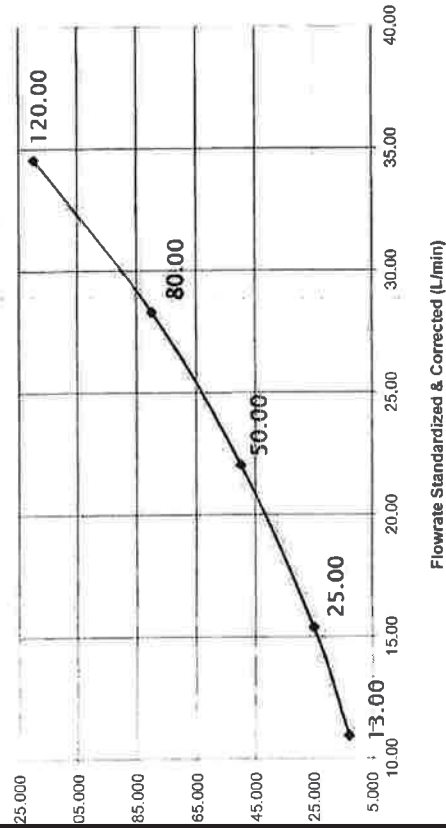
$$K_1 = \frac{T_{std}}{P_{std}} \quad Y = \frac{V_{cr(std)}}{V_{m(std)}} \quad Q_{w(std)} = \frac{V_{w(std)}}{\Theta}$$

$$Metric \Delta H_{15} = \frac{P_m(t) * 0.0011696 * (P_{bar} + \frac{P_{init}}{13.6})}{T_m} * \left(\frac{T_w * \Theta}{V_w * P_{bar}} \right)^2$$

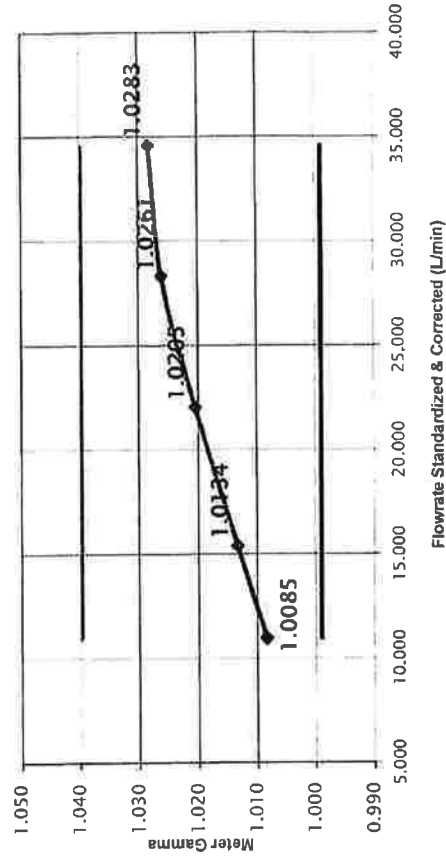
Calibration Train



Meter Pressure vs. Flowrate



Meter Gamma vs. Flowrate





Certificate of Calibration

Method 5 Console Sensor Calibration - Metric Units

Console Information

Model #: XC-572-V
Serial #: 1001003
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 759.8
Humidity (%): 60
Tamb (°C): 24.2
Elevation (m): 1.8
Corr. Pbar (mm. Hg): 759.7

Reference Devices

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

Temperature Display Calibration Data

| Reference Point # | Reference Temp. °C | Test Thermocouple Calibrations | | | | | | Reference Point Status ² |
|-------------------|--------------------|--------------------------------|----------|----------|---------|-----------|---------|-------------------------------------|
| | | Aux °C | Stack °C | Probe °C | Oven °C | Filter °C | Exit °C | |
| 1 | -18 | -17 | -17 | -17 | -17 | -17 | -17 | PASS |
| 2 | 38 | 37 | 37 | 37 | 37 | 37 | 37 | PASS |
| 3 | 93 | 93 | 93 | 93 | 93 | 93 | 93 | PASS |
| 4 | 149 | 150 | 149 | 149 | 149 | 149 | 149 | PASS |
| 5 | 260 | 260 | 260 | 260 | 260 | 260 | 260 | PASS |
| 6 | 371 | 372 | 372 | 372 | 372 | 372 | 372 | PASS |
| 7 | 482 | 483 | 482 | 483 | 483 | 482 | 482 | PASS |
| 8 | 593 | 594 | 594 | 594 | 594 | 593 | 593 | PASS |
| 9 | 816 | 817 | 817 | 817 | 817 | 817 | 817 | PASS |
| 10 | 1038 | 1039 | 1039 | 1039 | 1039 | 1039 | 1039 | PASS |

PASS

Overall Audit Status

NIST Reference Thermocouple ID: 12702001

| Ref Point # | Reference Temp. °C | DSM Thermocouple Sensor Reading °C | ΔT_{DS} % ⁴ |
|----------------------|--------------------|------------------------------------|--------------------------------|
| 1 | 1.8 | 2 | 0.07% |
| 2 | 24.2 | 24 | 0.04% |
| Maximum ² | | | 0.07% |
| 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 :

Date: 26 Feb 24

Notes

¹ Suggested, minimum reference points are 10 (0, 100, 200, 300, 500, 700, 900, 1100, 1500, 1900 °F), can test for more.

² For valid test results, the maximum difference between temperature and reference readings should be less than ± 5.4 °F (± 3 °C), for all thermocouples except for the stack thermocouple which should be less than ± 1.5 % absolute temperature from the reference reading and the exit thermocouple which should be less than ± 2 °F (± 1 °C) from the reference 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)

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

neediss
Neediss Supply Inc.

neediss Console Sensor Calibration Data Sheet

Console Information

Model #: XC-572-V
Serial #: 1001003
Units: Metric
Type: "English"

Calibration Conditions

Pbar (mm. Hg): 759.8
Humidity (%): 60.0
Tamb (°C): 24.2
Corr. Pbar (mm. Hg): 759.7

Reference Devices

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

Pressure Gauge / Manometer Calibration Data

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

| Reference Point ¹ | ΔH Manometer Calibration | | | Reference Point Status ² |
|------------------------------|--------------------------|---------------------|---------------------|-------------------------------------|
| | Reference | Positive (+) Pilot | Negative (-) Pilot | |
| # | 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 | AP Manometer Calibration | | | Reference Point Status ¹ |
|------------------------------|--------------------------|---------------------|---------------------|-------------------------------------|
| | Reference | Positive (+) Pilot | Negative (-) Pilot | |
| # | 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 |
| | | | | PASS |
| | | | | PASS |

Calibra

Date: 26 Feb 24

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 ±0.4 °C (±0.7 °F) 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, Section 2.1.1.1.1).

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).

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.



Console Sensor Audit QA Sheet

Meter Console Information (UUT)

Model #: XC-572-V
Serial #: 1001003
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 759.8
Humidity (%): 60.0
Amb. Temp. (°C): 24.2
Altitude (m): 1.8
Corrected Pbar (mm. Hg): 759.7

Reference Devices

TC Simulator Model: CC-VTR-SH
Reference #: 91109269
Barometer Model: 369307
Reference #: EBARODIALSPE01
Digital Pressure Calibrator Model: 718 30G
Reference #: 9543013

Audit Data

| Reference Point | Reference Temp. | Thermocouple Probe Audit | | | | | | Reference Point Status ¹ |
|-----------------|-----------------|--------------------------|-------|-------|------|--------|-----|-------------------------------------|
| | | Aux | Stack | Probe | Oven | Filter | Exh | |
| | °C | °C | °C | °C | °C | °C | °C | Pass/Fail |
| Ambient | 24.2 | 24 | 24 | 24 | 24 | 24 | 25 | PASS |
| Ice Water | 1.8 | 2 | 2 | 2 | 2 | 2 | 2 | PASS |

Audit Data

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

Calibrated

Date: 26 Feb 24

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 exhl 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 6.1.1.7-9.1.1.8)

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

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

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

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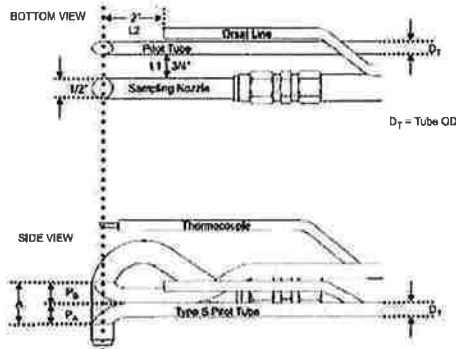
Sampling Probe and Pitot Validation

Sampling System Equipment Information

| | |
|-------------------|---|
| Probe Sheet | Apex 1 in. , 5 ft. |
| Probe Number | 1912498 |
| Pitot tube Number | A8778 |
| 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 Callipers | CD-15APX |
| Reference No. | A22070181 |
| Digital InclInometer | BASELINE |
| Reference No. | FEI 12-1057 |
| Temperature | 24.2 °C±3 |
| Barometric Pressure | 759.8 mm Hg |



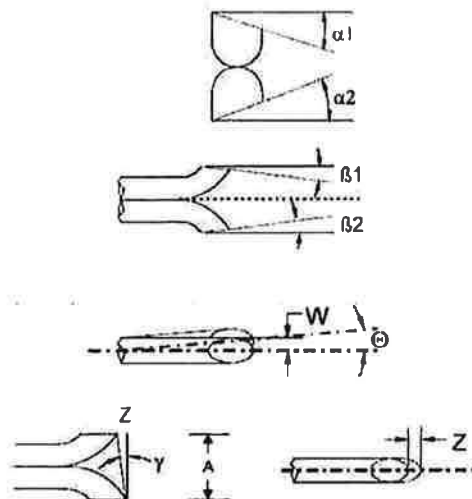
Sampling Probe Validation with Tune up

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

| Measured | Standard Range |
|---------------------|--|
| L ₁ = | 1.90 cm. (1.905 cm. or 3/4 in.) |
| L ₂ = | 5.10 cm. (5.08 cm. or 2.0 in.) |
| D _T = | 0.951 cm. (3/8 in.) |
| A = | 2.16 cm. (2.1 D _T ≤ A ≤ 3D _T) |
| A/2D _T = | 1.135 cm. (1.05 P _A / D _T ≤ A ≤ 1.5) |

Pitot Tube Validations and Engles measurement Result

☒ : Measure Result after Maintenance and Adjustable



P_B Size

| Standard Range |
|-------------------------------|
| α ₁ = 0.70 ° ≤ 10° |
| β ₁ = -0.60 ° ≤ 5° |

P_A Size

| Standard Range |
|-------------------------------|
| α ₂ = 1.20 ° ≤ 10° |
| β ₂ = -1.30 ° ≤ 5° |

Engles measurement

| Calculated Result | Standard Range |
|------------------------|--------------------------|
| W = -0.30 ° -0.011 cm. | W < 0.08 cm (1/32 in.) |
| Z = -1.10 ° -0.041 cm. | Z < 0.032 cm (1/8 in.) |

Cp(s) Solong as standard range

Validation Date: 26 Feb 24



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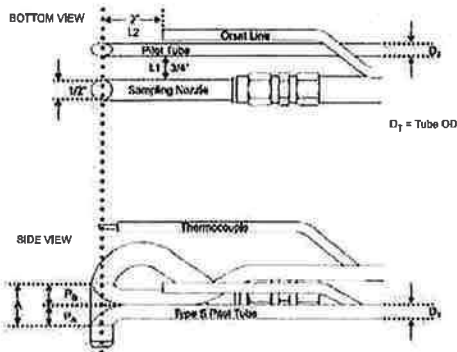
neediss Sampling Probe and Pitot Validation

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 |

Vallbration Conditions and Equipment

| | |
|---------------------|-------------|
| Digital Callipers | CD-15APX |
| Reference No. | A22070181 |
| Digital Inclnometer | BASELINE |
| Reference No. | FEI 12-1057 |
| Temperature | 24.2 °C±3 |
| Barometric Pressure | 759.8 mm Hg |



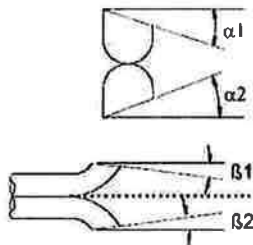
Sampling Probe Validation with Tune up

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

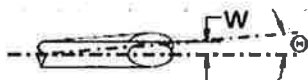
| Measured | Standard Range | |
|------------|----------------|--------------------------------------|
| $L_1 =$ | 1.92 cm. | (1.905 cm. or 3/4 in.) |
| $L_2 =$ | 5.56 cm. | (5.08 cm. or 2.0 in.) |
| $D_T =$ | 0.96 cm. | (3/8 in.) |
| $A =$ | 2.09 cm. | ($2.1 D_T \leq A \leq 3 D_T$) |
| $A/2D_T =$ | 1.089 cm. | ($1.05 P_A / D_T \leq A \leq 1.5$) |

Pitot Tube Validations and Engles measurement Result

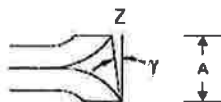
☒ : Measure Result after Maintanance and Adjustable



| P_B Size | Standard Range | |
|--------------|----------------|-----------------|
| $\alpha_1 =$ | -3.60 ° | $\leq 10^\circ$ |
| $\beta_1 =$ | 0.00 ° | $\leq 5^\circ$ |
| P_A Size | Standard Range | |
| $\alpha_2 =$ | -2.40 ° | $\leq 10^\circ$ |
| $\beta_2 =$ | -2.00 ° | $\leq 5^\circ$ |



| Engles measurement | Calculated Result | Standard Range |
|--------------------|-------------------|------------------------------------|
| $W =$ 1.20 ° | 0.044 cm. | $W < 0.08 \text{ cm (1/32 in.)}$ |



| | | |
|---------------|------------|------------------------------------|
| $Z =$ -0.90 ° | -0.033 cm. | $Z < 0.032 \text{ cm (1/8 in.)}$ |
|---------------|------------|------------------------------------|

Can't (s) Solong as standard range

Validation B

26 Feb 24

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Nozzle Validation

Samplig System Equipment Information

| | |
|----------------|---------------|
| Console Model | XC-572-V |
| Console Number | 1001003 |
| DGM Model | GB/T6968-2011 |
| DGM Number | L1500033221 |

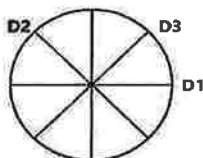
Validation Conditions

| | |
|---------------------|-------------|
| Digital Calipers | CD-15APX |
| Reference No | A22070181 |
| Temperatute | 24.2 °C±3 |
| Barometric Pressure | 759.8 mm Hg |

| Validation Data | | | | | Results | |
|-----------------|-----------------|----------------|----------------|----------------|-----------|--|
| Nozzle ID | Nozzle Diameter | | | | Different | (D ₁ + D ₂ + D ₃) / 3 |
| Sizes | | D ₁ | D ₂ | D ₃ | ΔD | Davg |
| | mm | mm | mm | mm | mm | mm |
| NS-4 | 3.17 | 3.17 | 3.17 | 3.16 | 0.006 | 3.167 |
| NS-8 | 6.35 | 6.35 | 6.34 | 6.35 | 0.006 | 6.347 |
| NS-9 | 7.13 | 7.14 | 7.12 | 7.12 | 0.012 | 7.127 |
| NS-12 | 9.52 | 9.52 | 9.52 | 9.51 | 0.006 | 9.517 |
| NS-14 | 11.09 | 11.07 | 11.09 | 11.09 | 0.012 | 11.083 |
| NS-16 | 12.70 | 12.70 | 12.71 | 12.70 | 0.006 | 12.703 |
| NS-18 | 14.17 | 14.16 | 14.17 | 14.18 | 0.010 | 14.170 |

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

Date: 26 Feb 24



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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 #: | 1903024 |
| DGM Model #: | SK-25-EX |
| DGM Serial #: | 20193918 |
| Bar. Pressure (mb): 1013 | |
| Ambient Temperature (°C): 24.5 | |
| Relative Humidity (%): 45 | |
| Altitude (m): 1.8 | |
| Bar. Pressure Corr. (mm Hg): 759.7 | |

Calibration Conditions

| | |
|---------------------------|--------|
| Std. Temp. (K): | 293.15 |
| Std. Press. (mm Hg): | 760 |
| K ₁ (K/mm Hg): | 0.3857 |

Factors/Conversions

| | |
|--------------------------|-----------|
| Calibration Meter Model: | DGMR-200H |
| Cal Due Date: | 25 Jun 23 |
| Serial #: | 0000026 |
| Gamma: | 1.0000 |

Reference Equipment

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 | | Initial | Final | Total | Initial | Final |
| Θ | P _{mf(g)} | C _{init} | C _{final} | C _{total} | t _{mf} | t _{mf} | P _w | V _{mf} | V _w | V _w | t _{wf} | t _{mf} |
| 280.94 | 120.00 | 0 | 95258 | 95258 | 24.0 | 24.0 | -14.0 | 0.0 | 168.9 | 168.9 | 24.0 | 24.0 |
| 340.63 | 80.00 | 0 | 94799 | 94799 | 25.0 | 25.0 | -10.0 | 0.0 | 165.6 | 165.6 | 24.0 | 24.0 |
| 430.64 | 50.00 | 0 | 93355 | 93355 | 25.0 | 26.0 | -7.0 | 0.0 | 161.8 | 161.8 | 24.0 | 24.0 |
| 603.23 | 25.00 | 0 | 89609 | 89609 | 26.0 | 27.0 | -4.0 | 0.0 | 154.5 | 154.5 | 24.0 | 24.0 |
| 810.32 | 13.00 | 0 | 87356 | 87356 | 27.0 | 27.0 | -2.0 | 0.0 | 150.5 | 150.5 | 24.0 | 24.0 |

Reference Meter

Standardized Data

| Reference Meter | Std. Flow Rate | Test Meter | Volume Conversion | | Correction Factor | | ΔH @ (mm H ₂ O) | |
|-----------------------|---------------------------|-------------------------|-------------------|-----------------------|-------------------|----------|----------------------------|--------|
| | | Totalizer | Scaling Fac | Std. Vol. | Value | Variance | ΔH@ | ΔH@ |
| VW _{std} (L) | QW _{std} (L/min) | Counts _(std) | Y _{sc} | Vm _{std} (L) | Y | ΔY | ΔH@ | ΔH@ |
| 160.788 | 34.339 | 95025 | 1.69E-03 | 162.3 | 0.9908 | -0.0092 | 42.7 | -2.605 |
| 159.319 | 28.063 | 93889 | 1.70E-03 | 160.3 | 0.9936 | -0.0064 | 43.2 | -2.120 |
| 156.800 | 21.846 | 92038 | 1.70E-03 | 157.2 | 0.9975 | -0.0025 | 45.0 | -0.298 |
| 150.835 | 15.003 | 87838 | 1.72E-03 | 150.0 | 1.0055 | 0.0055 | 48.2 | 2.853 |
| 147.678 | 10.935 | 85388 | 1.73E-03 | 145.8 | 1.0127 | 0.0127 | 47.5 | 2.170 |
| | | | = Avg. | | = Y Avg. | | = ΔH@ Avg. | |
| | | | 1.71E-03 | | 1.0000 | | 45.30 | |

Calibration Results

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 ±0.2inches (5.1mm) H₂O.

Pass/Fail Result: **Pass**

Console Input Value: **1.7079** Metre

Calibrate By:

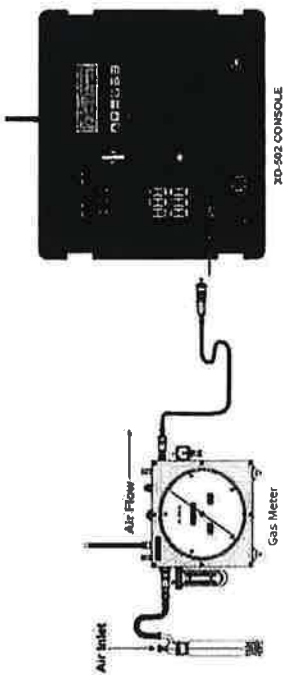
Date: 25 Jan 24

ce to EPA Method 5, Section 10.3.1.

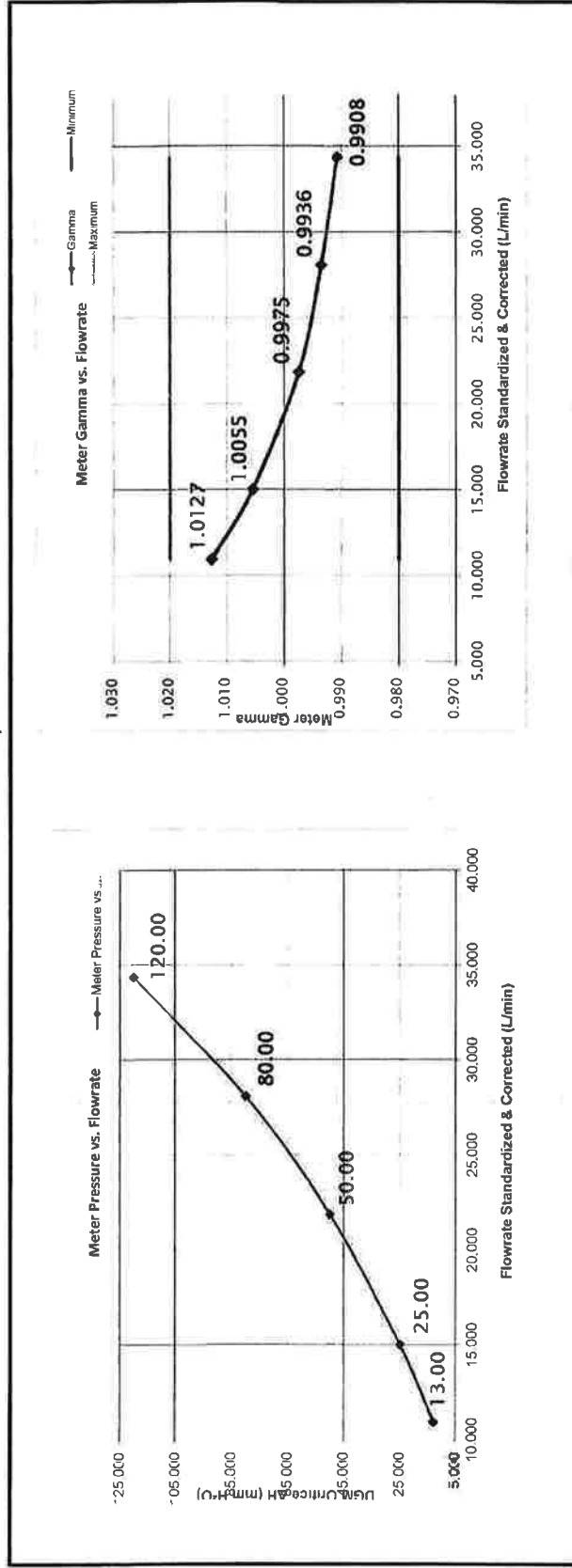


Certificate of Calibration - Supplemental

METHOD 5 PRE-TEST CONSOLE CALIBRATION

| Nomenclature | Equations | Calibration Train |
|---|--|--|
| P_b - Barometric Pressure | $V_{w(std)} = Y * K_1 * \frac{V_w * (P_{bar} + \frac{P_{m(t)})}{13.6}}{T_w}$ |  |
| DGM - Dry Gas Meter | $V_{m(std)} = Counts_{std} * Y_{ec(avg)}$ | |
| K_1 - Constant based on standard temp and press | $Counts_{std} = K_1 * \frac{C_{total} * (P_{bar} + \frac{P_{m(std)})}{13.6}}{T_m}$ | |
| θ - Run time, in minutes | $Q_{w(std)} = \frac{V_{w(std)}}{\theta}$ | |
| P_m - ΔH (Meter Pressure gauge) | $K_1 = \frac{T_{std}}{P_{std}}$ | |
| V_m - Volume collected by test meter, corrected for STP | $Y = \frac{V_{cr(std)}}{V_{m(std)}}$ | |
| $Q_{m(std)}$ - Calculated flow rate of test meter | $Y = \frac{V_{cr(std)}}{V_{m(std)}}$ | |
| K' - Critical orifice coefficient: | $Y = \frac{V_{cr(std)}}{V_{m(std)}}$ | |
| P_w - Measured pressure of reference meter | $Y = \frac{V_{cr(std)}}{V_{m(std)}}$ | |
| t_w - Temperature measured in reference meter | $Y = \frac{V_{cr(std)}}{V_{m(std)}}$ | |
| t_m - Temperature measured in test meter | $Y = \frac{V_{cr(std)}}{V_{m(std)}}$ | |
| Y - Ratio of volume collected from test meter and orifice | $Y = \frac{V_{cr(std)}}{V_{m(std)}}$ | |
| SC - Scaling Factor | $Y = \frac{V_{cr(std)}}{V_{m(std)}}$ | |
| Counts _s - Number of pulse counts, standardized | $Y = \frac{V_{cr(std)}}{V_{m(std)}}$ | |
| Counts _{std} - Number of raw pulse counts of a calibration run | $Y = \frac{V_{cr(std)}}{V_{m(std)}}$ | |

Calibration Graphs





Certificate of Calibration

Method 5 Console Temperature Calibration - Metric Units

Console Information

Model #: XD-502-MV
Serial #: 1903024
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 759.7
Humidity (%): 45
Tamb (°C): 24.5
Elevation (m): 1.8
Corr. Pbar (mm. Hg): 759.7

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 | 260 | 260 | 260 | 260 | 260 | 260 | PASS |
| 6 | 371 | 371 | 371 | 371 | 371 | 370 | 371 | PASS |
| 7 | 482 | 482 | 482 | 482 | 482 | 481 | 482 | PASS |
| 8 | 593 | 593 | 593 | 593 | 593 | 592 | 593 | PASS |
| 9 | 816 | 816 | 816 | 816 | 816 | 815 | 816 | PASS |
| 10 | 1038 | 1038 | 1038 | 1038 | 1038 | 1037 | 1038 | PASS |

TC Measure Overall Audit Status

PASS

NIST Reference Temperature Probe ID:

12702001

| Ref Point | Theoretical Temp. | DGM Thermocouple Sensor Reading | ΔT_{abs}^4 |
|----------------------|-------------------|---------------------------------|--------------------|
| # | °C | °C | °C |
| Ice Water | 1 | 1 | 0.00% |
| Ambient ³ | 24.5 | 25 | 0.10% |

Maximum⁵ 0.10%

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 ¹ |
| # | mm. Hg | mm. Hg | Pass/Fail |
| 1 | 50.0 | 49.0 | PASS |
| 2 | 100.0 | 99.0 | PASS |

Dual Inclined/Vertical Manometer

| Reference Pressure | Pressure audit with Console System testing for Inclined Range of 0-26 and Vertical Range of 26-150 mm 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 | -0.9 | PASS |
| 50.0 | 50.2 | PASS | 49.1 | PASS |
| 70.0 | 70.5 | PASS | 70.4 | PASS |
| 80.0 | 80.1 | PASS | 79.8 | PASS |
| 90.0 | 90.2 | PASS | 89.4 | PASS |
| 100.0 | 100.3 | PASS | 99.6 | PASS |
| 110.0 | 110.3 | PASS | 109.9 | PASS |
| 120.0 | 120.5 | PASS | 119.6 | PASS |
| 130.0 | 130.3 | PASS | 130.2 | PASS |
| 140.0 | 140.6 | PASS | 139.8 | PASS |

Audit Status

PASS

Calibr

Date; 25 Jan 24

²For valid test results, the maximum difference between temperature and reference readings should be less than $\pm 5.4^\circ\text{F}$ ($\pm 3^\circ\text{C}$), for all thermocouples except for the slack thermocouple which should be less than $\pm 1.5\%$ absolute temperature from the reference reading and the exit thermocouple which should be less than $\pm 2^\circ\text{F}$ ($\pm 1^\circ\text{C}$) from the reference reading (EPA Method 2, Section 6.3 and EPA Method 5, Sections 6.1.1-6.1.1.8)

³Do not change this cell value; it is instead based on input from cell H1 at the top of the sheet under "Calibration Conditions"

⁴Absolute temperature difference and other numerical values listed in the

⁵For valid test results, the maximum difference between console and reference

⁶For valid test results, the maximum difference between console and reference

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I certify that the above thermocouple sensors were calibrated



Console Sensor Audit QA Sheet

Meter Console Information (UIT)

Model #: XD-502-MV
Serial #: 1903024
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 759.7
Humidity (%): 71%
Amb. Temp. (°C): 24.9
Altitude (m): 1.8
Corrected Pbar (mm. Hg): 759.7

Reference Devices

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

Audit Data

| Reference Point # | Reference Temp. °C | Console Thermocouple Audit | | | | | | Reference Point Status ¹ |
|-------------------|--------------------|----------------------------|----------|----------|---------|-----------|---------|-------------------------------------|
| | | Aux °C | Stack °C | Probe °C | Oven °C | Filter °C | Exit °C | |
| 1 | 24.9 | 25 | 25 | 25 | 25 | 25 | 25 | PASS |

| Console Barometric Audit | | | |
|--------------------------|----------------------|--------------------|-------------------------------------|
| Reference Point | Reference Bar. Press | Console Bar. Press | Reference Point Status ² |
| # | mm. Hg | mm. Hg | Pass/Fail |
| 1 | 759.7 | 759.00 | PASS |

| Console Vacuum Audit | | | |
|----------------------|------------------|----------------|-------------------------------------|
| Reference Point | Reference Vacuum | Console Vacuum | Reference Point Status ³ |
| # | mm. Hg | mm. Hg | Pass/Fail |
| 1 | 100.1 | 99.00 | PASS |

Calibrated

Date: 25 Jan 24

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, 7.4.1, 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)



Neediss Supply Instrument Co., Ltd.

neediss Sampling Probe and Pitot Validation

Samplig System Equipment Information

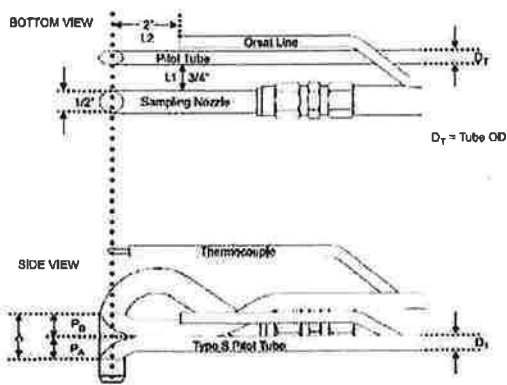
| | |
|--------------------|--|
| Probe Sheat: | Apex 1 in. , 3 ft. |
| Probe Number: | 1904202 |
| Pitot tube Number: | A8335 |
| Pitot tube Type: | S Type 3/8 Inc. |
| Validation method: | Standard Probe 1 in. and 1/2 in. Sampling Nozzle |

Validation Conditions and Equipment

| | |
|----------------------|-------------|
| Digital Calipers: | ET123456 |
| Reference No: | A22070181 |
| Digital Inclinator: | BASELINE |
| Reference No: | 12-1057 |
| Temperature: | 24.9 °C±3 |
| Barometric Pressure: | 759.7 mm Hg |

Sampling Probe Validation with Tune up

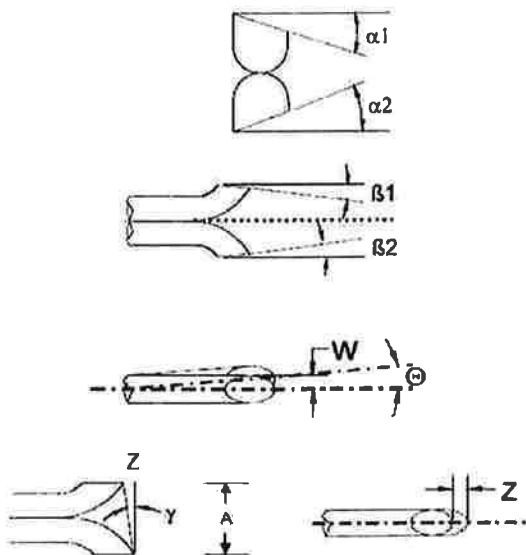
☒ Measure and Alinment with 1/2" Sampling Nozzle(12.7 mm)



| Measured | Standard Range |
|------------|--|
| $L_1 =$ | 1.91 cm. (1.905 cm. or 3/4 in.) |
| $L_2 =$ | 5.07 cm. (5.08 cm. or 2.0 in.) |
| $D_T =$ | 0.958 cm. (3/8 in.) |
| $A =$ | 2.12 cm. ($2.1 D_T \leq A \leq 3 D_T$) |
| $A/2D_T =$ | 1.107 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 |
|--------------|-------------------------|
| $\alpha_1 =$ | -1.00 ° $\leq 10^\circ$ |
| $\beta_1 =$ | 1.40 ° $\leq 5^\circ$ |
| P_A Size | |
| $\alpha_2 =$ | 1.00 ° $\leq 10^\circ$ |
| $\beta_2 =$ | -0.70 ° $\leq 5^\circ$ |

| Engles measurement | Calculated Result | Standard Range |
|--------------------|-------------------|---|
| $W =$ | -0.70 ° | -0.026 cm. $W < 0.08 \text{ cm (1/32 in.)}$ |
| $Z =$ | -0.50 ° | -0.019 cm. $Z < 0.032 \text{ cm (1/8 in.)}$ |

Can be [redacted] line value of Cp(s)

Validation

25 Jan 24

neediss Nozzle Validation

Samplig System Equipment Information

| | |
|-----------------------|-----------|
| Console Model Number | XD-502-MV |
| Console Serial Number | 1903024 |
| DGM Model Number | SK-25-EX |
| DGM Serial Number | 20193918 |

Valibration Conditions

| | |
|---------------------|-------------|
| Digital Calipers | CD-15APX |
| Reference No | A22070181 |
| Temperatute | 24.5 °C±3 |
| Barometric Pressure | 759.7 mm Hg |

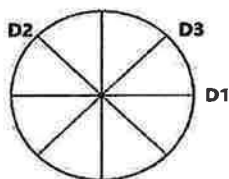
| Calibration Data | | | | | Results | |
|------------------|-----------------|----------------|----------------|----------------|-----------|--|
| Nozzle ID | Nozzle Diameter | | | | Different | (D ₁ + D ₂ + D ₃) / 3 |
| Sizes | | D ₁ | D ₂ | D ₃ | ΔD | Davg |
| | mm | mm | mm | mm | mm | mm |
| NS-4 | 3.17 | 3.17 | 3.17 | 3.17 | 0.000 | 3.170 |
| NS-6 | 4.77 | 4.76 | 4.76 | 4.76 | 0.000 | 4.760 |
| NS-8 | 6.35 | 6.35 | 6.35 | 6.35 | 0.000 | 6.350 |
| NS-10 | 7.92 | 7.93 | 7.92 | 7.92 | 0.006 | 7.923 |
| NS-12 | 9.52 | 9.53 | 9.53 | 9.53 | 0.000 | 9.530 |
| NS-14 | 11.09 | 11.08 | 11.09 | 11.09 | 0.006 | 11.087 |
| NS-16 | 12.70 | 12.71 | 12.72 | 12.71 | 0.006 | 12.713 |

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

25 Jan 24

 neediss

Neediss Supply Instrument Co., Ltd



Verification Test Report

Instruments Information

Page:1/2

Analyzer Type: Flue Gas Analyser
Model: Optima7

Manufacturer: MRU
Serial No.: 320779

Calibration Gas information

Standard Gas Mid Range

O2 Conc 2.2 %vol.
Cd/Ex: 343014/Jul 24,2025
CO Conc 99.94 ppm
NO Conc 99.69 ppm
NOX Conc 99.76 ppm
SO2 Conc 100.5 ppm
CO2 Conc 8.054 %
Cd/Ex: ED5716/May 16,2030

Standard Gas High Range

O2 Conc 10.22 %vol.
Cd/Ex: 343018/Jan 10,2025
CO Conc 594.5 ppm
NO Conc 197.2 ppm
NOX Conc 197.2 ppm
SO2 Conc 200.9 ppm
CO2 Conc 16.02 %
Cd/Ex: ND7514/Jun 21,2030

Environment: Temperature 25.8 °C Humidity: 47 %RH

SO2 calibration test

| Set point | Std.gas (ppm) | Before Adj Reading(ppm) | After Adj Reading(ppm) | Difference | % error |
|-----------|---------------|-------------------------|------------------------|------------|---------|
| Low/Zero | 0.0 | 0 | 0 | 0.0 | 0.0 |
| Mid | 100.5 | 92 | 100 | -0.5 | -0.5 |
| Hight | 200.9 | 194 | 201 | 0.1 | 0.0 |

NO calibration test

| Set point | Std.gas (ppm) | Before Adj Reading(ppm) | After Adj Reading(ppm) | Difference | % error |
|-----------|---------------|-------------------------|------------------------|------------|---------|
| Low/Zero | 0.0 | 0 | 0 | 0.0 | 0.0 |
| Mid | 99.69 | 90 | 100 | 0.3 | 0.3 |
| Hight | 197.2 | 182 | 200 | 2.8 | 1.4 |

NOX calibration test

| Set point | Std.gas (ppm) | Before Adj Reading(ppm) | After Adj Reading(ppm) | Difference | % error |
|-----------|---------------|-------------------------|------------------------|------------|---------|
| Low/Zero | 0.0 | 0 | 0 | 0.0 | 0.0 |
| Mid | 99.76 | 91 | 100 | 0.2 | 0.2 |
| Hight | 197.2 | 190 | 200 | 2.8 | 1.4 |

CO2 calibration test

| Set point | Std.gas (ppm) | Before Adj Reading(ppm) | After Adj Reading(ppm) | Difference | % error |
|-----------|---------------|-------------------------|------------------------|------------|---------|
| Low/Zero | 0.0 | 0 | 0 | 0.0 | 0.0 |
| Mid | 8.054 | 9.05 | | | |
| Hight | 16.0 | 17.68 | | | |



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www.neediss.com

We know the best thing to save environment



บริษัท นีดิส ซัพพลาย อินสตรูमेंท์ จำกัด
Neediss Supply Instrument Co., Ltd.
535 ซอยบางแค 7 แขวงบางแค เขตบางแค กรุงเทพฯ 10160 536 Soi Bangkhae 7 Bangkhae Bangkok Bangkok
Tel. 02-802-3980-2 Fax. 02-802-3988 E.info@neediss.com



Verification Test Report

Instruments Information

Page:2/2

Analyzer Type: Flue Gas Analyser
Model: Optima7

Manufacturer: MRU
Serial No.: 320779

Calibration Gas information

Standard Gas Mid Range

O2 Conc 2.2 %vol.
Cd/Ex: 343014/Jul 24,2025
CO Conc 99.94 ppm
NO Conc 99.69 ppm
NOX Conc 99.76 ppm
SO2 Conc 100.5 ppm
CO2 Conc 8.054 %
Cd/Ex: ED5716/May 16,2030

Standard Gas High Range

O2 Conc 10.22 %vol.
Cd/Ex: 343018/Jan 10,2025
CO Conc 594.5 ppm
NO Conc 197.2 ppm
NOX Conc 197.2 ppm
SO2 Conc 200.9 ppm
CO2 Conc 16.02 %
Cd/Ex: ND7514/Jun 21,2030

Environment: Temperature 25.8 °C Humidity: 47 %RH

CO calibration test

| Set point | Std.gas (ppm) | Before Adj Reading(ppm) | After Adj Reading(ppm) | Difference | % error |
|-----------|---------------|-------------------------|------------------------|------------|---------|
| Low/Zero | 0.0 | 0 | 0 | 0.0 | 0.0 |
| Mid | 99.94 | 101 | 99 | -0.9 | -0.9 |
| Hight | 594.5 | 607 | 601 | 6.5 | 1.1 |

O2 calibration test

| Set point | Std.gas (ppm) | Before Adj Reading(ppm) | After Adj Reading(ppm) | Difference | % error |
|-----------|---------------|-------------------------|------------------------|------------|---------|
| Low/Zero | 0.0 | 0 | 0 | 0.0 | 0.0 |
| Mid | 2.2 | 2.2 | 2.2 | 0.0 | 0.0 |
| Hight | 10.22 | 10.21 | 10.21 | 0.0 | -0.1 |

Note

Technical Data Calibration results.:Calibration reading response discrepancy

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

Calibrate By :

Approve By



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Certificate of Calibration

Certificate No. : 67-420034-1

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. : ELABPHH74BW01

Electrode

Model : 9615S

Serial No. : 9X1K0003

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

Ambient Temperature : (22.0 to 23.0)°C

Relative Humidity : (50 to 55) %

Date of Received : 20 March 2024

Date of Calibration : 20 March 2024

Date of Issue : 23 March 2024

Calibrated by : Permpon Chanpu

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-00307/66 | 23 Aug 2025 | National Institute of Metrology Thailand (NIMT) |

2. Standard Buffer Solution

| pH | Cert. No. | Lot No. | Exp. Date | Traceability |
|-------|-----------|---------|-------------|---|
| 4.008 | 61293328 | 944535 | 27 Nov 2025 | CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025 |
| 6.986 | 61281486 | 944537 | 17 Nov 2024 | CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025 |
| 9.997 | 61281073 | 944536 | 17 Nov 2024 | CPA Chem Ltd. Accredited to ISO 17034 and ISO/IEC 17025 |

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-420034-1

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 | 3.998 | 177.5 | 0.0 | 0.12 |
| | 0.0000 | 7 | 7.000 | 0.0 | 0.0 | 0.086 |
| | -177.4800 | 10 | 10.000 | -177.4 | -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 | 4.009 | -0.001 | 0.0084 |
| | 6.986 | 6.990 | -0.014 | 0.0092 |
| | 9.997 | 10.008 | -0.011 | 0.014 |

Remark

UUC : Unit Under Calibration

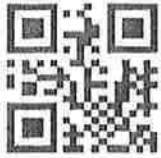
This result of calibration was found accurate as shown on date and place of calibration only.

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



MIRACLE INTERNATIONAL TECHNOLOGY CO.,LTD

214 Bangwaek Rd. Bangpai Bangkok 10160
Tel.: 0-2865-4647-8 Fax: 0-2865-4649 <http://www.mit.in.th>



CALIBRATION CERTIFICATE

Certificate No. : S2024040558-0002

Date Issued : 03-May-24

Customer : Envilab Co., Ltd.
540, 540/1 Soi Bangkhac 7, Bangkhac, Bangkok, Thailand
10160

Equipment : Lab Refrigerator (TMF-PLR221)

Manufacturer : Thermo Scientific

Model : PLR221

Serial No. : 2210M319042801

ID No./Tag No. : ELABREFRIGEN02

Date Received : 02-May-24

Date Calibrated : 02-May-24

Calibrated by : Mr. Varuch Jearrajinda

Calibration Method or Calibration Procedure Used

Standard method : CP-05 T1 AS G-20

This certificate is traceable to national standards, which realize the units of measurement according to the International System of Units (SI).

Result of Calibration

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

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Appr



Page 1 of 2



Certificate No. : S2024040558-0002

Environment : Ambient Temperature : Start record 26.6 °C, Stop record 26.8 °C
Relative Humidity : Start record 54.1 %RH, Stop record 54.5 %RH

| Calibration Temperature (°C) | Setting Temperature (°C) | Indicating Temperature (°C) | Measured Stability ¹ (°C) | Measured Uniformity ² (°C) | Overall Variation ³ (°C) |
|---------------------------------|-----------------------------|--------------------------------|---|--|--|
| 4 | 4 | 4 | 0.88 | 0.69 | 1.94 |

Without adjustment

| Calibration Temperature (°C) | STD No. 1 (°C) | STD No. 2 (°C) | STD No. 3 (°C) | STD No. 4 (°C) | STD No. 5 (°C) | STD No. 6 (°C) | STD No. 7 (°C) | STD No. 8 (°C) | STD No. 9 (°C) | Uncertainty ⁴ (±°C) |
|---------------------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-------------------|-----------------------------------|
| 4 | 4.23 | 4.35 | 4.44 | 4.46 | 4.35 | 4.24 | 4.34 | 3.96 | 4.13 | 1.2 |

Decision Rule with Guard Band

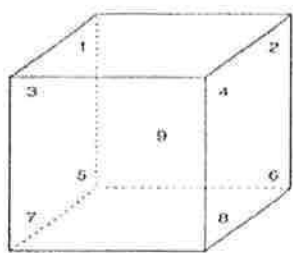
| Calibration Temperature (°C) | No. 1 | No. 2 | No. 3 | No. 4 | No. 5 | No. 6 | No. 7 | No. 8 | No. 9 | MPE (±°C) |
|---------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|--------------|
| 4 | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | Pass | 2 |

Pass : $|\text{error}| + |\text{uncertainty}| \leq |\text{MPE}|$ MPE = Maximum Permissible Error

Fail : $|\text{error}| + |\text{uncertainty}| > |\text{MPE}|$

Note : Probe No. 9 is Reference Probe

Setting Air Fresh No. : 0



Condition As-Received : Used Item

The measurement results and statements of conformity with specification only relate to the item calibrated.

Measurement Standards Used & Traceability :

The International System of Units (SI) through

MTC Certificate No. L202403007-0012 for Digital Thermometer with Probe (Agilent) Module 1 (93) Serial No. MY-H1008700. Due 10-Sep-24

- Notes :
1. The temperature stability is the one-half of greatest maximum difference of measured temperatures at any one probe.
 2. The temperature uniformity is the maximum difference of measured temperatures between of any probes and the measured temperature at the reference location which are observed at same time.
 3. Overall variation is the difference of maximum and minimum measured temperatures throughout observation time.
 4. The uncertainty of measurement is included temperature stability.
 5. The temperature uniformity, stability, overall variation and indicating temperature is applicable to all air or gas filled temperature controlled enclosures at atmospheric pressure.

End of Certificate



Greengate Co. Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

CAL

Calibratech Co., Ltd.

7/106-7 Moo 2, Sukhapiachasan 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. : 67-400166-1

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

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

Equipment : Temperature controlled enclosure (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 : (29.0 to 30.0) °C

Relative Humidity : (60 to 650) %

Line Voltage : (224.2 to 225.2) V

Date of Received : 20 March 2024

Date of Calibration : 20 March 2024

Date of Issue : 22 March 2024

Calibrated by : Kittisak Kokaco

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

400046 & 400028 66-400547-3

05 Apr 2024

National Institute of Metrology Thailand (NIMT)

Approved by :

(Surachai Promthong)

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-400166-1

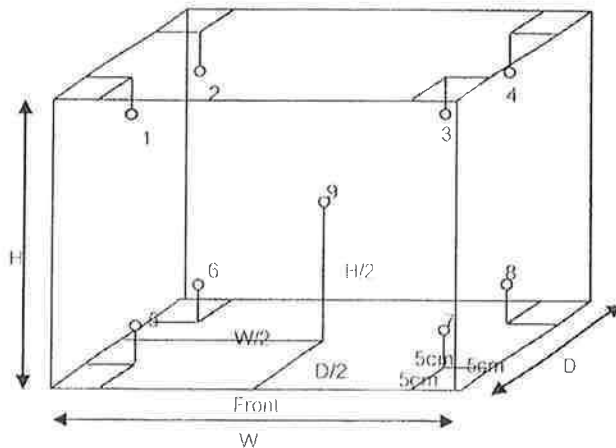
Page : 2 of 2

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 = 0.40 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 | 104.1 | 104.4 | 104.1 | 104.3 | 104.1 | 104.0 | 104.0 | 103.7 | 104.3 | 0.70 |
| 110.0 | 109.5 | 109.5 | 110.1 | 110.4 | 110.1 | 110.3 | 110.2 | 110.1 | 110.1 | 109.4 | 110.3 | 0.72 |
| 180.0 | 179.0 | 179.0 | 179.5 | 180.9 | 180.3 | 180.6 | 180.5 | 180.3 | 180.2 | 180.2 | 180.8 | 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 | 1.0 |
| 110.0 | 109.5 | 109.5 | 1.1 | 0.1 | 1.2 |
| 180.0 | 179.0 | 179.0 | 1.5 | 0.2 | 1.6 |

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%

- 000 -

ABJ

Certificate of Calibration

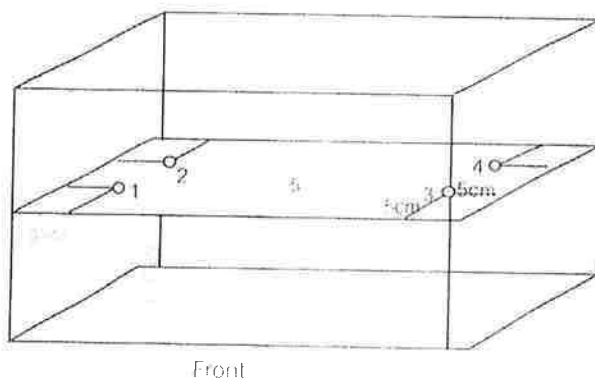
Certificate No. : 67-400166-2

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) a | | | | | Uncertainty (± °C) | Measured Uniformity (°C) | Measured Stability (°C) |
|----------------------|-------------------------------|----------------------------------|-------------------------------|-------|-------|-------|-------|-------------------------|-------------------------------|------------------------------|
| | | | Sensor No | | | | | | | |
| | | | 1 | 2 | 3 | 4 | 5 | | | |
| 95.0 | 94.5 | 94.5 | 95.12 | 95.18 | 95.11 | 95.02 | 95.17 | 0.23 | 0.26 | 0.12 |

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%

Cal

Certificate of Calibration

Certificate No. : 67-300147-2

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 : 50 ml

Graduation : 1 ml

ID No. : C-WW-011/23

Environment : Ambient Temperature : (20 ± 3) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1009.4 mbar.

Date of Received : 13 March 2024

Date of Calibration : 19 March 2024

Date of Issue : 19 March 2024

Calibrated by : Areerat Sombun

Calibration Method : In-house method CAL-M3001 based on ASTM E 542-22

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

Electronic Balance

ID No.

Cert. No.

Due Date

Traceability

241002

66-200388-1

02 Jun 2024

National Institute of Metrology (Thailand) (NIMT)

The Uncertainties are for a confidence probability of approximately 95%

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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. : 67-300147-2

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) |
|-----------------------|-------------------------|
| 30 | 29.69 |
| 50 | 49.87 |

Uncertainty of measurement with in \pm 0.054 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 -



CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhaphrachasan 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. : 67-300293-12

Page : 1 of 2

Submitted by : Envilab Co.,Ltd.

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

Equipment : Cylinder

Manufacturer : PYREX

Class : A

Capacity : 100 ml

Graduation : 1 ml

ID No. : C-HM-001/22

Environment : Ambient Temperature : (20 ± 3) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1006.0 mbar.

Date of Received : 15 May 2024

Date of Calibration : 20 May 2024

Date of Issue : 20 May 2024

Calibrated by : Arcerat Sombun

Calibration Method : In-house method CAL-M3001 based on ASTM E 542-22

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 | 66-200388-1 | 02 Jun 2024 | National Institute of Metrology (Thailand) (NIMT) |

Appr

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



CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhprachasan 3 Rd., Dangpood, 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. : 67-300293-12

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 | 50.19 |
| 100 | 100.16 |

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 $k = 2.000$, providing a level of confidence of approximately 95%

- oOo -



CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhaphrachasan 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-TIS 17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 67-300147-6

Page : 1 of 2

Submitted by : Envilab Co.,Ltd.

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

Equipment : Cylinder

Manufacturer : PYREX

Class : A

Capacity : 1000 ml

Graduation : 10 ml

ID No. : C-WW-001/24

Environment : Ambient Temperature : (20 ± 3) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1009.3 mbar

Date of Received : 13 March 2024

Date of Calibration : 19 March 2024

Date of Issue : 19 March 2024

Calibrated by : Arcerat Sombun

Calibration Method : In-house method CAL-M3001 based on ASTM E 542-22

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

Electronic Balance

| ID No. | Cert. No. | Due Date | Traceability |
|--------|-------------|-------------|---|
| 241002 | 66-200388-1 | 02 Jun 2024 | National Institute of Metrology (Thailand) (NIMT) |

Approved

The Uncertainties are for a confidence probability of approximately 95%

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CAL-F0031-03



ผู้จัดทำ: ฝ่ายควบคุมคุณภาพ

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_cali@yahoo.com, calibratech_cali@hotmail.com

Certificate of Calibration

Certificate No. : 67-300147-6

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) |
|-----------------------|-------------------------|
| 500 | 500.75 |
| 1000 | 1000.66 |

Uncertainty of measurement with in \pm 0.17 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%.

- o() o -

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. : 66-400546-1

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

540, 540/1 Soi Bangkhac 7, 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

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

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 66-400546-1

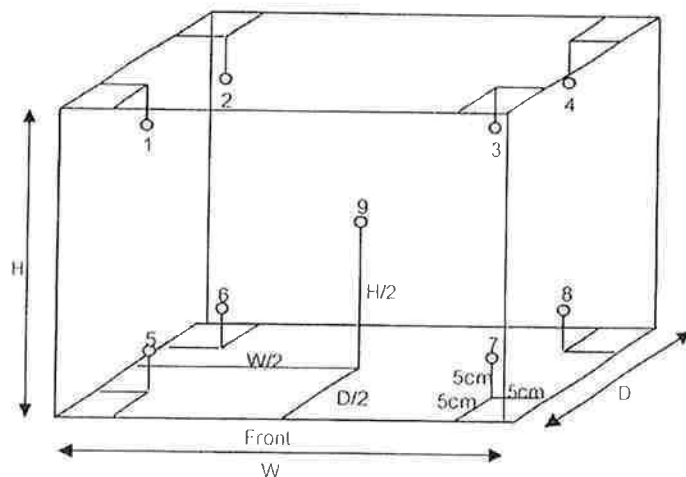
Page : 2 of 2

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 -

Certificate of Calibration

Certificate No. : 67-400054-2

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

540,540/1 Soi Bangkhac7, Bangkhac, 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, Envilab Co., Ltd.

Ambient Temperature : (30.0 to 31.0) °C

Relative Humidity : (50 to 55) %

Line Voltage : (224.0 to 225.0) V

Date of Received : 01 February 2024

Date of Calibration : 01 February 2024

Date of Issue : 03 February 2024

Calibrated by : Permpon Chanpu

Calibration Method : This instrument was calibrated by In-house method CAL-M4007 based on BS 2646 Part 1 : 2021

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

| <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> | <u>Traceability</u> |
|---------------|------------------|-----------------|---|
| 400039 | 66-400707-1 | 27 Jun 2024 | National Institute of Metrology Thailand (NIMT) |
| 400040 | 66-400707-2 | 27 Jun 2024 | National Institute of Metrology Thailand (NIMT) |
| 400041 | 66-400707-3 | 27 Jun 2024 | National Institute of Metrology Thailand (NIMT) |

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

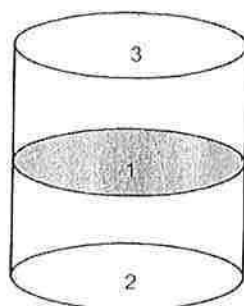
Certificate No. 67-400054-2

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 | 121.4 | 121.4 | 121.4 | 1.0 | 1.0 | 0.5 | 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 -



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 : B224051

Issued Date : 1 March 2024

Job Number : B224051

Page : 1 of 7 Pages

Customer : ENVILAB CO.,LTD. (HEAD OFFICE)

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

Environment Condition : Temperature: 20.8 °C ± 0.5 °C

Humidity: 53.0 %RH ± 3.1 %RH

Voltage: 221.5 VAC ± 0.3 VAC

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

Test By : Mr.Achira Kaewpaitoon

Test Date : 29 February 2024

Due Date : 28 February 2025

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-0-86850

Leak test of HEPA filter is traceable to WK Certificate Number :WK2309-176-1

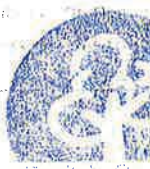
Illumination test is traceable to SP Certificate Number :SPR23030030-1

Ultraviolet Radiation test is traceable to EEI Certificate Number :CO20230085EA

Sound test is traceable to SP Certificate Number :SPR23030030-2

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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Primary Test Results

1. Downflow Velocity Test

Test equipment used

- Thermo anemometer
- Brand: Testo
- Model: 425
- Serial number: 3101751
- Calibration due: 6-Nov-2024

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 front window. Start 150 mm from the left side window and with 300 mm between the measuring spots.

Downflow Velocity Unit: m/s

Back

| | | | |
|------|------|------|------|
| 0.35 | 0.36 | 0.35 | 0.34 |
| 0.33 | 0.35 | 0.35 | 0.34 |

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. | 0.35 | 0.36 | 0.33 | 0.28 - 0.42 |

Result Summary : Pass



AIRFLOW CALIBRATION CO.,LTD.

Continuation of the Certificate of Test Report Number : B224051

Page 3 of 7 Pages

2. Inflow Velocity Test

Test equipment used

- Thermo anemometer ● Brand: Testo ● Model: 425
- Serial number: 3101751 ● Calibration due: 6-Nov-2024

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

| | | | | | | | | | | |
|------|------|------|------|------|------|------|------|------|------|------|
| 1.29 | 1.28 | 1.29 | 1.31 | 1.32 | 1.32 | 1.31 | 1.32 | 1.31 | 1.32 | 1.32 |
|------|------|------|------|------|------|------|------|------|------|------|

Characteristic of air velocities in the work opening

| Specification | Mean Inflow (m/s) |
|---|-------------------|
| • Mean Inflow velocity to achieve product protection : ≥ 0.40 m/s. | 0.50 |

Result Summary : Pass

Adjustments Required

Fan speed



No Change

Damper



No Change

AIR FM - SV - 08 : 01 Sep 2021

51/104 Moo 9, Ladswai, Lamtukka Phatunthani 12150 Thailand

Tel : 0 2152 8350 , 0 2152 8348 , 0 2152 8070 , 08 4360 2558 , 09 2145 3175

http:// www.airflow-calibration.com E-mail : bm.airflow@gmail.com , info.airflow@gmail.com



Airflow Co., Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ



Page 4 of 7 Pages

3. Leak Test of HEPA Filters

Test equipment used

Test equipment used:

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

Characteristic of PAO test

| Characteristic of PAO test | | |
|--|-------|------|
| Concentration on the upstream side of main HEPA filter | 34 | 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

[illegible]

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

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51104 Moo 9, Ladsawai, Lamukha Phatunthani 12150 Thailand

Tel: 0 2152 8350, 0 2152 8348, 0 2152 8070, 08 4360 2558, 09 2265 3175, 0 2152 8344

http://www.airflow-calibration.com E-mail: bob.airflow@gmail.com, info@airflow-cal.com



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AIRFLOW CALIBRATION CO.,LTD.

Continuation of the Certificate of Test Report Number : B224051

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

AIR FM - SV - 08 : 01 Sep 2021

54/104 Moo 9, Ladsawai, Lam Lukka Phatunthani 12150 Thailand

Tel : 0 2152 8350 , 0 2152 8348 , 0 2152 8070 , 08 4360 2558 , 09 2265 3111 Fax : 0 2152 8311

http://www.airflow-calibration.com E-mail : bm.airflow@gmail.com , noo.airflow@gmail.com





AIRFLOW CALIBRATION CO.,LTD.

Continuation of the Certificate of Test Report Number : B224051

Page 6 of 7 Pages

5. Site Installation

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

6. Soap Solution

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

Result Summary : Absence of soap bubbles. N/A

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: Daiichi
- Model: LM507
- Serial number: 1300421511013
- Calibration due: 2-Mar-2024

Illumination Unit: Lux

Back

| | | | | |
|-----|-----|-----|------|------|
| 819 | 923 | 944 | 1059 | 1049 |
|-----|-----|-----|------|------|

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

AIR FM - SV - 08 - 01 Sep 2021

51/104 Moo 9, Ladsawai, Lamukha Phatamthani 12150 Thailand

Tel : 0 2152 8350 , 0 2152 8348 , 0 2152 8070, 08 4360 2558 , 09 2265 4455 Fax : 0 2152 8351

http://www.airflow-calibration.com E-mail : hn.airflow@gmail.com hn.airflow@gmail.com



Airflow Co., Ltd.



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: Lutron ● Model: UVC-254SD
● Serial number: Q853539 ● Calibration due: 26-Sep-2024

Ultraviolet Radiation Unit: mW/m^2

Back

| | | | | |
|------|------|------|------|------|
| 2300 | 2920 | 3350 | 2080 | 1960 |
|------|------|------|------|------|

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: 19090231 ● Calibration due: 2-Mar-2024

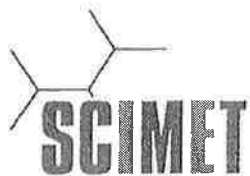
* Sound pressure level of the background: 50.6 dBA

* Sound levels: 59.2 dBA

Result Summary : Pass

End of Certificate of Test Report





SCIMET Co., Ltd.
1194 Soi Wachirathamsathit 57, Bangchak,
Phrakhanong, Bangkok 10260 Thailand
Email:scimet2022@gmail.com, Tel:095-552-4939

Certificate No. C27240001

Calibration Certificate

Equipment: DO METER

Model: HI9147

Serial No.(or ID): H00007030

Manufacturer: HANNA

Condition: In Condition

Job No.: KSMT2400445

Received Date: 04 March 2024

Issued Date: 14 March 2024

Page: 1 of 2

Customer

Envilab Co., Ltd.

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

Calibration Place

Environment Laboratory, SCIMET Co., Ltd.

1194 Soi Wachirathamsathit 57, Bangchak, Prakhnong, Bangkok 10260 Thailand

Calibration Date

14 March 2024

Environment Condition

Temperature: 23 °C \pm 2 °C

Humidity: 50 %RH \pm 15 %RH

The Method used

In-house method, WI27 , By comparison with certified dissolved oxygen solution standard

Traceability

This is certificate is traceable to SI Units , Sample test and temperature test are assured through HANNA instruments company certificare No. 29E31, through Quality Reborn Co.,LTD certificare No.QR23-1169

This certificate is issued the units of measurement according to the International System of Units (SI). It provides traceability of measurement to international or national standard or other recognized national standard laboratories.

The measurement uncertainty stated is the expanded uncertainty which is obtained from the standard uncertainty multiplied by the coverage factor ($k=2$) to provide a level of confidence of approximately 95%. It is determined in accordance with the Guide to Expression of Uncertainty in Measurement (GUM).

These results may be affected by deviations from specified conditions. The results relate only to the items tested, calibrated or sampled. The report shall not be reproduced except in full without approval of SCIMET Co., Ltd.



Mr.Dumrong Boonsopon

Person in charge



Envilab Co.,Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

Calibration Results:

Electrode Serial No. KC3N05V1R
Model : H176409
Brand : HANNA

Electrode Test

Atmospheric pressure measured while calibrating. 755.54 mmHg
Temperature measured while calibrating.(± 0.2 °C) 25.0 °C
The Oxygen Solubility was calculated from the ambient conditions. 8.21 \pm 0.03 mg/L
The Oxygen Solubility reading from the DO METER 8.23 mg/L

Sample Test

| Standard Oxygen Solution | Unit Under Calibration Reading | Correction | Coverage Factor (<i>k</i>) | Uncertainty of Measurement (\pm) |
|-----------------------------|-----------------------------------|------------|---------------------------------|---|
| 0.00 mg/L | 0.00 mg/L | 0.000 mg/L | 2.00 | 0.13 mg/L |

Temperature Electrode

Dimension of Probe;

Length : 140 mm.
Diameter : 21 mm.
Immersion Depth 80 mm.

| STD. Reading (°C) | UUC. Reading (°C) | Correction of UUC (°C) | Coverage Factor (<i>k</i>) | Uncertainty of Measurement (\pm °C) |
|----------------------|----------------------|---------------------------|---------------------------------|---|
| 25.01 | 25.0 | 0.01 | 2.00 | 0.15 |

The End of Certificate



ใบตรวจสอบสภาพเครื่อง Do Meter

เลขที่ใบงาน: KSMT2400445

ชนิดเครื่องมือ: DO METER

รุ่น: HI9147

หมายเลขเครื่อง: H00007030

| ตรวจสอบ (รับ) | | รายการตรวจเช็ค | ตรวจสอบ (ส่ง) | | หมายเหตุ |
|-------------------------------------|--------------------------|---|-------------------------------------|--------------------------|----------|
| 14 Mar 2024 | | | 14 Mar 2024 | | |
| ปกติ | ไม่ปกติ | | ปกติ | ไม่ปกติ | |
| | | | | | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 1. ความสมบูรณ์เครื่อง | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Swicth) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 4. ปุ่มกด (Keypad) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 5. หน้าจอ (Display, Screen Contrast) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 6. อิเล็กโทรด (Electrode and Connection Cable) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 7. สายอิเล็กโทรด | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 8. เช็นเซอร์อิเล็กโทรด | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |
| <input checked="" type="checkbox"/> | <input type="checkbox"/> | 9. ขาจับอิเล็กโทรด (Stand) | <input checked="" type="checkbox"/> | <input type="checkbox"/> | |

ข้อแนะนำ :

Mr.Dumrong Boonsopon

Service Engineer

บริษัท ชายนีเมก จำกัด (SCIMET CO., LTD.)

119/4 Soi Wacharathammasathit 57, Bangchak, Phraekhanong, Bangkok 10260 Thailand
Email scimet2022@gmail.com, Tel 095 552 4939



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, TIAS 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



Envilab Co., Ltd.

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 66-400546-3

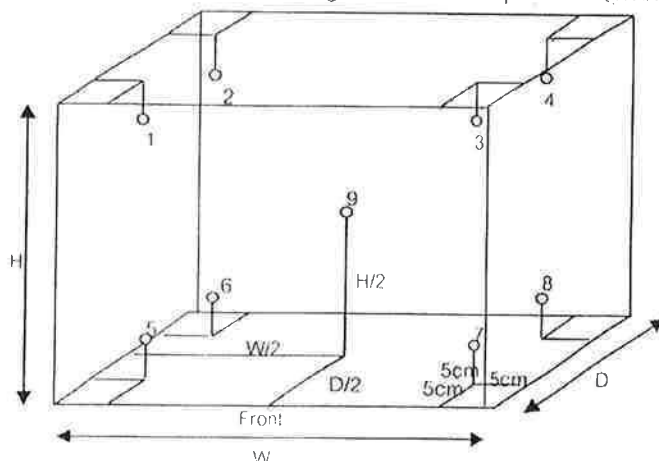
Page : 2 of 2

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%

- o0o -



ผู้ตรวจการสอบเทียบ



Certificate of Calibration

Certificate No. : 67-400312-1

Page : 1 of 2

Submitted by : Envilab Co., Ltd.

540,540/1 Soi Bangkhac7, Bangkhac, Bangkok 10160

Equipment : COD Reactor

Manufacturer : Hanna

Model : HI839800

Range : N/A °C

Resolution : 0.1 °C

Serial No. : 06480040101

ID No. : ELABHI83980001

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

Relative Humidity : (50 ± 15) %

Date of Received : 30 May 2024

Date of Calibration : 04 June 2024

Date of Issue : 04 June 2024

Calibrated by : Chortip Samchusri

Calibration Method : This instrument was calibrated by In-house method direct measurement with

The temperature scale used was based on ITS-90

Reference Standard Instruments :

Standard Digital Thermometer with TC Type T probe

| <u>ID No.</u> | <u>Cert. No.</u> | <u>Due Date</u> | <u>Traceability</u> |
|-----------------|------------------|-----------------|---|
| 400046 & 400023 | 67-400198-1 | 01 Oct 2024 | National Institute of Metrology Thailand (NIMT) |

Approved by



The Uncertainties are for a confidence probability of approximately 95%

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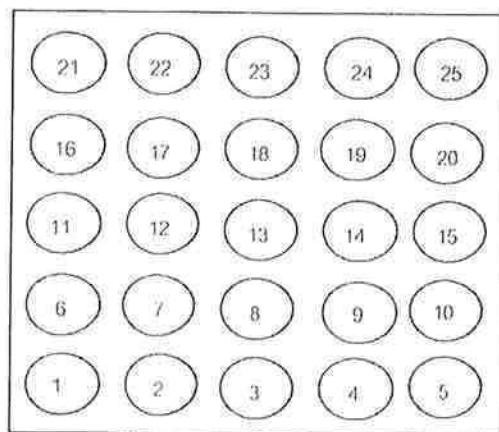
Certificate of Calibration

Certificate No. : 67-400312-1

Page : 2 of 2

Result of Calibration : Without Adjustment

Function : Temperature measurement



Controller

| Test Point (° C) | UUC Setting (° C) | UUC Reading (° C) | Standard Reading at Position (° C) | | | | | | | | | |
|-----------------------|------------------------|------------------------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| 150.0 | 150.0 | 150.0 | 148.9 | 149.1 | 149.4 | 148.4 | 148.3 | 148.5 | 149.8 | 148.8 | 148.9 | 149.5 |

| Test Point (° C) | UUC Setting (° C) | UUC Reading (° C) | Standard Reading at Position (° C) | | | | | | | | | |
|-----------------------|------------------------|------------------------|--------------------------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| | | | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
| 150.0 | 150.0 | 150.0 | 149.2 | 150.3 | 149.7 | 149.8 | 148.2 | 149.4 | 148.7 | 148.8 | 151.7 | 149.6 |

| Test Point (° C) | UUC Setting (° C) | UUC Reading (° C) | Standard Reading at Position (° C) | | | | | Uncertainty (± ° C) |
|-----------------------|------------------------|------------------------|--------------------------------------|-------|-------|-------|-------|--------------------------|
| | | | 21 | 22 | 23 | 24 | 25 | |
| 150.0 | 150.0 | 150.0 | 148.8 | 149.3 | 149.2 | 148.7 | 149.3 | 0.78 |

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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CAL

Calibratech Co.,Ltd.

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

Tel.(02) 964-6211 Fax.(02) 961-5155, e-mail : calibratech.cal@yahoo.com, calibratech.cal@hotmail.com



NSC-TISI-TIS17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 67-300293-5

Page : 1 of 2

Submitted by : Envilab Co.,Ltd.

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

Equipment : Volumetric Pipette

Manufacturer : Witeg

Class : A

Capacity : 5 ml

ID No. : P-HM-009/61

Environment : Ambient Temperature : (20 ± 3) °C

Relative Humidity : (50 ± 10) %

Air Pressure : 1003.7 mbar.

Date of Received : 15 May 2024

Date of Calibration : 20 May 2024

Date of Issue : 20 May 2024

Calibrated by : Arcerat Sombun

Calibration Method : In-house method CAL-M3001 based on ASTM E 542-22

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> |
|---------------|------------------|-----------------|---|
| 241005 | 66-200388-4 | 02 Jun 2024 | National Institute of Metrology (Thailand) (NIMT) |

Approved by

*The Uncertainties are for a confidence probability of approximately 95%

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CAL

Calibratech Co.,Ltd.

7/106-7 Moo 2, Sukhaphrasan 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. : 67-300293-5

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

Delivery Time : 10.26 sec.

| Nominal Volume (ml) | Measuring Volume (ml) |
|-----------------------|-------------------------|
| 5 | 4.9881 |

Uncertainty of measurement with in \pm 0.0026 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%

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Agilent CrossLab Start Up Services

Agilent 5100 5110 ICP-OES Preventive Maintenance

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

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

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

Customer Information

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

✓

Important Customer Web Links

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



Service Engineer's Responsibilities

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



Instrument Maintenance

System Information

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

| | |
|-------------------------------------|--------------------------------------|
| Instrument System Name and ID | ICP 5110 VDV / MY17490002 |
| Instrument System Site and Location | ENVILAB Company Limited / Laboratory |

| List System Component Product Numbers | List the Serial Numbers of each Component |
|---------------------------------------|---|
| 1. G8015A | MY17490002 |
| 2. G8481A | 1709-05327 |
| 3. G8410A | AU17393768 |
| 4. | |
| 5. | |
| 6. | |
| 7. | |
| 8. | |
| 9. | |

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



Preparation

- ☒ Discuss any specific issues with the customer before starting.
- ☒ Review the instrument logbook for recorded problems and comments.
- ☒ Save instrument control settings before starting the procedure.
- ☒ Perform a general inspection of the system for cleanliness.
- ☒ Check for proper installation of parts, assemblies, sensors etc.
- ☒ Check system for required installation of components and implementation of Service Notes
- ☒ Check for required firmware/software updates and verify with customers if they would like them installed.
- ☒ For HF application systems, if standard sample introduction system was not installed, ask the customer to install it.
- ☒ 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
- ☒ Test using customer's tray and move the sample probe to the sample vial 1, wash vial and rinse port and ensure that the probe is centered in the vial. If not use calibration wizard and calibrate the position.

AVS 4, 6, 7 Advanced Valve System

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



ICP-OES adjustment

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

Record Post-PM instrument performance

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



Restore Instrument

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

Service Review

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



Test Results

Instrument Performance Test Results Table

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

| | Pre PM Sensitivity Check | | Post PM Sensitivity Check | |
|--------------------|--------------------------|---------|---------------------------|---------|
| | Radial | Axial * | Radial | Axial* |
| Zn 213.857 nm SRBR | 1597.1 | 3382.6 | 3780.2 | 7240.8 |
| Mn 257.610 nm SRBR | 5945.3 | 16145.3 | 11049.1 | 24678.4 |
| Al 396.152 nm SBR | 7.0 | 16.3 | 6.8 | 17.0 |
| K 766.491 nm SBR | 5.2 | 67.3 | 3.5 | 56.3 |

* 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 | VAC | 217 | VAC |
| Mains Current | 0.082 | A | 0.098 | A |
| Instrument Temperature | 23.5 | °C | 24.5 | °C |
| RF Air Flow (sensor speed) | 13.0 | Hz | 19.0 | Hz |
| Plasma Exhaust Temperature | No measurement | | 56.4 | °C |
| Water Flow Oscillator | No measurement | | 1.51 | L/min |
| Water Flow Detector | 1.09 | 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 | -39.6 | °C |
| Thermal Stabilizer | 35.0 | °C | 35.0 | °C |
| Argon Supply Pressure | 619 | kPa | 560 | kPa |
| Purge Gas Supply Pressure*1 | 616 | kPa | 597 | kPa |
| Option Gas Supply Pressure*1 | N/A | kPa | N/A | kPa |
| Nebulizer Flow | No measurement | | 0.7 | L/min |
| Nebulizer Back Pressure | No measurement | | 283 | kPa |
| Plasma Gas Flow | No measurement | | 11.98 | L/min |
| Auxiliary Gas Flow | No measurement | | 1.00 | L/min |
| RF Power | No measurement | | 1195.1 | W |
| RF Supply Current | No measurement | | | |
| RF Supply Voltage | No measurement | | | |

*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 | |
| Purge Gas Filter | G8010-60136 | All | 1 |
| Air inlet filter | G8010-68002 | All | 1 |
| High Capacity Air Filter | G8010-60189 | Optional | |
| Rotor seal for 6-7 port valve for AVS5/7 | G8494-60002 | G8494A/G8495 | |
| Rotor seal for 4 port valve for AVS4 | G8493-60002 | G8493A | |
| Rinse solution to rinse station 2.5mm id x 1m | G8410-80123 | SPS 4 | |
| Barb connector 2.5mm-1.5mm ID | G8410-80124 | SPS 4 | |
| PVC waste tubing, 8mm od x 5mm id, 2m | G8410-80122 | SPS 4 | |
| Additional Parts may be required from engineer's stock: | | | |
| X axis drive belt | 5-10047500 | SPS 3 | |
| Z axis drive belt | 5-10047400 | SPS 3 | |
| Peristaltic pump tubing, PVC SolvaFlex 3 bridged, | 5-710049000 | SPS 4 | |

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.

Performed PM on date 31 May 2024 but sensitivity is still low in some wavelength on Axial view.
After replace mirror kit and Prism grating test performance again all pass result.

Service Verification

Service Request Number:

6006868005

Service Engineer Name:

Worawit Timakul

Service Engineer Signature:



Total number of pages in this document:

14

Date Service Completed:

3 July 2024

Customer Name:

K Jenjira

Customer Signature:



Agilent

Report Summary

| | |
|--------------------------|-------------------------------|
| Instrument Model | Agilent 5100/5110 VDV ICP-OES |
| Instrument ID | G8011A/G8015A |
| Instrument Serial Number | MY17490002 |
| Software Version | 7.6.2.12331 |
| Firmware Version | 5590 |
| Tested By | PM Functional Test |
| Test started on | 7/3/2024 5:11:51 PM |
| Test Completed On | 7/3/2024 5:18:04 PM |

Result Summary

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

Subsystem Communications Test

Pass

Air Flow Test

Pass

| | |
|-------------------------------|-------------------------------|
| 30% Air Flow (relative speed) | 60% Air Flow (relative speed) |
| 11.00 | 16.00 |

Water Flow Test

Pass

| | | |
|----------------------|---------------------------|-------------------------|
| RF Water Flow(L/min) | Camera Water Flow (L/min) | Water Inlet Temperature |
| 1.48 | 1.06 | 18.92 |



Gas Flows Test**Pass**

| Nebulizer Target Flow | Actual Flow | Back Pressure | Auxiliary Target Flow | Actual Flow | Back Pressure |
|--------------------------|-------------|------------------|--------------------------|-------------|------------------|
| 0.70 | 0.71 | 298.41 | 2.00 | 2.00 | 92.61 |

| Makeup Target Flow | Actual Flow | Back Pressure | Plasma Target Flow | Actual Flow | Back Pressure |
|-----------------------|-------------|------------------|-----------------------|-------------|------------------|
| 2.00 | 2.00 | 93.99 | 18.00 | 17.93 | 22.74 |

RF Generator Test**Pass**

| | |
|----------------------|---------|
| RF Power Supply Test | Passed |
| RF Power Supply (V) | 147.399 |

| | |
|----------------------------------|--------|
| RF Oscillator Test | Passed |
| RF Oscillator Frequency (MHz) | 25.961 |
| Work Coil Current (A) | 45.586 |
| RF Power Supply Current (A) | 2.000 |

Camera Test**Pass**

| | | |
|------------------|------------|---------------------|
| Black Level Test | Noise Test | Photo Response Test |
| Passed | Passed | Passed |

Report Detail

Tests Run - Operator: PM Functional Test

Subsystem Communications Test- Started

SubSystem Status

Mains Power Module - Passed
Gas Control Module - Passed
RF Generator - Passed
pre-optics Module - Passed
Optics/Camera Control Module - Passed
Peristaltic Pump - Passed
Subsystem Communications Test Completed - Passed

Air Flow- Started

Fan Speed(%) Air Flow(relative speed) Status

30% 11 - Passed

60% 16 - Passed
Air Flow Completed - Passed

Water Flow- Started

RF Water Flow(L/min) = 1.48
Camera Water Flow (L/min) = 1.06
Water Inlet Temperature = 18.92
RF Water Flow(L/min) (off) = 0.01
Water Flow Completed - Passed

Gas Flows- Started

Channel Target Actual Pressure Failure Status

Auxiliary Gas 0.00 0.00 N/A N/A - Passed
Auxiliary Gas 2.00 2.00 N/A N/A - Passed
Nebulizer Gas 0.00 0.00 0.00 N/A - Passed
Nebulizer Gas 0.70 0.71 298.41 N/A - Passed
Plasma Gas 0.00 0.00 N/A N/A - Passed
Plasma Gas 18.00 17.93 N/A N/A - Passed
Makeup Gas 0.00 0.00 N/A N/A - Passed
Makeup Gas 2.00 2.00 N/A N/A - Passed
Purge Gas 0.70 0.69 N/A N/A - Passed
Purge Gas 3.70 3.70 N/A N/A - Passed
All Channel flows ON : - Passed
All Channel flows OFF : - Passed
Gas Flows Completed - Passed

RF Generator- Started

RF generator turned off - Passed
RF generator turned on - Passed
Bias Control = 0 V - Passed
RF Power Supply - Set Value = 150V, Actual Value = 147.40V - Passed
RF Oscillator Started - Passed
RF Oscillator Frequency(MHz) = 25.96 , Workcoil Current(Amps) = 45.59, RF Power Supply
Current(Amps) = 2.00 - Passed
RF Oscillator stopped - Passed
RF generator turned off - Passed
RF Generator Completed - Passed

Camera Test- Started

Black level test - PASSED
Noise test - PASSED
Photo response test - PASSED
Camera Test Completed - Passed



Report Summary

| | |
|--------------------------|-------------------------------|
| Instrument Model | Agilent 5100/5110 VDV ICP-OES |
| Instrument ID | G8011A/G8015A |
| Instrument Serial Number | MY17490002 |
| Software Version | 7.6.2.12331 |
| Firmware Version | 5590 |
| Tested By | PM Performance Test |
| Test started on | 7/3/2024 5:21:57 PM |
| Test Completed On | 7/3/2024 5:27:49 PM |

Result Summary

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

Optics Test

Pass

| | Radial | Axial |
|------------|---------|---------|
| Intensity | 3761468 | 3583981 |
| Wavelength | 737.212 | 737.212 |



Resolution Test

Pass

| Element Wavelength | Specification | Width |
|--------------------|---------------|-------|
| N (174.213 nm) | ≤ 9.40 | 8.03 |
| As (188.980 nm) | ≤ 8.20 | 6.83 |
| C (193.027 nm) | ≤ 11.50 | 8.85 |
| Mo (202.032 nm) | ≤ 8.20 | 6.89 |
| Cr (206.158 nm) | ≤ 13.40 | 10.35 |
| Zn (213.857 nm) | ≤ 8.70 | 7.56 |
| Pb (220.353 nm) | ≤ 9.50 | 7.95 |
| Co (228.615 nm) | ≤ 17.20 | 12.73 |
| Ba (230.424 nm) | ≤ 9.40 | 7.74 |
| Mn (257.610 nm) | ≤ 13.30 | 9.62 |
| Mn (260.568 nm) | ≤ 20.30 | 15.70 |
| Cr (267.716 nm) | ≤ 11.00 | 8.63 |
| Cu (324.754 nm) | ≤ 25.00 | 18.35 |
| Cu (327.395 nm) | ≤ 14.20 | 11.46 |
| Sr (338.071 nm) | ≤ 33.50 | 26.02 |
| Ba (455.403 nm) | ≤ 44.00 | 30.98 |
| Sr (460.733 nm) | ≤ 36.00 | 22.30 |
| Ba (493.408 nm) | ≤ 36.00 | 25.46 |
| Ba (614.171 nm) | ≤ 42.00 | 28.20 |
| Ar (675.283 nm) | ≤ 74.00 | 62.42 |
| K (766.491 nm) | ≤ 80.00 | 56.34 |



Sensitivity Test**Pass**

Radial

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|--------------------|---------------|--------|---------|-----------|---------|
| As (188.980 nm) | ≥ 46.0 | SRBR | 182.4 | 2397.8 | 151.6 |
| Se (196.026 nm) | ≥ 41.0 | SRBR | 93.7 | 1389.6 | 169.5 |
| Zn (213.857 nm) | ≥ 1421.0 | SRBR | 3780.2 | 66441.0 | 306.1 |
| Pb (220.353 nm) | ≥ 46.0 | SRBR | 196.0 | 4072.1 | 358.9 |
| Mn (257.610 nm) | ≥ 3518.0 | SRBR | 11049.1 | 301588.1 | 741.4 |
| Al (396.152 nm) | ≥ 3.4 | SBR | 6.8 | 50477.4 | 6509.3 |
| Ba (493.408 nm) | ≥ 34.0 | SBR | 93.1 | 2100930.1 | 22316.9 |
| K (766.491 nm) | ≥ 1.8 | SBR | 3.5 | 131427.0 | 29110.8 |

Axial

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|--------------------|---------------|--------|---------|-----------|---------|
| As (188.980 nm) | ≥ 208.0 | SRBR | 322.7 | 5632.4 | 275.6 |
| Se (196.026 nm) | ≥ 159.0 | SRBR | 187.7 | 3584.9 | 305.2 |
| Zn (206.200 nm) | ≥ 243.0 | SRBR | 1725.1 | 29055.7 | 278.3 |
| Zn (213.857 nm) | ≥ 1743.0 | SRBR | 7240.8 | 182856.8 | 633.3 |
| Cd (214.439 nm) | ≥ 4227.0 | SRBR | 6425.3 | 142739.0 | 490.1 |
| Pb (220.353 nm) | ≥ 320.0 | SRBR | 535.9 | 15385.9 | 746.2 |
| Mn (257.610 nm) | ≥ 10625.0 | SRBR | 24678.4 | 1013126.8 | 1679.8 |
| Cr (267.716 nm) | ≥ 1048.0 | SRBR | 4369.9 | 193094.8 | 1914.0 |
| Cu (324.754 nm) | ≥ 19.0 | SBR | 43.6 | 268495.8 | 6020.9 |
| Al (396.152 nm) | ≥ 6.0 | SBR | 17.0 | 229052.6 | 12716.0 |
| Ba (493.408 nm) | ≥ 60.0 | SBR | 205.6 | 9093893.8 | 44014.0 |
| K (766.491 nm) | ≥ 24.0 | SBR | 56.3 | 2713674.7 | 47391.6 |

Precision Test**Pass**

Radial

| Element Wavelength | Specification | Measured Value % RSD |
|--------------------|---------------|----------------------|
| As (188.980 nm) | ≤ 2.60 | 0.66 |
| Se (196.026 nm) | ≤ 2.60 | 0.53 |
| Zn (213.857 nm) | ≤ 1.50 | 0.38 |
| Pb (220.353 nm) | ≤ 2.60 | 0.69 |
| Mn (257.610 nm) | ≤ 1.50 | 0.38 |

| | | | | |
|-----------------|--------|------|--|--|
| Al (396.152 nm) | ≤ 1.50 | 0.38 | | |
| Ba (493.408 nm) | ≤ 1.50 | 0.84 | | |
| K (766.491 nm) | ≤ 1.50 | 0.34 | | |

Axial

| Element Wavelength | Specification | Measured Value | % RSD | |
|--------------------|---------------|----------------|-------|--|
| As (188.980 nm) | ≤ 1.50 | 0.32 | | |
| Se (196.026 nm) | ≤ 1.50 | 0.36 | | |
| Zn (206.200 nm) | ≤ 1.50 | 0.37 | | |
| Zn (213.857 nm) | ≤ 1.50 | 0.43 | | |
| Cd (214.439 nm) | ≤ 1.50 | 0.61 | | |
| Pb (220.353 nm) | ≤ 1.50 | 0.45 | | |
| Mn (257.610 nm) | ≤ 1.50 | 1.02 | | |
| Cr (267.716 nm) | ≤ 1.50 | 0.29 | | |
| Cu (324.754 nm) | ≤ 1.50 | 0.43 | | |
| Al (396.152 nm) | ≤ 1.50 | 0.31 | | |
| Ba (493.408 nm) | ≤ 1.50 | 0.47 | | |
| K (766.491 nm) | ≤ 1.50 | 0.35 | | |

Report Detail

Tests Run - Operator: PM Performance Test

Optics Test- Started

Test View Mode Intensities Status

LED Off - Passed
 Shutter opened - Passed
 Peak Intensity Radial mode 3761468.41 - Passed
 Shutter closed - Passed
 Peak Intensity(closed shutter) Radial mode 96.33 - Passed
 Shutter opened - Passed
 Optical Argon Ratio: Calculated Value = 4.86, Factory Value = 3.80
 Peak Intensity Axial mode 3583980.93 - Passed
 Radial-Axial Intensity Ratio:(Range 0-100) - 0.95 - Passed
 Shutter closed - Passed
 Optics Test Completed - Passed

Instrument Performance- Started

Instrument Performance Completed - Passed



Report Summary

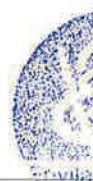
| | |
|--------------------------|-------------------------------|
| Instrument Model | Agilent 5100/5110 VDV ICP-OES |
| Instrument ID | G8011A/G8015A |
| Instrument Serial Number | MY17490002 |
| Software Version | 7.4.0.10280 |
| Firmware Version | 3562 |
| Tested By | Kanyakorn S. |
| Test Started On | 5/31/2023 10:07:17 AM |
| Test Completed On | 5/31/2023 10:12:01 AM |

Result Summary

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

Subsystem Communications Test

Pass



Pa

Resolution Test

Pass

| Element Wavelength | Specification | Width |
|--------------------|---------------|-------|
| N (174.213 nm) | ≤ 9.40 | 6.76 |
| As (188.980 nm) | ≤ 8.20 | 6.26 |
| C (193.027 nm) | ≤ 11.50 | 8.06 |
| Mo (202.032 nm) | ≤ 8.20 | 6.41 |
| Cr (206.158 nm) | ≤ 13.40 | 8.55 |
| Zn (213.857 nm) | ≤ 8.70 | 7.31 |
| Pb (220.353 nm) | ≤ 9.50 | 7.52 |
| Co (228.615 nm) | ≤ 17.20 | 11.51 |
| Ba (230.424 nm) | ≤ 9.40 | 7.59 |
| Mn (257.610 nm) | ≤ 13.30 | 9.76 |
| Mn (260.568 nm) | ≤ 20.30 | 14.02 |
| Cr (267.716 nm) | ≤ 11.00 | 8.88 |
| Cu (324.754 nm) | ≤ 25.00 | 18.97 |
| Cu (327.395 nm) | ≤ 14.20 | 12.29 |
| Sr (338.071 nm) | ≤ 33.50 | 24.53 |
| Ba (455.403 nm) | ≤ 44.00 | 33.64 |
| Sr (460.733 nm) | ≤ 36.00 | 22.78 |
| Ba (493.408 nm) | ≤ 36.00 | 27.34 |
| Ba (614.171 nm) | ≤ 42.00 | 29.37 |
| Ar (675.283 nm) | ≤ 74.00 | 62.91 |
| K (766.491 nm) | ≤ 80.00 | 66.34 |



Sensitivity Test

Fail

Radial

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|------------------------|---------------|--------|---------------|-----------|---------|
| As (188.980 nm) | ≥ 46.0 | SRBR | 103.4 | 920.7 | 68.0 |
| Se (196.026 nm) | ≥ 41.0 | SRBR | 95.9 | 1058.1 | 99.9 |
| Zn (213.857 nm) | ≥ 1421.0 | SRBR | 1597.1 | 21509.7 | 178.4 |
| Pb (220.353 nm) | ≥ 46.0 | SRBR | 84.9 | 988.5 | 107.6 |
| Mn (257.610 nm) | ≥ 3518.0 | SRBR | 5945.3 | 191181.0 | 1023.0 |
| Al (396.152 nm) | ≥ 3.4 | SBR | 7.0 | 36724.0 | 4571.6 |
| Ba (493.408 nm) | ≥ 34.0 | SBR | 80.3 | 1231010.1 | 15137.8 |
| K (766.491 nm) | ≥ 1.8 | SBR | 5.2 | 102201.3 | 16364.6 |

Axial

| Element Wavelength | Specification | Method | Ratio | Standard | Blank |
|------------------------|------------------|--------|---------|-----------------|---------|
| As (188.980 nm) | ≥ 208.0 | SRBR | 216.5 | 2999.7 | 170.8 |
| Se (196.026 nm) | ≥ 159.0 | SRBR | 206.0 | 3578.4 | 259.6 |
| Zn (206.200 nm) | ≥ 234.0 | SRBR | 133.9 | 1466.2 | 103.6 |
| Zn (213.857 nm) | ≥ 1743.0 | SRBR | 3382.6 | 82237.7 | 582.7 |
| Cd (214.439 nm) | ≥ 4227.0 | SRBR | 2507.4 | 45255.5 | 321.1 |
| Pb (220.353 nm) | ≥ 320.0 | SRBR | 307.0 | 5807.3 | 319.6 |
| Mn (257.610 nm) | ≥ 10625.0 | SRBR | 16145.3 | 1167258.0 | 5180.6 |
| Cr (267.716 nm) | ≥ 1048.0 | SRBR | 4178.6 | 193917.0 | 2107.1 |
| Cu (324.754 nm) | ≥ 19.0 | SBR | 46.1 | 339833.3 | 7221.3 |
| Al (396.152 nm) | ≥ 6.0 | SBR | 16.3 | 237471.0 | 13698.2 |
| Ba (493.408 nm) | ≥ 60.0 | SBR | 134.4 | 7284606.0 | 53817.7 |
| K (766.491 nm) | ≥ 24.0 | SBR | 67.3 | 2906474.3 | 42555.9 |



Precision Test**Pass**

Radial

| Element Wavelength | Specification | Measured Value % RSD |
|--------------------|---------------|----------------------|
| As (188.980 nm) | ≤ 2.60 | 1.06 |
| Se (196.026 nm) | ≤ 2.60 | 0.98 |
| Zn (213.857 nm) | ≤ 1.50 | 0.38 |
| Pb (220.353 nm) | ≤ 2.60 | 1.05 |
| Mn (257.610 nm) | ≤ 1.50 | 0.39 |
| Al (396.152 nm) | ≤ 1.50 | 0.36 |
| Ba (493.408 nm) | ≤ 1.50 | 0.51 |
| K (766.491 nm) | ≤ 1.50 | 0.29 |

Axial

| Element Wavelength | Specification | Measured Value % RSD |
|--------------------|---------------|----------------------|
| As (188.980 nm) | ≤ 1.50 | 0.37 |
| Se (196.026 nm) | ≤ 1.50 | 0.52 |
| Zn (206.200 nm) | ≤ 1.50 | 0.47 |
| Zn (213.857 nm) | ≤ 1.50 | 0.65 |
| Cd (214.439 nm) | ≤ 1.50 | 0.47 |
| Pb (220.353 nm) | ≤ 1.50 | 0.41 |
| Mn (257.610 nm) | ≤ 1.50 | 0.97 |
| Cr (267.716 nm) | ≤ 1.50 | 0.31 |
| Cu (324.754 nm) | ≤ 1.50 | 0.42 |
| Al (396.152 nm) | ≤ 1.50 | 0.38 |
| Ba (493.408 nm) | ≤ 1.50 | 1.23 |
| K (766.491 nm) | ≤ 1.50 | 0.64 |



Certificate of Calibration

| Calibration Certification Information | | | |
|---------------------------------------|----------------------|-----------------|--|
| Cal. Date: February 9, 2024 | Rootsmer S/N: 438320 | Ta: 295 °K | |
| Operator: Jim Tisch | | Pa: 749.0 mm Hg | |
| Calibration Model #: TE-5025A | Calibrator S/N: 5411 | | |

| Run | Vol. Init (m3) | Vol. Final (m3) | ΔVol. (m3) | ΔTime (min) | ΔP (mm Hg) | ΔH (in H2O) |
|-----|----------------|-----------------|------------|-------------|------------|-------------|
| 1 | 1 | 2 | 1 | 1.3950 | 3.2 | 2.00 |
| 2 | 3 | 4 | 1 | 0.9840 | 6.4 | 4.00 |
| 3 | 5 | 6 | 1 | 0.8790 | 7.9 | 5.00 |
| 4 | 7 | 8 | 1 | 0.8430 | 8.8 | 5.50 |
| 5 | 9 | 10 | 1 | 0.6940 | 12.7 | 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) |
| 0.9914 | 0.7106 | 1.4111 | 0.9957 | 0.7138 | 0.8875 |
| 0.9871 | 1.0032 | 1.9956 | 0.9915 | 1.0076 | 1.2551 |
| 0.9851 | 1.1207 | 2.2312 | 0.9895 | 1.1257 | 1.4033 |
| 0.9839 | 1.1672 | 2.3401 | 0.9883 | 1.1723 | 1.4718 |
| 0.9787 | 1.4103 | 2.8222 | 0.9830 | 1.4165 | 1.7750 |
| QSTD | m= | 2.02024 | QA | m= | 1.26504 |
| | b= | -0.02667 | | b= | -0.01677 |
| | r= | 0.99993 | | r= | 0.99993 |

| Calculations | | | |
|--|---|-----|--|
| Vstd= | $\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$ | Va= | $\Delta Vol((Pa-\Delta P)/Pa)$ |
| Qstd= | $Vstd/\Delta Time$ | Qa= | $Va/\Delta Time$ |
| For subsequent flow rate calculations: | | | |
| Qstd= | $1/m \left(\left(\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)} \right) - b \right)$ | 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, R Determination of Suspended Solids in the Atmosphere |



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Tel: 02-502-1760-2 Fax: 02-602-3683 E-mail: info@neediss.com



SO₂ Analyzer Verification Test Report

Calibration Report No.: 6707005

Page:1/1

Calibrated Date: 1-Jul-24

☒ PM ☐ Onsite

Instruments Information

| | |
|---|---|
| Analyzer Type: SO2 Analyzer Model: THERMO.,43C | Manufacturer: THERMO S/N: ESOTE43C069871 |
|---|---|

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 |

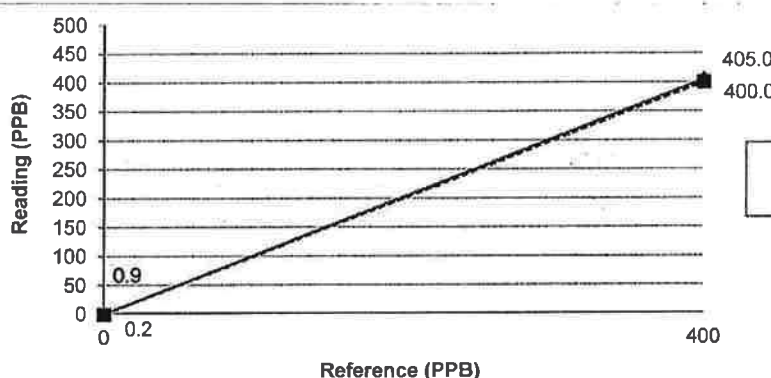
Environment: Temperature 25.6 °C

Humidity: 61 %RH

Calibration Report

| Status | Zero | | | Span | | |
|--------|-----------------|---------------|-------------|-----------------|---------------|--------|
| | Reference (PPB) | Reading (PPB) | Drift (PPB) | Reference (PPB) | Reading (PPB) | Drift% |
| Before | 0.0 | 0.9 | 0.9 | 400.0 | 405 | 1.3 |
| After | 0.0 | 0.2 | 0.2 | 400.0 | 400 | 0.0 |

Single Point Calibration Chart



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Tel: 02-802-1280-2 Fax: 02-802-1280-3 Email: info@neediss.com



MODEL : SO2 ANALYZER Model 43C THERMO

DATE : 1-07-2024

S/N : ESOTE43C069871

| Test Function Value | Before | After |
|---------------------------------|--------|-------|
| Range 500 (PPB) | 500 | 500 |
| PMT VOLTS -450 - -850 (V) | -650 | -653 |
| LAMP VOLTAGE 950 - 1,200 (V) | 990 | 985 |
| LAMP INTENSITY 20000 - 50000 Hz | 32568 | 32577 |
| INTER TEMP 15 - 45 DEG C | 37 | 37 |
| CHAMBER TEMP 47 - 51 C | 49 | 49 |
| COOLER TEMP -5 - (-2) DEG C | -2.5 | -2.5 |
| PRESSURE 400 - 1000.0 mm Hg | 764 | 765 |
| FLOW 0.350 - 0.650 LPM | 0.42 | 0.4 |
| | | |
| | | |
| | | |

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Calibrate

Sirirat Poonlak

Sarawut Keawsrinual

Date: 1-Jul-24

Date:

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SO₂ Analyzer Verification Test Report

Calibration Report No.: 6707009

Page:1/1

Calibrated Date: 1-Jul-24

☒ PM ☐ Onsite

Instruments Information

| | |
|---|--|
| Analyzer Type: SO2 Analyzer Model: THERMO.,43C | Manufacturer THERMO S/N: ESOTE43C069869 |
|---|--|

Calibration System

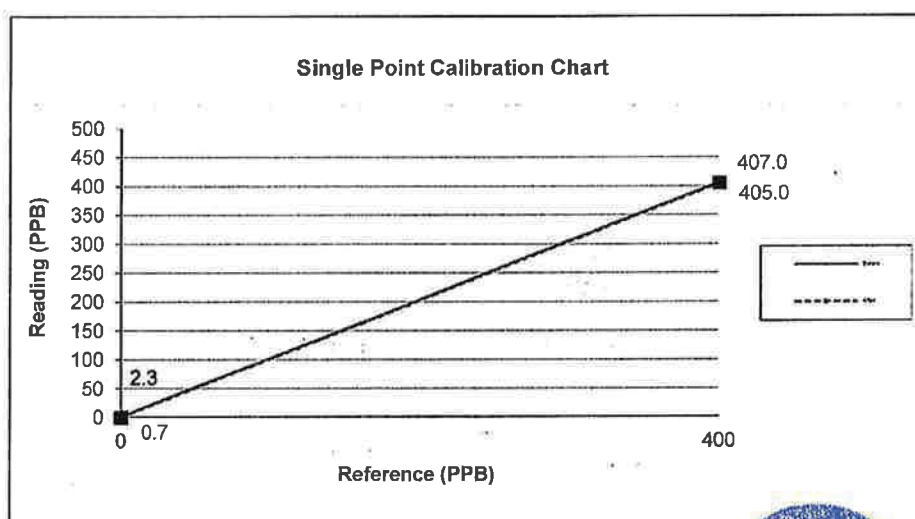
| Calibrator Unit | Standard Gas |
|--|---|
| Dilutor Model ESA MGC101 S/N: 792 ZERO AIR Generator ZAG7001 S/N: 644 | NOx Conc 46.50 PPM NO Conc 46.50 PPM SO2 Conc 45.59 PPM CO Conc 4507 PPM Expire Date: Mar 31,2026 EB0160267 |

Environment: Temperature 25.7 °C

Humidity: 60 %RH

Calibration Report

| Status | Zero | | | Span | | |
|--------|-----------------|---------------|-------------|-----------------|---------------|--------|
| | Reference (PPB) | Reading (PPB) | Drift (PPB) | Reference (PPB) | Reading (PPB) | Drift% |
| Before | 0.0 | 2.3 | 2.3 | 400.0 | 407 | 1.8 |
| After | 0.0 | 0.7 | 0.7 | 400.0 | 405 | 1.3 |



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Tel. 02-502-3785-2 Fax. 02-502-3788 E: info@neediss.com



MODEL : SO2 ANALYZER Model 43C THERMO

DATE : 1-07-2024

S/N : ESOTE43C069865

| Test Function Value | Before | After |
|---------------------------------|--------|-------|
| Range 500 (PPB) | 500 | 500 |
| PMT VOLTS -450 - -850 (V) | -650 | -653 |
| LAMP VOLTAGE 950 - 1,200 (V) | 990 | 985 |
| LAMP INTENSITY 20000 - 50000 Hz | 32568 | 32577 |
| INTER TEMP 15 - 45 DEG C | 37 | 37 |
| CHAMBER TEMP 47 - 51 C | 49 | 49 |
| COOLER TEMP -5 - (-2) DEG C | -2.5 | -2.5 |
| PRESSURE 400 - 1000.0 mm Hg | 764 | 765 |
| FLOW 0.350 - 0.650 LPM | 0.42 | 0.4 |
| | | |
| | | |
| | | |

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Calibrate By :

Approve By :

Sirirat Poonlak

Sarawut Keawsrinual

Date:

1-Jul-24

Date:

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NOx Analyzer Verification Test Report

Calibration Report No.: 6707002

Page:1/2

Calibrated Date: 1-Jul-24

☒ PM ☐ Onsite

Instruments Information

| | |
|--|--|
| Analyzer Type: NO/NO2/NOx Analyzer Model: 42C | Manufacturer THERMO S/N: ENOTE42C671356 |
|--|--|

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 25.8 °C

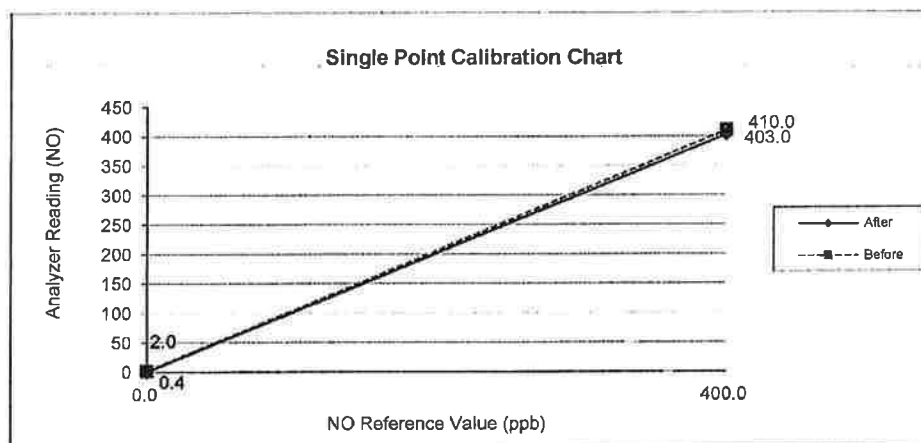
Humidity: 61 %RH

Calibration Check (Before adjust)

| GAS | Zero | | | Span | | |
|-----------------|---------------------|----------------------|-------------|---------------------|----------------------|--------|
| | Reading Value (ppb) | Expected Value (ppb) | Drift (ppb) | Reading Value (ppb) | Expected Value (ppb) | Drift% |
| NO | 2.0 | 0.0 | 2.0 | 410 | 400.0 | 1.2 |
| NO ₂ | 2.5 | 0.0 | 2.5 | 2.0 | 0.0 | 0.2 |
| NOx | 4.5 | 0.0 | 4.5 | 412 | 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 | 0.4 | 0.0 | 0.4 | 403 | 400.0 | 0.4 |
| NO ₂ | 0.3 | 0.0 | 0.3 | 2.0 | 0.0 | 0.2 |
| NOx | 0.7 | 0.0 | 0.7 | 405 | 400.0 | 0.6 |



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We know the best thing to do is to provide the best service to our customers.
ผู้จัดการฝ่ายควบคุม



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บริษัท นีดีส ซัพพลาย อินสตรูเมนต์ จำกัด
Neediss Supply Instrument Co., Ltd.

535 ซอย เจริญนคร 7 แขวง เจริญนคร เขต คลองเตย กรุงเทพมหานคร 10110 535 Soi Bangnae 7 Bangkhae Bangkok Bangkok
Tel: 02-262-1968 Fax: 02-262-9906 Email: info@neediss.com



MODEL : NOx ANALYZER Model 42C THERMO

DATE : 1-07-2024

S/N : ENOTE42C671356

Page:2/2

| Test Function Value | Before | After |
|----------------------------------|---------|---------|
| Range 500 (PPB) | 500 | 500 |
| PMT VOLTS -450 - -850 (V) | -675 | -678 |
| LAMP VOLTAGE 950 - 1,200 (V) | | |
| INTER TEMP 15 - 45 DEG C | 43 | 43 |
| CHAMBER TEMP 47 - 51 C | 49 | 50 |
| COOLER TEMP -5 - (-2) DEG C | -2 | -2 |
| PRESSURE 400 - 1000.0 mm Hg | 350 | 380 |
| SAMPLE FLOW 0.350 - 0.900 LPM | 0.45 | 0.46 |
| OZONEATOR FLOW 0.035 - 0.075 LPM | 0.05 | 0.05 |
| No/Nox BKG | 12/9.0 | 12/9.1 |
| No/Nox Slope | 1.0/0.8 | 0.9/0.8 |

Calibrate By :

Sirirat Poonlak

Sarawut Keawsrinual

Date:

1-Jul-24

Date:

1-Jul-24



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Neediss Supply Instrument Co., Ltd.535 ซอยบางนา 7 แขวงบางนา เขตคลองเตย กรุงเทพฯ 10150 535 Soi Bangnae 7 Bangkhae Bangkok
Tel. 02-802-1940-2 Fax. 02-802-3288 E-mail: info@neediss.com

MODEL : NOx ANALYZER Model 42C THERMO

DATE : 1-07-2024

S/N : ENOTE42C704365

Page:2/2

| Test Function Value | Before | After |
|----------------------------------|---------|---------|
| Range 500 (PPB) | 500 | 500 |
| PMT VOLTS -450 - -850 (V) | -675 | -678 |
| LAMP VOLTAGE 950 - 1,200 (V) | | |
| INTER TEMP 15 - 45 DEG C | 44 | 43 |
| CHAMBER TEMP 47 - 51 C | 50 | 50 |
| COOLER TEMP -5 - (-2) DEG C | -3 | -2 |
| PRESSURE 400 - 1000.0 mm Hg | 350 | 380 |
| SAMPLE FLOW 0.350 - 0.900 LPM | 0.45 | 0.46 |
| OZONEATOR FLOW 0.035 - 0.075 LPM | 0.05 | 0.05 |
| No/Nox BKG | 12/9.0 | 12/9.1 |
| No/Nox Slope | 1.0/0.8 | 0.9/0.8 |
| | | |

Calibrate By :

Sirirat Poonlak

Sarawut Keawsrinual

Date:

1-Jul-24

Date:

1-Jul-24



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



Envilab & Needless Supply Instrument

Verification Test Report

Report No.:

SO2400210-E001 -SLM 01

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

Calibrated Date: 12 July 2024

Site : บริษัท เอ็นไวแล็บ จำกัด

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1844

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test

| Reference Standard (dB) | Instrument reading (dB) | Error (dB) | Adjust (dB) |
|----------------------------|----------------------------|---------------|----------------|
| 93.72 | 94.10 | 0.38 | 93.72 |

Calibrated By:

Date:

Approve By:

Date:

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



Envilab & Needless Supply Instrument

Verification Test Report

Report No.:

SO2400210-E001 -SLM 02

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

Calibrated Date: 12 July 2024

Site : บริษัท เอ็นไวแล็บ จำกัด

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1812

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test

| Reference Standard (dB) | Instrument reading (dB) | Error (dB) | Adjust (dB) |
|----------------------------|----------------------------|---------------|----------------|
| 93.72 | 94.30 | 0.58 | 93.72 |

Calibrated By:

Date:

Approve By:

Date:

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



Envilab & Needless Supply Instrument

Verification Test Report

Report No.:

SO2400210-E001 -SLM 03

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

Calibrated Date: 12 July 2024

Site : บริษัท เอ็นไวแล็บ จำกัด

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1811

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test

| Reference Standard (dB) | Instrument reading (dB) | Error (dB) | Adjust (dB) |
|----------------------------|----------------------------|---------------|----------------|
| 93.72 | 94.20 | 0.48 | 93.72 |

Calibrated By:

Date:

Approve By:

Date:

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CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

Customer: BANGKOK INDUSTRIAL
GAS CO LTD
Part Number: E04NI99E15A00V3
Cylinder Number: EB0160267
Laboratory: 124 - Plumsteadville - PA
PGVP Number: A12023
Gas Code: CO,NO,NOX,SO2,BALN
Reference Number: 160-402685487-1
Cylinder Volume: 144.0 CF
Cylinder Pressure: 2015 PSIG
Valve Outlet: 660
Certification Date: Mar 31, 2023

Expiration Date: Mar 31, 2026

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. The results relate only to the items tested. The report shall not be reproduced except in full without approval of the laboratory. 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 | 46.50 PPM | G1 | +/- 1.4% NIST Traceable | 03/24/2023, 03/31/2023 |
| NITRIC OXIDE | 45.00 PPM | 46.50 PPM | G1 | +/- 1.4% NIST Traceable | 03/24/2023, 03/31/2023 |
| SULFUR DIOXIDE | 45.00 PPM | 45.59 PPM | G1 | +/- 1.0% NIST Traceable | 03/24/2023, 03/31/2023 |
| CARBON MONOXIDE | 4500 PPM | 4507 PPM | G1 | +/- 1.4% NIST Traceable | 03/24/2023 |
| NITROGEN | Balance | | | | |

CALIBRATION STANDARDS

| Type | Lot ID | Cylinder No | Concentration | Uncertainty | Expiration Date |
|------|--------------|-------------|-------------------------------------|-------------|-----------------|
| NTRM | 210607-22 | CC708067 | 48.41 PPM NITRIC OXIDE/NITROGEN | +/- 1.2% | Sep 21, 2025 |
| PRM | 12395 | D887660 | 9.91 PPM NITROGEN DIOXIDE/AIR | +/- 2.0% | Feb 22, 2022 |
| GMIS | 124206889104 | CC322509 | 4.326 PPM NITROGEN DIOXIDE/AIR | +/- 2.0% | Feb 21, 2025 |
| NTRM | 160610-01 | CC473196 | 49.02 PPM SULFUR DIOXIDE/NITROGEN | +/- 0.8% | Mar 22, 2028 |
| GMIS | 07212022B109 | EB0141209 | 50.08 PPM SULFUR DIOXIDE/NITROGEN | +/- 1.0% | Dec 21, 2026 |
| CO | 220608 | CC744768 | 2501.8 PPM CARBON MONOXIDE/NITROGEN | +/-0.5% | Sep 30, 2028 |

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

ANALYTICAL EQUIPMENT

| Instrument/Make/Model | Analytical Principle | Last Multipoint Calibration |
|----------------------------------|----------------------|-----------------------------|
| SIEMENS ULTRAMAT 6 N1KD579 | NDIR | Mar 07, 2023 |
| Nicolet iS50 FTIR AUP2010245 NO | FTIR | Mar 09, 2023 |
| Nicolet iS50 FTIR AUP2010245 NO2 | FTIR | Mar 23, 2023 |
| Nicolet iS50 FTIR AUP2010245 SO2 | FTIR | Mar 16, 2023 |

Triad Data Available Upon Request

NOTES: Gross Weight: 27.8 Kg
Net Weight: 4.8 Kg
PO# 5223001123





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 6 April, 2024

Certification No. 171/24

Page : 1 of 6

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : . NovaLynx

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

Serial No. : EWSNV110WS2501

Customer : ENVILAB Co.,Ltd.
540, 540/1 Soi Bangkhæ 7, Bangkhæ, Bangkhæ,
Bangkok 10160, Thailand.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.9 hPa

NATIONAL STANDARD WIND TUNNEL : Wind Aloft Plotting Board

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119 : HOOK GAGE NO 1425

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.9188 : testo, testo 645 Serial No. 02848057

STANDARD BAROMETER : Digital Barometer Vaisala Type BTP220 No. V43200117

Calibration

Mr. W

Mec





THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Sensor model

EWSNV110WS2501

Certification No. 171/24

6 April, 2024

Page : 2 of 6

| Standard Ultrasonic Anemometer | HOOK GAGE NO. 1425 | | | TESTED ANEMOMETER | |
|-----------------------------------|--------------------|------------|----------|-------------------|------------|
| | Pressure | Vacumm | Velocity | Velocity | Correction |
| m/sec | inches H2O | inches H2O | m/sec | m/sec | m/sec |
| 1.00 | - | - | - | 0.3 | 0.70 |
| 3.02 | - | - | - | 2.4 | 0.62 |
| 5.00 | - | - | - | 4.9 | 0.10 |
| 7.04 | - | - | - | 6.9 | 0.14 |
| 9.02 | - | - | - | 8.8 | 0.22 |
| 11.01 | - | - | - | 10.8 | 0.21 |
| 13.01 | - | - | - | 12.8 | 0.21 |
| 15.01 | - | - | - | 14.8 | 0.21 |
| 17.02 | - | - | - | 17.1 | -0.08 |
| 20.02 | - | - | - | 19.9 | 0.12 |

| Wind Aloft Plotting Board. | |
|--|-----------------------|
| US.DEPARTMENT OF COMMERCE WEATHER BUREAU | |
| WIND DIRETION | TESTED WIND DIRECTION |
| 0 | 0 |
| 90 | 92 |
| 180 | 181 |
| 270 | 269 |

C



ผู้ตรวจการฝ่ายควบคุมคุณภาพ



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Sensor model EWSNV110WS2501

Certification No. 171/24

6 April, 2024

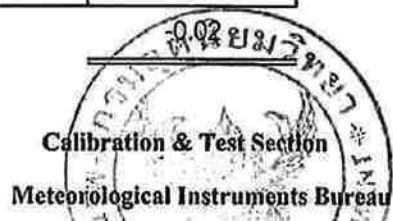
Page : 3 of 6

| Standard Barometer | Tested Barometer | Correction |
|--------------------|------------------|------------|
| Pressure | Pressure | |
| 1009.59 | 1009.46 | 0.13 |
| 1009.45 | 1009.56 | -0.11 |
| 1010.10 | 1010.09 | 0.01 |
| 1010.94 | 1010.83 | 0.11 |
| 1011.46 | 1011.49 | -0.03 |
| 1011.84 | 1011.96 | -0.12 |
| 1012.06 | 1012.23 | -0.17 |
| 1013.04 | 1013.05 | -0.01 |
| 1013.18 | 1013.29 | -0.11 |
| 1012.89 | 1012.79 | 0.10 |
| 1013.20 | 1013.32 | -0.12 |
| 1013.44 | 1013.49 | -0.05 |
| 1013.81 | 1013.76 | 0.05 |
| 1014.19 | 1014.23 | -0.04 |
| 1015.96 | 1016.09 | -0.13 |
| 1016.23 | 1016.31 | -0.08 |
| 1015.64 | 1015.63 | 0.01 |
| 1015.23 | 1015.19 | 0.04 |
| 1012.87 | 1012.72 | 0.15 |
| 1013.63 | 1013.62 | 0.01 |

Average

Mr. Watcharapol Subwat

Mechanical Engineer





THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Sensor model

EWSNV110WS2501

Certification No. 171/24

6 April, 2024

Page : 4 of 6

| Standard Temp. °C | Temperature Sensor Reading | |
|-------------------------|----------------------------|------------------|
| | Reading °C | Correction °C |
| 45.6 | 45.9 | -0.3 |
| 30.1 | 30.3 | -0.2 |
| 15.4 | 15.6 | -0.2 |



Mr. Watcharaporn Suwatt

Mechanical Engineer



Watcharaporn Suwatt



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Sensor model EWSNV110WS2501 Certification No. 171/24

6 April, 2024

Page : 5 of 6

| Standard Humidity % R.H. | Relative Humidity Sensor Reading | |
|--------------------------------|----------------------------------|------------|
| | Reading | Correction |
| | % R.H. | % R.H. |
| 85.2 | 90.2 | -5.0 |
| 62.4 | 66.8 | -4.4 |
| 41.5 | 44.2 | -2.7 |

C



Mr. Watcharaporn Subwat

Mechanical Engineer





Date of Issue 6 April, 2024

Certification No. 171/24

Page: 6 of 6

ใบรับรอง

หนังสือฉบับนี้ขอรับรองว่า เครื่องวัดฝน ยี่ห้อ Davis Instruments แบบ TIPPING
BUCKET Product No. #7852 Mfg. Code. EWSNV110WS2501 ทำการสอบเทียบกับแก้ววัดฝน
แบบแก้วดวง GAUGE DIAMETER 8.0 INCHES, NEGRETTI & ZAMBRA LONDON No.
71082 และสามารถนำไปใช้ได้ มีค่าถูกต้องตามรายละเอียดของเครื่องมือ (0.2 mm./TIP)



วิศวกรชำนาญการ





บริษัท เอวิล เทสติ้ง จำกัด 543540/1 ซอยบางนา 7 แขวงคลองเตย เขตคลองเตย กรุงเทพมหานคร 10160
Evinlab Co., Ltd. 543540/1 Soi Bangna 7 Bang Nae Bangkok Bangkok 10160
Tel : 02-3577-28 Fax: 02-302-3713 E-mail : info@evltesting.com



02-3577-28-3713

Verification Test Report

Report No.:

SO2400210-E001 -PU 01

Calibrated Date: 12-Jul-24

Equipment: Air Sampling Pump

Manufacturer: Gillian

Model: HFS-113A

Serial or ID No. 09940

Environment: Temperature 25 °C Humidity 62 %RH

Reference Standard: Bios Flow Calibrator Model 510-M, MESALABS

Serial No. 200368

Date of Calibration : 17 July 2024

Result of Test

| Reference Flow (ml/min) | Test No. | Reading (ml/min) | Average (ml/min) |
|----------------------------|----------|---------------------|---------------------|
| 2000 | 1 | 2001.0 | 2000.2 |
| | 2 | 1999.0 | |
| | 3 | 2002.0 | |
| | 4 | 1998.0 | |
| | 5 | 2001.0 | |

Calibrated By

Date

Approve By

Date

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Evinlab Co., Ltd.



บริษัท อีวีแอล จำกัด 540,540/1 ถนนสุขุมวิท 7 แขวงคลองเตย เขตคลองเตย กรุงเทพฯ 10160
Envilab Co., Ltd. 540,540/1 Soi Bangkhoe 7 Bangkhoe Bangkhoe Bangkok 10160
Tel : 02-802-3577-2 Fax: 02-802-3573 E-mail : info@evltesting.com



Environ & Food Supply (Pvt.) Ltd.

Verification Test Report

Report No.:

SO2400210-E001 -PU 02

Calibrated Date: 12-Jul-24

Equipment: Air Sampling Pump

Manufacturer: Gillian

Model: HFS-113A

Serial or ID No. 09938

Environment: Temperature 25 °C Humidity 62 %RH

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

Serial No. 164578

Date of Calibration : 17 July 2025

Result of Test

| Reference Flow (ml/min) | Test No. | Reading (ml/min) | Average (ml/min) |
|----------------------------|----------|---------------------|---------------------|
| 1700 | 1 | 1699.0 | 1700.2 |
| | 2 | 1703.0 | |
| | 3 | 1699.0 | |
| | 4 | 1698.0 | |
| | 5 | 1702.0 | |

Calibrated By

Date

Approve By

Date

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บริษัท เอวิลเทสติ้ง จำกัด 540/44/1 ซอย พหลโยธิน 7 แขวง บางพลี กรุงเทพมหานคร 10150
Evltest Co., Ltd. 540/44/1 Soi Phayathai 7 Bangkhoe Bangkok 10150
Tel : 02-802-3572-8 Fax : 02-802-3173 E-mail : info@evltesting.com



ISO 9001:2015 Certified

Verification Test Report

Report No.:

SO2400210-E001 -PU 04

Calibrated Date: 12-Jul-24

Equipment: Air Sampling Pump

Manufacturer: Gillian

Model: HFS-113A

Serial or ID No. 09816

Environment: Temperature 25 °C Humidity 62 %RH

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

Serial No. 164578

Date of Calibration : 17 July 2025

Result of Test

| Reference Flow (ml/min) | Test No. | Reading (ml/min) | Average (ml/min) |
|----------------------------|----------|---------------------|---------------------|
| 2000 | 1 | 1999.0 | 2000.0 |
| | 2 | 1998.0 | |
| | 3 | 2002.0 | |
| | 4 | 2002.0 | |
| | 5 | 1999.0 | |

Calibrated

D

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EnviLab Co., Ltd. 542/40/1 Soi Bangkok 7 Bang Kae Bangkok Bang- 10115
Tel : 02-802-3577-8 Fax: 02-802-3773 E-mail : info@evltesting.com



Q1 542/40 01 10115

Verification Test Report

Report No.:

SO2400210-E001 -SLM 01

☒ PM

☐ Onsite UTM:

47P 1514458 N 654247 E

Calibrated Date: 12 July 2024

Site : บริษัท เอ็นไวแล็บ จำกัด

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1844

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test

| Reference Standard (dB) | Instrument reading (dB) | Error (dB) | Adjust (dB) |
|----------------------------|----------------------------|---------------|----------------|
| 93.72 | 94.10 | 0.38 | 93.72 |

Calibrated By:

Date:

Approve By:

Date:

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Envilab Co., Ltd. 540,540/1 ซอยสุขุมวิท 7 แขวงคลองเตย เขต คลองเตย กรุงเทพมหานคร 10150
Tel : 02-802-3577-8 Fax: 02-802-3577-9 E-mail: info@evltesting.com



Envilab & Envilab Supply - (In)novate

Verification Test Report

Report No.:

SO2400210-E001 -SLM 02

☒ PM

☐ Onsite UTM :

47P 1514458 N 654247 E

Calibrated Date: 12 July 2024

Site : บริษัท เอ็นไวแล็บ จำกัด

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1812

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No. 1351075

Date of Calibration : 10 Apr 2024

Result of Test

| Reference Standard (dB) | Instrument reading (dB) | Error (dB) | Adjust (dB) |
|----------------------------|----------------------------|---------------|----------------|
| 93.72 | 94.30 | 0.58 | 93.72 |

Calibrated By:

Date:

Approve By:

Date:

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บริษัท เอ็นไวเทส จำกัด 547 ซ.วิภาวดีรังสิต 7 แขวงบางเขน เขตบางเขน กรุงเทพฯ 10160
Envitest Co., Ltd. 547 S. Wi Phawadi Rangsit 7 Bangkhoe Bangkok Bangkok 10160
Tel : 02-9177-8 Fax : 02-802-1775 E-mail : info@envitest.com



envi Co. Secreted Page - All Rights Reserved

Verification Test Report

Report No.:

SO2400210-E001 -SLM 03

☒ PM

☐ Onsite UTM :

47P 1514458 N 654247 E

Calibrated Date: 12 July 2024

Site : บริษัท เอ็นไวเทส จำกัด

Equipment: Sound Level Meter

Manufacturer: PULSAR

Model: 44

Serial : 1811

Environment: Temperature 25 °C Humidity 72 %RH

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

Serial No.1351075

Date of Calibration : 10 Apr 2024

Result of Test

| Reference Standard (dB) | Instrument reading (dB) | Error (dB) | Adjust (dB) |
|----------------------------|----------------------------|---------------|----------------|
| 93.72 | 94.20 | 0.48 | 93.72 |

Calibrated By:

Date:

Approve By:

Date:

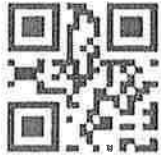
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MIRACLE INTERNATIONAL TECHNOLOGY CO.,LTD

214 Bangwaek Rd. Bangpai Bangkok 10160
Tel.: 0-2865-4647-8 Fax: 0-2865-4649 <http://www.mit.in.th>



CALIBRATION CERTIFICATE

Certificate No. : L202407194-0001

Date Issued : 18-Jul-24

Customer : Envilab Co., Ltd.
540, 540/1 Soi Bangkhae 7, Bangkhae, Bangkok, Thailand 10160

Equipment : Bios Flow Calibrator

Manufacturer : MesaLabs

Model : 510-M

Serial No. : 200368

ID No./Tag No. : NCALBI510M0368

Date Received : 12-Jul-24

Date Calibrated : 17-Jul-24

Calibrated by : Jame Khaothong

Calibration Method or Calibration Procedure Used

In-house method : CP-26 by comparison against Bell Prover.

In-house method : CP-44 by comparison against Piston Prover.

This certificate is traceable to national standards, which realize the units of measurement according to the International System of Units (SI).

Result of Calibration

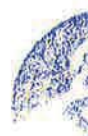
The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor $k = 2$, providing a level confidence approximately 95 percent.

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Approved by



Page 1 of 4



Certificate No. : L202407194-0001

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

Relative humidity : (50 ± 15)%RH

Capacity Range : 5000 ml/min

Calibration Media : Air

Type : Volumetric Flowmeter

UUC Reference Condition : At atmospheric pressure and room temper

Measurement Gas Flow rate function

| Temperature | Pressure | UUC | STD | Error | Uncertainty | MPE | Pass / Fail |
|-------------|----------|----------|----------|----------|-------------|-----------|-------------------|
| (° C) | (kPa) | (ml/min) | (ml/min) | (ml/min) | (± ml/min) | ±(ml/min) | Simple Acceptance |
| 22.30 | 100.38 | 0.00 | 0.00 * | 0.00 | 0.58 | 50 | Pass |
| 22.73 | 101.00 | 100.340 | 98.3950 | 1.945 | 1.9 | 50 | Pass |
| 20.90 | 100.83 | 499.99 | 508.6 | -8.61 | 2.3 | 50 | Pass |
| 21.50 | 100.95 | 1000.4 | 1013.8 | -13.4 | 3.6 | 50 | Pass |
| 21.56 | 101.46 | 2499.8 | 2524.9 | -25.1 | 7.1 | 50 | Pass |
| 21.51 | 102.04 | 3999.8 | 4040 | -40.2 | 12 | 50 | Pass |

Marked * are not included in the NSC-ONSC accreditation schedule for our laboratory.

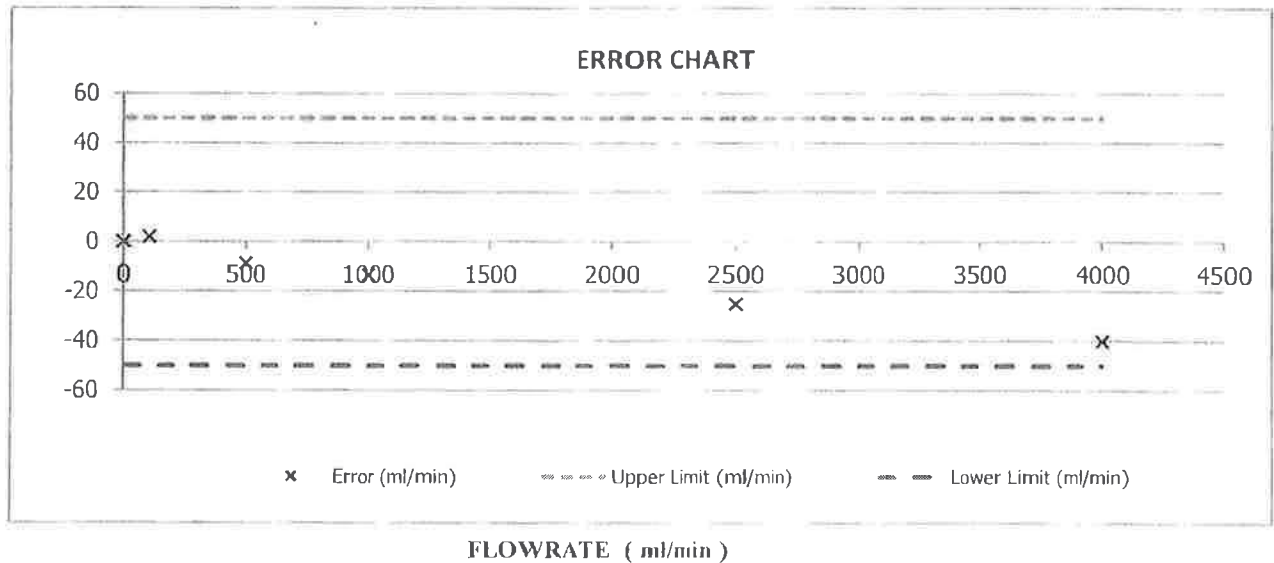
Error = Unit Under Calibration - Standard

Pass = |error| ≤ |MPE|

MPE = Maximum Permissible Error

Fail = |error| > |MPE|

MAX ALLOWED ERROR (ml/min)



Note :Flow Rate was corrected for non-standard operating condition by using equation :

$$Q_{Meas} = Q_{Ref} \times \frac{P_{Ref}}{P_{Meas}} \times \frac{T_{Meas}}{T_{Ref}}$$

where Q = Flow rate P = Absolute pressure T = Absolute temperature

M = Gas molecular weight , Mstandard (Air) = 28.9646431 g/mol

Subscript "Meas" - Measurement condition

Subscript "Standard" = Standard condition



Sanyab Co.,Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

Certificate No. : L202407194-0001

Environment : Ambient temperature : (23 \pm 2) °C

Relative humidity : (50 \pm 15) % RH

Capacity Range : 5000 ml/min

Calibration Media : Air

UUC Reference Condition : At atmosphere and room temperature and room

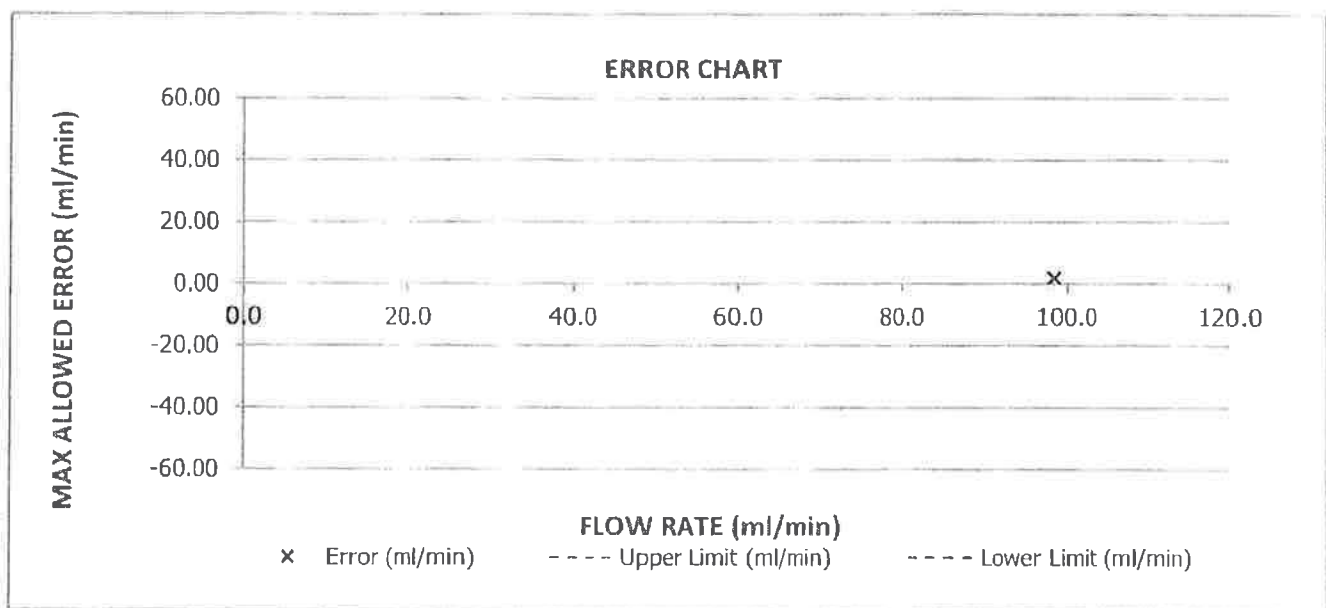
| Temperature (°C) | Pressure (kPa) | Flow Rate Reading (ml/min) | | Error (ml/min) | Uncertainty \pm (ml/min) | MPE \pm (ml/min) | Pass / Fail Simple Acceptance |
|---------------------|-------------------|----------------------------|-------------|-------------------|-------------------------------|-----------------------|----------------------------------|
| | | UUC Reading | STD Reading | | | | |
| 22.733 | 101.00 | 100.34 | 98.395 | 1.95 | 1.1 | 50 | Pass |

Error = Unit Under Calibration - Standard

Pass = $|\text{error}| \leq |\text{MPE}|$

MPE = Maximum Permissible Error

Fail = $|\text{error}| > |\text{MPE}|$



Certificate No. :

L202407194-0001

Condition As-Received : Used Item

The measurement results and statements of conformity with specification only relate to the item calibrated.

Measurement Standards Used & Traceability :

The International System of Units (SI) through

MIT Calibration Certificate No. L202403371-0002 for Bell Prover Volume (60L) Serial No. 9511HC028626, Due 12-Apr-26

MIT Calibration Certificate No. L202405041-0002 for Temperature Transmitter with probe Serial No. MIT-STD-122,
Due 13-May-25

MIT Calibration Certificate No. L202405041-0003 for Pressure Transmitter with indicator Serial No. MIT-STD-123,
Due 24-May-25

MIT Calibration Certificate No. L202307322-0007 for Bell Prover Timer Serial No. 9511HC028626, Due 09-Aug-24

MIT Calibration Certificate No. L202405039-0005 for Piston Prover Volume Serial No. 85, Due 30-May-25

MIT Calibration Certificate No. L202403007-0026 for Piston Prover Timer Serial No. 122199, Due 06-Mar-26

MIT Certificate No. L202403007-0026 for Piston Prover Timer Serial No. 122199, Due 06-Mar-26

MIT Calibration Certificate No. L202403007-0025 for Temperature Indicator with Sensor (Piston Prover)
Serial No. MIT-STD-258, Due 01-Mar-25

End of Certificate

Page 4 of 4



Certificate of Calibration

Certificate No. : 67-410025-1

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. : | ELABTMITTC10003 |

Environment : Ambient Temperature : $(23 \pm 2) ^\circ\text{C}$
Relative Humidity : $(50 \pm 15) \%$

Date of Received : 20 February 2024

Date of Calibration : 22 February 2024

Date of Issue : 22 February 2024

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 & 400035 | SG-H-00020/67 | 05 Jul 2024 | Success Gateway Co., Ltd., Accredited by TISI Calibration No.0268 |

Appr

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-410025-1

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) |
|--------------------------------|-----------------------|----------------------|-------------------------|
| 24.98 | 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.) |
|--------------------------------|--------------------------|-------------------------|----------------------------|
| 50.03 | 50 | 0 | 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%.



Certificate of Calibration

Certificate No. : 67-200060-2

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 | 0.000015 |
| 0.5 | 0.00001 | 0.000022 |
| 1 | 0.00000 | 0.000026 |
| 2 | 0.00001 | 0.000034 |
| 5 | -0.00001 | 0.000043 |
| 10 | 0.00000 | 0.000053 |
| 50 | 0.00003 | 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.

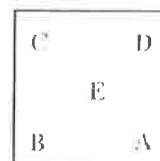
This reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k = 2.00$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 50 g

| | | | | |
|---------|---------|---------|---------|---------|
| A | B | C | D | E |
| 0.00000 | 0.00000 | 0.00010 | 0.00000 | 0.00000 |

g



Repeatability

Load test : 200 g

Stdev. : 0.000032 g

- o O -





CALIBRATION LABORATORY CO., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



Supplement to Calibration Certificate No. Q24002404

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE : HEAT STRESS MONITOR
MANUFACTURER : METROSONICS
MODEL / TYPE : hs-32
SERIAL NO. : MCG080040[NHEMTHS3280040]
CLID. NO. : 232400058
JOB CONTROL NO. : 240110002404
CALIBRATION SERVICE : ☒ IN-LABORATORY ☐ ON-SITE

CUSTOMER : ENVILAB CO., LTD.
540, 540/1 SOI BANGKHAE 7, BANGKHAE,
BANGKHAE, BANGKOK 10160 THAILAND

DATE OF RECEIVED : 10 January 2024

DATE OF ISSUED : 06 February 2024

The report of calibration shall not be reproduced except in full without approval of the Calibration Laboratory Co., Ltd.

Calibrated By : Tanawan Seenam-Ngoen
Calibration Engineer

Approved By :

Authorized Signatory
06 February 2024

^oThis Calibration Certificate documents the traceability to national standards, which realize the units of
the International System of Units (SI)

Certificate No. Q24002404A1

F3-012-05/12-23



Envilab Co., Ltd.

ผู้ตรวจการฝ่ายควบคุมคุณภาพ

page 1 of 3



คลิกเพื่อดูภาพ



CALIBRATION LABORATORY Co., LTD.

2/10-11, 14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



REPORT OF CALIBRATION

FOR

NOMENCLATURE : HEAT STRESS MONITOR
MANUFACTURER : METROSONICS
MODEL / TYPE : hs-32
SERIAL NO. : MCG080040[NHEMTHS3280040]
DATE OF CALIBRATION : 16 January 2024

ENVIRONMENT CONDITIONS :

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

Relative Humidity : $(55 \pm 10) \% \text{RH}$

PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPT11-11. The calibration was performed by using Chilled Mirror Hygrometer and Temperature & Humidity Chamber which maintained by the Calibration Laboratory Co., Ltd.

REFERENCE STANDARD USED :

Chilled Mirror Hygrometer, Edgetech Model Dew Master S/N. 44602.

Temperature & Humidity Chamber, PGC Model 9141-5116 S/N. 1304261.

TRACEABILITY :

The measurements are traceable to International System of Units (SI) , through Thunder Scientific Corporation.
Certificate No. 21594, Due Date 06 July 2024.

UNCERTAINTY :

The reported expanded uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor $k = 2,00$ which for a normal distribution corresponds to a coverage probability of approximately 95 %.
It has been evaluated according to the "Evaluation of the Uncertainty of Measurement in Calibration".

Certificate No. Q24002404

F3-011-05/12-23





CALIBRATION LABORATORY CO., LTD.

2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com



CONDITION OF CALIBRATION ITEM : RECEIVED IN GOOD OPERATIONAL CONDITION

MEASUREMENT RESULTS : (X) without adjustment () adjustment

The table in the following gives the calibration results and associated measurement uncertainties of the measuring heat stress monitor.

CALIBRATION DATA

1. CORRECTION OF TEMPERATURE : WET

| Test point (° C) | Actual Temperature (° C) | DUC Reading (° C) | Correction (° C) | Uncertainty \pm (° C) |
|-----------------------|-------------------------------|------------------------|-----------------------|------------------------------|
| 20.0 | 20.01 | 20.1 | -0.09 | 0.40 |
| 30.0 | 30.00 | 30.0 | 0.00 | |
| 40.0 | 39.99 | 40.0 | -0.01 | |

2. CORRECTION OF TEMPERATURE : DRY

| Test point (° C) | Actual Temperature (° C) | DUC Reading (° C) | Correction (° C) | Uncertainty \pm (° C) |
|-----------------------|-------------------------------|------------------------|-----------------------|------------------------------|
| 20.0 | 20.01 | 19.9 | +0.11 | 0.40 |
| 30.0 | 30.00 | 30.0 | 0.00 | |
| 40.0 | 39.99 | 40.0 | -0.01 | |

3. CORRECTION OF TEMPERATURE : GLOBE

| Test point (° C) | Actual Temperature (° C) | DUC Reading (° C) | Correction (° C) | Uncertainty \pm (° C) |
|-----------------------|-------------------------------|------------------------|-----------------------|------------------------------|
| 20.0 | 20.01 | 20.1 | -0.09 | 0.40 |
| 30.0 | 30.00 | 30.0 | 0.00 | |
| 40.0 | 39.99 | 39.9 | +0.09 | |

Note, The Scope of Accredited ANAB Certificate No. ACDM-2814 Version 012 Page 59 of 67

This report is valid for the above stated instrument/s only.

End of Certificate

Certificate No. Q24002404

F3-011-05/12-23



page 3 of 3



for information



Request No. 22-67 / 0140

MTC No. PSL-H 0034 / 67

Certificate of Calibration

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

Item : Thermo-Hygrometer (Area Heat Stress Monitor)

Model /Type : hs-32

Serial Number : MCG080039

Manufacturer : METROSONICS

Date of Request : 9 November 2023

Date of Calibration : 27 November 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 : 2012266110904511003

Issued Date : 6 December 2023

Page 1 of 4

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

Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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 : tumpai@tistr.or.th Website: www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Chanewat Samutprakarn 10140, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th





Request No. 22-67 / 0140

MTC No. PSL-H 0034 / 67

Description of Unit Under Calibration :

Customer : Neediss Supply Instrument Co., Ltd.
Address : 536 Soi Bangkhae 7, Bangkhae, Bangkhae, Bangkok, 10160
Item : Thermo-Hygrometer (Area Heat Stress Monitor)
Serial Number : MCG080039
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 0976/66.

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. 22-67 / 0140

MTC No. PSL-H 0034 / 67

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 | 20.0 | -0.1 | 0.50 |
| 30.0 | 30.0 | 0.0 | 0.50 |
| 40.0 | 40.0 | 0.0 | 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 | 30.2 | -0.2 | 0.50 |
| 40.0 | 40.2 | -0.2 | 0.50 |

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

Advertising the results of calibration and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Request No. 22-67 / 0140

MTC No. PSL-H 0034 / 67

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) |
|--|--|--|---|
| 19.9 | 20.5 | -0.6 | 0.50 |
| 30.0 | 30.4 | -0.4 | 0.50 |
| 40.0 | 40.2 | -0.2 | 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. 22-67 / 0140

MTC No. PSL-H 0033 / 67

Certificate of Calibration

Customer : Neediss Supply Instrument Co., Ltd.
536 Soi Bangkhae 7, Bangkhae, Bangkok, 10160
Item : Thermo-Hygrometer (Thermal Environment Monitor)
Model /Type : hs-32
Serial Number : MCG080038
Manufacturer : METROSONICS
Date of Request : 9 November 2023
Date of Calibration : 27 November 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 %.

Director

Photometry and Temperature Standards Laboratory

Ref. No : 2012266110904511005

Issued Date : 6 December 2023

Page 1 of 4

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

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Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
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Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand
Tel. (66) 0 3225 1672-50 ext. 115, 116
Fax. (66) 0 2225 9165
E-mail : mt@tistr.or.th



Office

196, Sukhumvit Road,
Thammasat University,
Tel. (66) 0 2210 9321 ext. 9210, 9211
Fax. (66) 0 2579 8592
E-mail : sunalee@tistr.or.th

Request No. 22-67 / 0140

MTC No. PSL-H 0033 / 67

Description of Unit Under Calibration :

Customer : Neediss Supply Instrument Co., Ltd.
Address : 536 Soi Bangkhae 7, Bangkhae, Bangkhae, Bangkok, 10160
Item : Thermo-Hygrometer (Thermal Environment Monitor)
Serial Number : MCG080038
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 0976/66.

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. 22-67 / 0140

MTC No. PSL-H 0033 / 67

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) |
|--|--|--|---|
| 20.0 | 20.4 | -0.4 | 0.50 |
| 30.1 | 30.5 | -0.4 | 0.50 |
| 40.0 | 40.4 | -0.4 | 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) |
|--|--|--|---|
| 20.0 | 20.3 | -0.3 | 0.50 |
| 30.1 | 30.4 | -0.3 | 0.50 |
| 40.0 | 40.5 | -0.5 | 0.50 |

Request No. 22-67 / 0140

MTC No. PSL-H 0033 / 67

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 | 20.0 | 0.0 | 0.50 |
| 30.1 | 30.1 | 0.0 | 0.50 |
| 40.0 | 39.9 | 0.1 | 0.50 |

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

...end of certificate...



ID LINE: IEC17025



Certificate of Calibration

Certificate Number : SPR24030525-4

Page : 1 of 3

Customer : Envilab Co., Ltd.

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

Equipment Name : Light Meter

Manufacturer : Tenmars

Model : TM-720

Serial Number : 190600385

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-04-32

Received Date : 30 Mar 2024

Calibration Date : 18 Apr 2024

Recommend Due Date : 18 Apr 2025

Date of Issue : 19 Apr 2024

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.

The calibration certificate shall not be reproduced except in full, without written approval of SP Metrology System (Thailand).

Calibrated by : Mr.Nanthawat Wanasit

Approved by :

Calibration Officer



Envilab Co., Ltd.

SP-M-04-15 rev.0



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24030525-4

Page : 2 of 3

Reference Standards

| Equipment Name | Model | Serial No. | Certificate No. | Due. Date |
|---------------------|-------|------------|-----------------|-------------|
| Digital Light Meter | LX-73 | Q842777 | 23PH462 | 05 Sep 2024 |

Traceability

This certification is traceable to the International System of Unit maintained at :
TPA - Technology Promotion Association (Thailand-Japan)



Metrology System (Thailand) Co., Ltd.



ID LINE : IEC17025



Result of Calibration

Certificate No. : SPR24030525-4

Page : 3 of 3

Function: Illumination Measurement

Unit : Lux

| Calibration Point | Standard Reading | UUC Reading | Error | Uncertainty (±) |
|-------------------|------------------|-------------|-------|-------------------|
| 100 | 100.0 | 93.7 | -6.3 | 1.3 |
| 500 | 500 | 463.9 | -36.1 | 6.6 |
| 1000 | 1000 | 924.9 | -75.1 | 13 |
| 1500 | 1500 | 1378 | -122 | 20 |
| 2000 | 2000 | 1837 | -163 | 26 |

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.

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