เอกสารรับรองการสอบเทียบ

ของเครื่องมือตรวจวัด

Certificate of Calibration

Method 5 Pre-Test Calibration - Liters (L)

[redacted]

UUT Meter Console Information		Calibration Conditions		Factors/Conversions		Reference Equipment	
Model #:	XC-572-V	Bar. Pressure (mm Hg):	759.8	Std. Temp. (K):	293.15	Calibration Meter Model:	DGMR-200H
Serial #:	A2001003	Ambient Temperature (°C):	24.8	Std. Press. (mm Hg):	760	Cal. Due Date:	25-Jul-24
DGM Model #:	SK25EX	Relative Humidity (%):	55.0	K_1 (K/mm Hg):	0.3857	Serial No.:	0000026
DGM Serial #:	00005796	Altitude (m):	1.33			Gamma:	1.0000
		Bar. Pressure Corr. (mm Hg):	759.7				

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UUT Meter (DGM)							Reference Meter (WTM)					
Run Time	Orifice, ΔH (mm H2O)	Volume			Meter Temperature (°C)		Meter Pressure (in H2O)	Volume (L)			Outlet Temperature (°C)	
		Initial (L)	Final (L)	Total (L)	Initial	Final		Initial	Final	Total	Initial	Final
θ	$P_{m(g)}$	V_{mi}	V_{mf}	V_m	t_{mi}	t_{mf}	P_w	V_{wi}	V_{wf}	V_w	t_{wi}	t_{wf}
830.00	13.00	701219.2	701370.2	151.0	25.0	25.0	0.3	0.00	157.49	157.49	25.0	25.0
600.00	25.00	701370.2	701524.0	153.8	25.0	25.0	0.5	0.00	158.64	158.64	25.0	25.0
450.00	50.00	701524.0	701690.6	166.6	26.0	26.0	0.6	0.00	170.76	170.76	25.0	25.0
450.00	80.00	701690.6	701901.2	210.6	26.0	27.0	2.0	0.00	215.91	215.91	25.0	25.0
300.00	120.00	701901.2	702073.0	171.8	27.0	28.0	2.4	0.00	178.06	178.06	25.0	25.0

Standardized Data

Reference Meter (L)		UUT Meter (L)		Correction Factor		ΔH @ (mm H2O)	
Std. Vol	Std. Flow	Std. Vol.	Std. Flow	Value	Variation	0.0212 SCMM	Variance
$V_{w(std)}$	$Q_{w(std)}$	$V_{m(std)}$	$V_{w(std)}$	Y	ΔY	ΔH@	ΔΔH@
154.90	11.20	148.59	11.2	1.0425	0.0096	46.1	1.267
156.11	15.61	151.52	15.6	1.0303	-0.0026	45.7	0.878
168.06	22.41	163.98	22.4	1.0249	-0.0079	44.3	-0.486
213.24	28.43	207.53	28.4	1.0275	-0.0054	44.4	-0.401
176.03	35.21	169.38	35.2	1.0392	0.0064	43.6	-1.258
				1.0329	= Y Avg.	44.8	= ΔH@ Avg.

Metric

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 $\Delta H_{@}$, orifice pressure differential that equates to 0.0212m^3/min at standard temperature and pressure, acceptable tolerance of individual values from the average is +- 0.2inches (5.1mm) H_2O

Pass/Fail Judgment : **Pass**

Calibrate By : Pattanapong Pongpan Appproved By: Teerri Date: 14 Feb 24

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

Certificate of Calibration - Supplemental

Nomenclature

- P_b - Barometric Pressure
- DGM - Dry Gas Meter
- K_1 - Constant based on standard temp and press
- Θ - Run time, in minutes
- P_{bar} - ΔH (Meter Pressure, gauge)
- V_m - Volume collected by test meter, corrected for STP
- $Q_{m(std)}$ - Calculated flow rate of test meter
- K' - Critical orifice coefficient
- P_a - Measured pressure of reference meter
- T_m - Temperature measured in reference meter

Equations

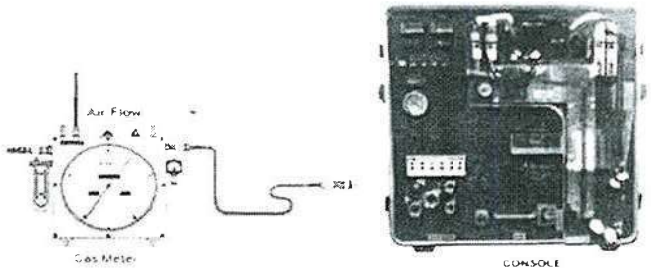
$$V_{m(std)} = Y * K_1 \frac{V_m * (P_{bar} + \frac{\Delta H}{13.6})}{T_m}$$

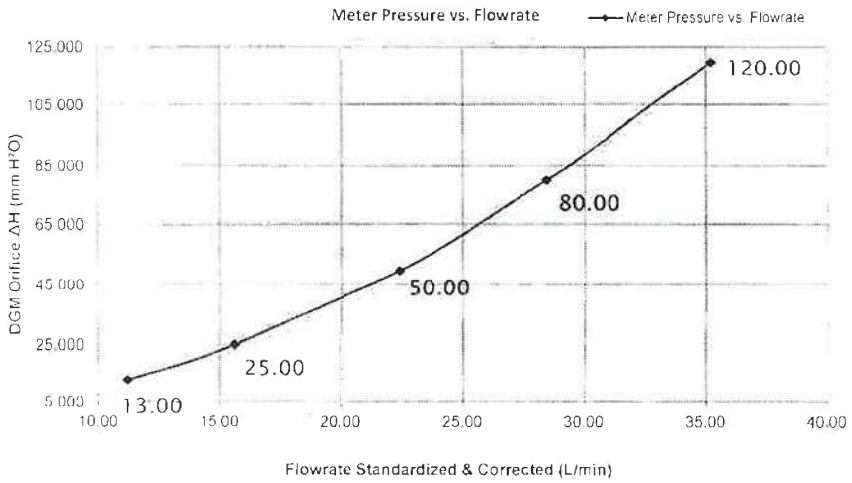
$$V_{m(std)} = \frac{K_1 V_m (P_{bar} + \frac{\Delta H}{13.6})}{T_m}$$

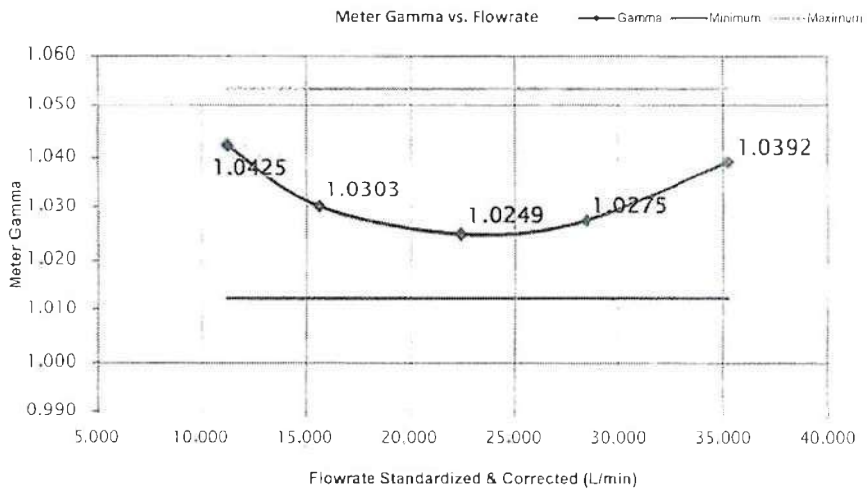
$$K_1 = \frac{T_{std}}{P_{std}} \qquad Y = \frac{V_{m(std)}}{V_{m(std)}} \qquad Q_{m(std)} = \frac{V_{m(std)}}{\Theta}$$

$$\Delta H@ = \Delta H_@ = \frac{P_{std} * 0.0011696 * (P_{bar} + \frac{\Delta H}{13.6})}{T_m} * \left(\frac{T_m + 460}{V_m * P_{bar}}\right)^2$$

Calibration Train







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Certificate of Calibration

Method 5 Console Sensor Calibration - Metric Units

Console Information		Calibration Conditions		Reference Devices	
Model #:	XC-572-V	Pbar (mm Hg):	759.8	TC Calibrator Model:	CC-VTR-SH
Serial #:	A2001003	Humidity (%):	55	Reference #:	091109269
Units:	Metric	Tamb (°C):	24.3	Barometer Model:	736930
		Elevation (m):	1.6	Reference #:	EBARODIALSPE01
		Corr. Pbar (mm. Hg):	759.7	Pressure Model:	718.30G
				Reference #	9543013

Temperature Display Calibration Data

Reference Point[1]	Reference Temp.	Test Thermocouple Calibrations						Reference Point Status[2]
		Aux	Stack	Probe	Oven	Filter	Exit	
#	°C	°C	°C	°C	°C	°C	°C	*Pass/Fail*
1	-18	-17	-17	-17	-17	-17	-17	PASS
2	38	37	37	37	37	37	37	PASS
3	93	93	93	92	93	93	93	PASS
4	149	149	149	149	149	149	149	PASS
5	260	259	259	258	259	258	259	PASS
6	371	371	371	371	371	371	371	PASS
7	482	482	482	482	482	482	482	PASS
8	593	594	594	593	593	593	593	PASS
9	816	816	816	815	815	815	815	PASS
10	1038	1038	1038	1038	1038	1038	1038	PASS
								PASS
								Overall Audit Status

NIST Reference ***Thermocouple ID:*** *12702001*

	Ref Point	Theoretical Temp	DGM Thermocouple Sensor Reading	ΔT_{abs} [4]
	#	°C	°C	°C
Ice Water	1	0.9	1	0.04%
Ambient[3]	2	24.8	25	0.04%
			Maximum[2]	0.04%
			Status	PASS

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

Calibrate By: Pattanapan P. Appproved By: Terri Date: 14 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)

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

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Neediss Supply Instrument C[redacted]

neediss *Console Sensor Calibration Data Sheet*

Console Information		Calibration Conditions		Reference Devices	
Model #:	XC-572-V	Pbar (mm. Hg):	759.8	TC Simulator Model	CC-VTR-SH
Serial #:	A2001003	Humidity (%):	55.0	Reference #	091109269
Units:	Metric	Tamb (°C):	24.8	Barometer Mode	736930
Type:	"English"	Corr. Pbar (mm. Hg):	759.7	Reference #	EBARODIALSPE01
				Digital Pressure Calibrator Model	718 30G
				Reference #	3891001

Pressure Gauge / Manometer Calibration Data

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

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

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

Calibrate By: Pattanapan P. Appproved By: Tarin Date: 14 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 9.3 and EPA Method 5, Sections 6.1.1, 6.1.2, 6.1.3)

[3] Do not change this cell value, this 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 les [redacted]

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neediss Console Sensor Audit QA Sheet

Meter Console Information (UUT)

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

Calibration Conditions

Pbar (mm. Hg):	759.8
Humidity (%):	55.0
Amb. Temp. (°C):	24.8
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	Exit	
	°C	°C	°C	°C	°C	°C	°C	*Pass/Fail*
Ambient	24.4	25	25	24	25	24	25	PASS
Ice Water	1.4	1	1	1	1	1	1	PASS

Audit Data

Console Vacuum Audit			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status[3]
#	*in. Hg*	*in. Hg*	*Pass/Fail*
1	-17.0	-16.5	PASS

Calibrate By: Pattanapum P. Appproved By: Tarin Date: 14 Feb 24

Notes

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

[2]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)

[3]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)

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

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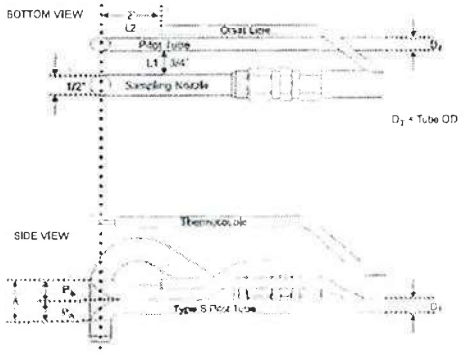
neediss Sampling Probe and Pitot Validation

Samplig System Equipment Information	
Probe Sheat	Apex 1 in. , 5 ft.
Probe Number	w1906152
Pitot tube Number	A8777
Pitot tube Type	S Type 3/8 Inc.
Validation method	Standard Probe 1 in. and 1/2 in. Sampling Nozzle

Valibration Conditions and Equipment		
Digital Calipers	CD-15APX	
Reference No.	A22070181	
Digital Inclinometer	BASELINE	
Reference No.	FEI 12-1057	
Temperatute	24.8	°C±3
Barometric Pressure	759.8	mm Hg



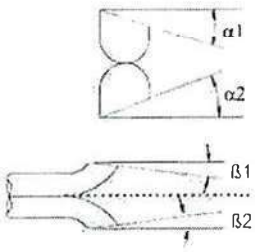
Sampling Probe Validation with Tune up

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

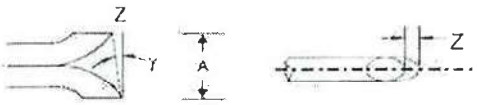
	Measured	Standard Range
L_1 =	1.91 cm.	(1.905 cm. or 3/4 in.)
L_2 =	5.00 cm.	(5.08 cm. or 2.0 in.)
D_T =	0.951 cm.	(3/8 in.)
A =	2.05 cm.	($2.1\ D_T \le A \le 3D_T$)
$A/2D_T$ =	1.057 cm.	($1.05\ P_A / D_T \le A \le 1.5$)

Pitot Tube Validations and Engles measurement Result

☑ : Measure Result after Maintanance and Adjustable



P_B Size		Standard Range
α_1 =	2.30 °	≤ 10°
β_1 =	-2.10 °	≤ 5°
P_A Size		
α_2 =	-0.70 °	≤ 10°
β_2 =	-0.90 °	≤ 5°



Engles measurement		Calculated Result	Standard Range
W =	0.80 °	0.029 cm.	W < 0.08 cm (1/32 in.)
Z =	-0.40 °	-0.014 cm.	Z < 0.032 cm (1/8 in.)

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

Validation By: _____ Appproved By: _____ Date: 14 Feb 24

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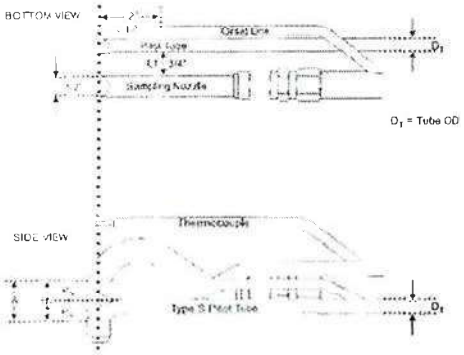
neediss Sampling Probe and Pitot Validation

Samplig System Equipment Information	
Probe Sheat	Apex 1 in. , 3 ft.
Probe Number	w2001490
Pitot tube Number	A8996
Pitot tube Type	S Type 3/8 Inc.
Validation method	Standard Probe 1 in. and 1/2 in. Sampling Nozzle

Valibration Conditions and Equipment		
Digital Callpers	CD-15APX	
Reference No.	A22070181	
Digital Inclinometer	BASELINE	
Reference No.	FEI 12-1057	
Temperatute	24.8	°C±3
Barometric Pressure	759.8	mm Hg



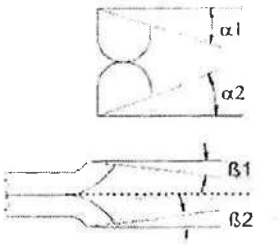
Sampling Probe Validation with Tune up

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

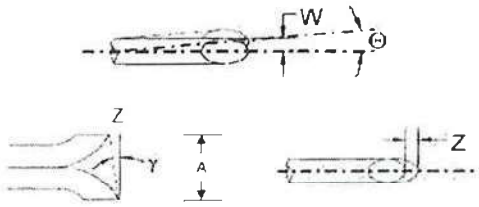
Measured		Standard Range
L_1 =	1.91 cm.	(1.905 cm. or 3/4 in.)
L_2 =	4.99 cm.	(5.08 cm. or 2.0 in.)
D_T =	0.962 cm.	(3/8 in.)
A =	2.08 cm.	($2 \cdot 1\ D_T \le A \le 3D_T$)
$A/2D_T$ =	1.081 cm.	($1.05\ P_A / D_T \le A \le 1.5$)

Pitot Tube Validations and Engles measurement Result

☑ : Measure Result after Maintanance and Adjustable



P_B Size			Standard Range
α_1	=	-1.30 °	≤ 10°
β_1	=	1.20 °	≤ 5°
P_A Size			
α_2	=	3.50 °	≤ 10°
β_2	=	1.90 °	≤ 5°



	Engles measurement	Calculated Result	Standard Range
W =	0.40 °	0.015 cm.	W < 0.08 cm (1/32 in.)
Z =	1.10 °	0.040 cm.	Z < 0.032 cm (1/8 in.)

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

Validation By: Pattanapan P. Appproved By: Tarin Date: 14 Feb 24

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neediss Nozzle Validation

Samplig System Equipment Information	
Console Model	XC-572-V
Console Number	A2001003
DGM Model	SK25EX
DGM Number	00005796

Validation Conditions		
Digital Calipers	CD-15APX	
Reference No	A22070181	
Temperatute	24.8	°C±3
Barometric Pressure	759.8	mm Hg

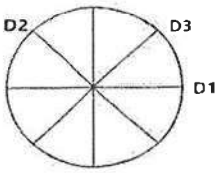
Validation Data					Results	
Nozzle ID	Nozzle Diameter				Different	$(D_1 + D_2 + D_3) / 3$
Sizes		D_1	D_2	D_3	ΔD	Davg
	mm	mm	mm	mm	mm	mm
NS-5	**3.96**	3.96	3.96	3.97	0.006	3.963
NS-6	**4.77**	4.76	4.76	4.77	0.006	4.763
NS-10	**7.92**	6.35	6.36	6.36	0.006	6.357
NS-11	**8.71**	8.72	8.72	8.73	0.006	8.723
NS-13	**10.31**	10.32	10.32	10.31	0.006	10.317
NS-15	**11.88**	11.88	11.88	11.87	0.006	11.877
NS-17	**13.48**	13.48	13.47	13.48	0.006	13.477

Where :

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

ΔD = Maximum difference between any two diameters, must be $\leq$ 0.100 mm

D avg = $(D_1 + D_2 + D_3) / 3$



Validation By: Appproved By: Date: 14 Feb 24

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Neediss Supply Instrument Co.,Ltd.

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Certificate of Calibration

Method 5 Pre-Test Calibration - Liters (L)

UUT Meter Console Information		Calibration Conditions		Factors/Conversions		Reference Equipment	
Model #:	XC-572-V	Bar. Pressure (mm Hg):	759.8	Std. Temp. (K):	293.15	Calibration Meter Model:	DGMR-200H
Serial #:	1001003	Ambient Temperature (°C):	24.2	Std. Press. (mm Hg):	760	Cal. Due Date:	25-Jul-24
DGM Model #:	GB/T6968-2011	Relative Humidity (%):	60.0	K_1 (K/mm Hg):	0.3857	Serial No.:	0000026
DGM Serial #:	L1500033221	Altitude (m):	1.83			Gamma:	1.0000
		Bar. Pressure Corr. (mm Hg):	759.7				

Run Time (min)	Orifice, ΔH (mm H2O)	UUT Meter (DGM) Volume (L) Initial	Volume (L) Final	Volume (L) Total	Meter Temperature (°C) Initial	Meter Temperature (°C) Final	Reference Meter (WTM) Meter Pressure (in H2O)	Volume (L) Initial	Volume (L) Final	Volume (L) Total	Outlet Temperature (°C) Initial	Outlet Temperature (°C) 0.00
θ	$P_{m(g)}$	V_{mi}	V_{mf}	V_m	t_{mi}	t_{mf}	P_w	V_{wi}	V_{wf}	V_w	t_{wi}	t_{wf}
870.00	13.00	483737.2	483897.2	160.0	25.0	25.0	0.3	0.00	161.44	161.44	25.0	25.0
630.00	25.00	483897.2	484059.0	161.8	25.0	25.0	0.5	0.00	164.16	164.16	25.0	25.0
450.00	50.00	484059.0	484223.5	164.5	26.0	26.0	0.6	0.00	167.88	167.88	25.0	25.0
360.00	80.00	484223.5	484391.4	167.9	26.0	27.0	2.0	0.00	171.91	171.91	25.0	25.0
300.00	120.00	484391.4	484561.5	170.1	27.0	27.0	2.4	0.00	174.74	174.74	25.0	25.0

Standardized Data

Reference Meter (L) Std. Vol	Reference Meter (L) Std. Flow	UUT Meter (L) Std. Vol	UUT Meter (L) Std. Flow	Correction Factor Value	Correction Factor Variation	ΔH @ (mm H2O) 0.0212 SCMM	Variance
$V_{w(std)}$	$Q_{w(std)}$	$V_{m(std)}$	$V_{w(std)}$	Y	ΔY	ΔH@	ΔΔH@
158.78	10.95	157.44	11.0	1.0085	-0.0109	48.2	1.935
161.53	15.38	159.40	15.4	1.0134	-0.0060	47.1	0.802
165.23	22.03	161.91	22.0	1.0205	0.0011	45.9	-0.385
169.78	28.30	165.46	28.3	1.0261	0.0068	44.9	-1.407
172.75	34.55	167.99	34.5	1.0283	0.0090	45.3	-0.944
				1.0194	= Y Avg.	46.3	= ΔH@ Avg.

Metric

[redacted]

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 $\Delta H_@$, orifice pressure differential that equates to 0.0212 m^3/min at standard temperature and pressure, acceptable tolerance of individual values from the average is ± 0.20inches (5.1mm) H_2O

Pass/Fail Judgment : **Pass**

Calibrate By : Pattanayan P.

Appproved By: [signature]

Date: 26 Feb 24

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

neediss

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

Θ - 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_a - Measured pressure of reference meter

t_a - Temperature measured in reference meter

Equations

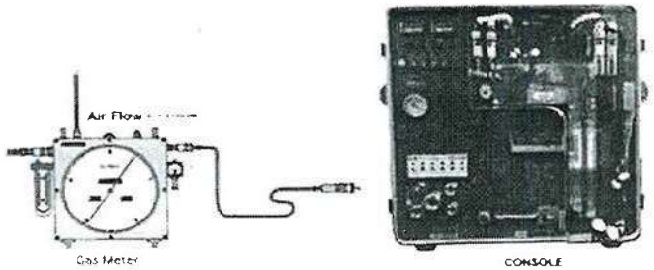
$$V_{w(std)} = Y * K_1 \frac{V_w * (P_{bar} + \frac{P_{m(y)}}{13.6})}{T_w}$$

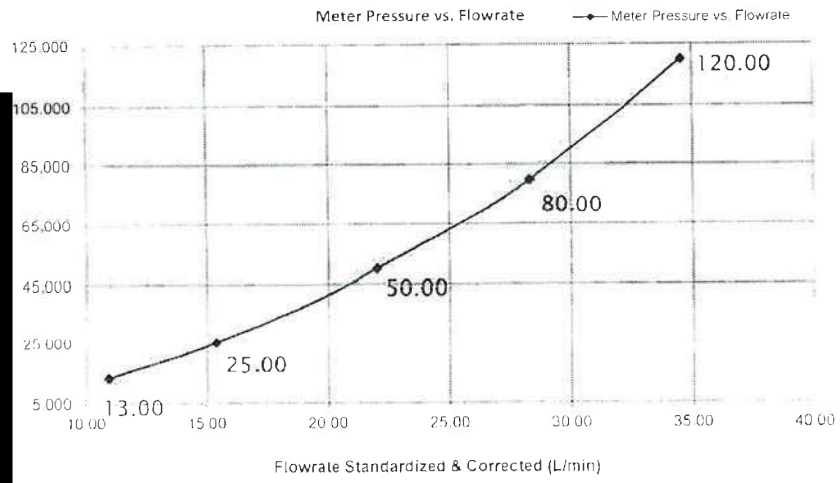
$$V_{m(std)} = \frac{K_1 V_m (P_{bar} + \frac{\Delta H}{13.6})}{T_m}$$

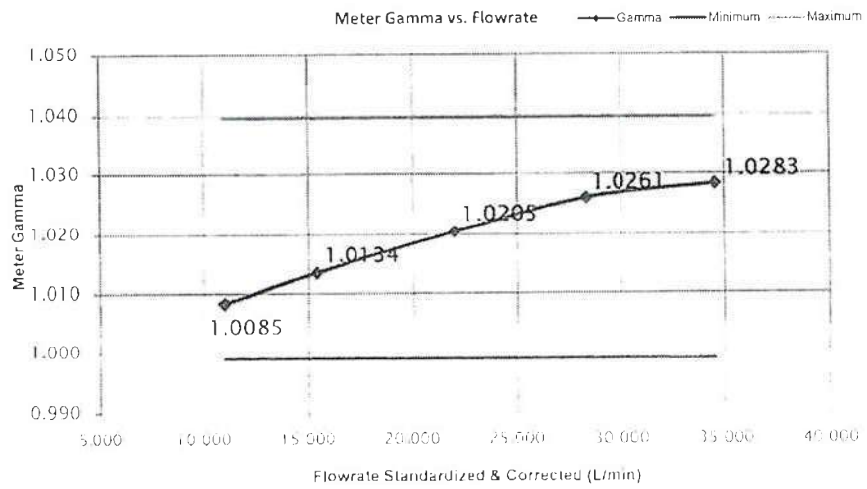
$$K_1 = \frac{T_{std}}{P_{std}} \qquad Y = \frac{V_{w(std)}}{V_{m(std)}} \qquad Q_{w(std)} = \frac{V_{w(std)}}{\Theta}$$

$$Metric\ \Delta H_{@} = \frac{P_{m(y)} * 0.0011696 * (P_{bar} + \frac{P_{m(y)}}{13.6})}{T_m} * \left(\frac{T_w * \Theta}{V_w * P_{bar}}\right)^2$$

Calibration Train







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Envilab Co.,Ltd. ห้องปฏิบัติการสิ่งแวดล้อม

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[1]	Reference Temp.	Test Thermocouple Calibrations						Reference Point Status[2]
		Aux	Stack	Probe	Oven	Filter	Exit	
#	°C	°C	°C	°C	°C	°C	°C	*Pass/Fail*
1	-18	-17	-17	-17	-17	-17	-17	PASS
2	38	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	Theoretical Temp.	DGM Thermocouple Sensor Reading	ΔT_{abs}[4]
	#	°C	°C	°C
Ice Water	1	1.8	2	0.07%
Ambient[3]	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: [signature] Appproved By: [signature] 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)

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

neediss

Neediss Supply Instrument Co [redacted]

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

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

Calibrate By: Pattanapon P. Appproved 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 [illegible])

[3] Do not change this cell value, it is instead based on input from Cell H9 at the top of this sheet under "Calibration Conditions"

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

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

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

[8] 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 M[redacted]

neediss

Neediss Supply Instrument Co., Lt[redacted]

Envilab Co.,Ltd.

neediss 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	Exit	
	°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[3]
#	*in. Hg*	*in. Hg*	*Pass/Fail*
1	-17.0	-17.0	PASS

Calibrate By: Pattanapan P. Appproved By: _____ Date: 26 Feb 24

Notes

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

[2]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)

[3]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)

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

neediss

Neediss Supply Instrument Co.,Ltd

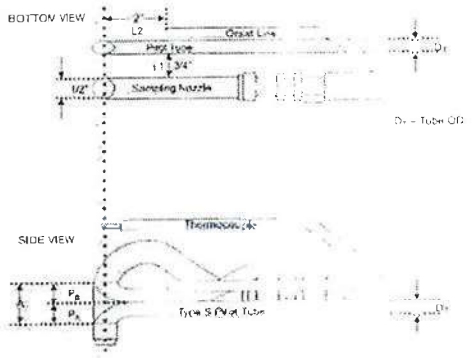
[redacted]

Enviab Co.,Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

neediss Sampling Probe and Pitot Validation

Samplig System Equipment Information	
Probe Sheat	Apex 1 in , 5 ft
Probe Number	1912498
Pitot tube Number	A8778
Pitot tube Type	S Type 3/8 nc
Validation method	Standard Probe : in. and 1/2 in. Sampling Nozzle

Valibration Conditions and Equipment		
Digital Calipers	CD-15APX	
Reference No.	A22070181	
Digital Inclinometer	BASELINE	
Reference No.	FEI 12-1057	
Temperatute	24.2	°C±3
Barometric Pressure	759.8	mm Hg



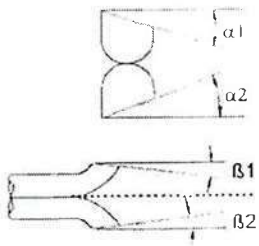
Sampling Probe Validation with Tune up

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

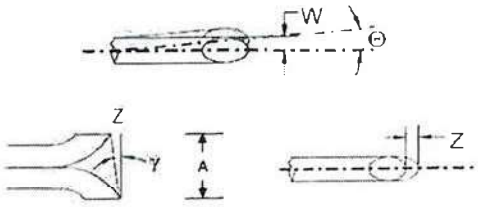
Measured		Standard Range
L_1 =	1.90 cm.	(1.905 cm. or 3/4 in.)
L_2 =	5.10 cm.	(5.08 cm. or 2.0 in.)
D_T =	0.951 cm.	(3/8 in.)
A =	2.16 cm.	($2.1\ D_T \le A \le 3D_T$)
$A/2D_T$ =	1.135 cm.	($1.05\ P_A / D_T \le A \le 1.5$)

Pitot Tube Validations and Engles measurement Result

☑ : Measure Result after Maintanance and Adjustable



P_B Size			Standard Range
α_1	=	0.70 °	≤ 10°
β_1	=	-0.60 °	≤ 5°
P_A Size			
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.)

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

Validation By: Pattanapan P. Approved By: _____ Date: 26 Feb 24

neediss

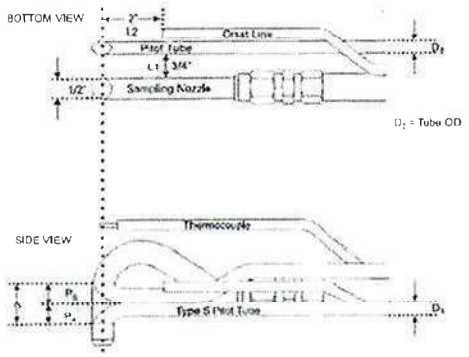
Neediss Supply Instrument Co.,Ltd.

[redacted]

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

Valibration Conditions and Equipment		
Digital Calipers	CD-15APX	
Reference No	A22070181	
Digital Inclinometer	BASELINE	
Reference No.	FEI 12-1057	
Temperatute	24.2	°C±3
Barometric Pressure	759.8	mm Hg



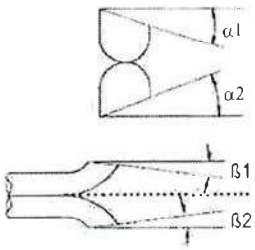
Sampling Probe Validation with Tune up

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

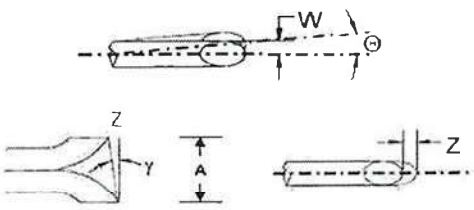
	Measured	Standard Range
L_1 =	1.92 cm	(1.905 cm. or 3/4 in.)
L_2 =	5.56 cm	(5.08 cm. or 2.0 in.)
D_T =	0.96 cm	(3/8 in.)
A =	2.09 cm	($2.1\ D_T \le A \le 3D_T$)
$A/2D_T$ =	1.089 cm	($1.05\ P_A / D_T \le A \le 1.5$)

Pitot Tube Validations and Engles measurement Result

☑ : Measure Result after Maintanance and Adjustable



P_B Size			Standard Range
α_1	=	-3.60 °	≤ 10°
β_1	=	0.00 °	≤ 5°
P_A Size			
α_2	=	-2.40 °	≤ 10°
β_2	=	-2.00 °	≤ 5°



Engles measurement		Calculated Result	Standard Range
W =	1.20 °	0.044 cm.	W < 0.08 cm (1/32 in.)
Z =	-0.90 °	-0.033 cm	Z < 0.032 cm (1/8 in.)

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

Validation By: Pattarapon P. Appproved By: _____ Date: 26 Feb 24

neediss

Neediss Supply Instrument Co.,Ltd

[redacted]

neediss 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

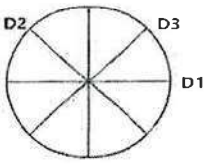
Validation Data					Results	
Nozzle ID	Nozzle Diameter				Different	$(D_1 + D_2 + D_3) / 3$
Sizes		D_1	D_2	D_3	ΔD	Davg
	mm	mm	mm	mm	mm	mm
NS-4	**3.17**	3.17	3.17	3.16	0.006	3.167
NS-8	**6.35**	6.35	6.34	6.35	0.006	6.347
NS-9	**7.13**	7.14	7.12	7.12	0.012	7.127
NS-12	**9.52**	9.52	9.52	9.51	0.006	9.517
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 = $(D_1 + D_2 + D_3) / 3$



Validation By: Appproved By: Date: 26 Feb 24

neediss

Neediss Supply Instrument Co.,Ltd.

[redacted]

Envilab Co.,Ltd.

Certificate of Calibration

Method 5 Pre-Test Calibration - Liters (L)

UUT Meter Console Information		Calibration Conditions		Factors/Conversions		Reference Equipment	
Model #:	800-STACKS-5	Bar. Pressure (mm Hg):	758.5	Std. Temp. (K):	293.15	Calibration Meter Model:	DGMR-200H
Serial #:	1837	Ambient Temperature (°C):	26.4	Std. Press. (mm Hg):	760	Cal.Due Date:	25-Jul-24
DGM Model #:	GB/T6968-2011	Relative Humidity (%):	54	K_1 (K/mm Hg):	0.3857	Serial No.:	0000026
DGM Serial #:	L1500033637	Altitude (m):	1.83			Gamma:	1.0000
		Bar. Pressure Corr. (mm Hg):	758.3				

Run Time (seconds)	Orifice, ΔH (mm H2O)	UUT Meter (DGM) Volume (L)			Meter Temperature (°C)		Meter Pressure (in H2O)	Reference Meter (WTM) Volume (L)			Outlet Temperature (°C)	
		Initial (L)	Final (L)	Total (L)	Initial	Final		Initial	Final	Total	Initial	Final
θ	$P_{m(g)}$	V_{mi}	V_{mf}	V_m	t_{mi}	t_{mf}	P_w	V_{wi}	V_{wf}	V_w	t_{wi}	t_{wf}
840.00	13.00	605939.7	606104.2	164.5	26.0	26.0	0.3	0.00	153.63	153.63	26.0	26.0
630.00	25.00	606104.2	606274.7	170.5	25.0	26.0	0.5	0.00	158.84	158.84	26.0	26.0
450.00	50.00	606274.7	606446.5	171.8	26.0	26.0	0.6	0.00	161.39	161.39	26.0	26.0
360.00	80.00	606446.5	606620.4	173.9	26.0	26.0	2.0	0.00	164.05	164.05	26.0	26.0
318.00	120.00	606620.4	606801.0	180.6	26.0	26.0	2.4	0.00	172.35	172.35	26.0	26.0

Standardized Data

Reference Meter (L)		UUT Meter (L)		Correction Factor		ΔH @ (mm H2O)	
Std. Vol.	Std. Flow	Std. Vol.	Std. Flow	Value	Variation	0.0212 SCMM	Variance
std)	$Q_{w(std)}$	$V_{m(std)}$	$V_{w(std)}$	Y	ΔY	ΔH@	ΔΔH@
.33	10.74	161.05	10.7	0.9334	-0.0042	49.9	-0.781
.50	14.81	167.39	14.8	0.9290	-0.0087	50.6	-0.044
.04	21.07	168.79	21.1	0.9363	-0.0014	50.1	-0.592
.19	26.86	171.35	26.9	0.9407	0.0030	49.8	-0.893
.52	31.98	178.64	32.0	0.9489	0.0113	53.0	2.311
				0.9377	= Y Avg.	50.7	= ΔH@ Avg.

Metric

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 $\Delta H_@$, 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) H_2O.

Pass/Fail Judgment : **Pass**

Calibrate By: Pattanapon P. Appproved By: Tarn Date: 9 Apr 24

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

[redacted]

Certificate of Calibration - Supplemental

Nomenclature

P_b - Barometric Pressure

DGM - Dry Gas Meter

K_1 - Constant based on standard temp and press

Θ - Run time, in minutes

P_m - ΔH (Meter Pressure, gauge)

V_m - Volume collected by test meter, corrected for STP

$Q_{m(std)}$ - Calculated flow rate of test meter

K' - Critical orifice coefficient

P_w - Measured pressure of reference meter

t_w - Temperature measured in reference meter

Equations

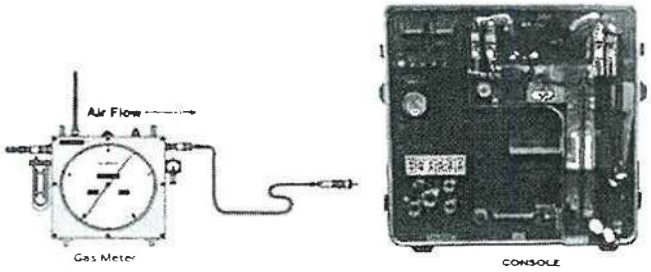
$$V_{w(std)} = Y * K_1 \frac{V_w * (P_{bar} + \frac{P_{m(g)}}{13.6})}{T_w}$$

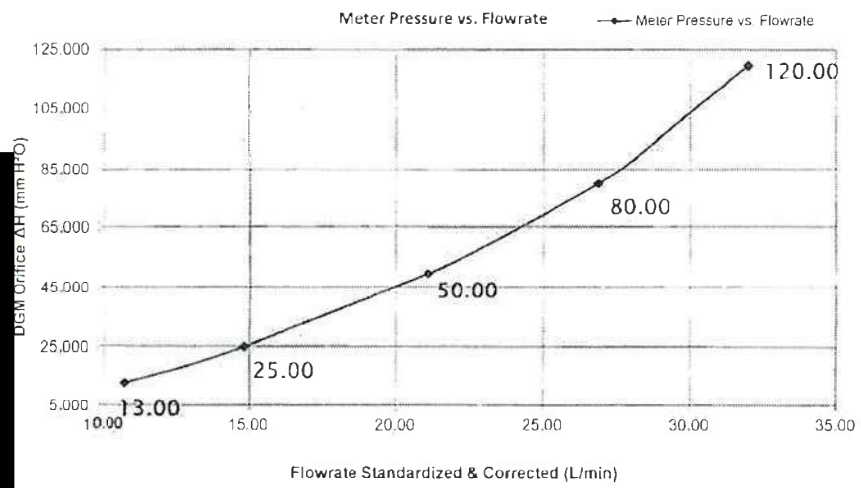
$$V_{m(std)} = \frac{K_1 V_m (P_{bar} + \frac{\Delta H}{13.6})}{T_m}$$

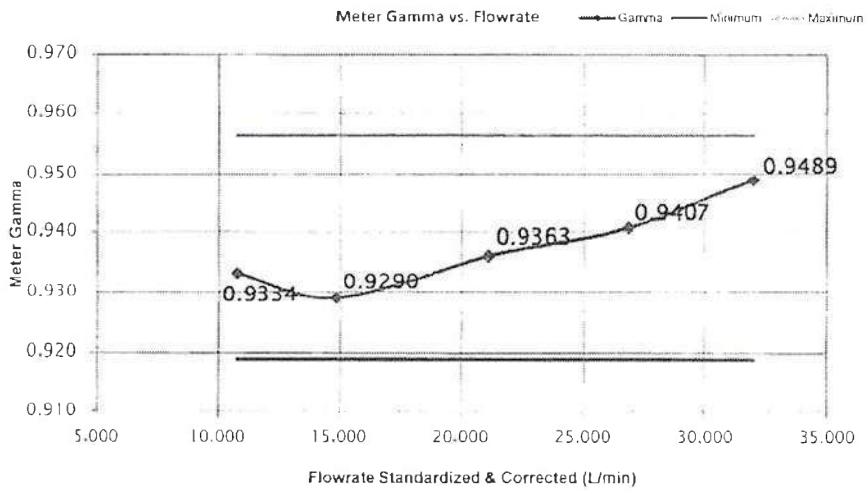
$$K_1 = \frac{T_{std}}{P_{std}} \qquad Y = \frac{V_{cr(std)}}{V_{m(std)}} \qquad Q_{m(std)} = \frac{V_{m(std)}}{\Theta}$$

$$Metric\ \Delta H_@ = \frac{P_{m(g)} * 0.0014696 * (P_{bar} + \frac{P_{m(g)}}{13.6})}{T_m} * \left(\frac{T_m * \Theta}{V_m * P_{bar}}\right)^2$$

Calibration Train







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neediss

Certificate of Calibration

Method 5 Console Sensor Calibration - Metric Units

Console Information

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

Calibration Conditions

Pbar (mm. Hg): 758.5
Humidity (%): 54
Tamb (°C): 26.4
Elevation (m): 1.8
Corr. Pbar (mm. Hg): 758.3

Reference Devices

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

Temperature Display Calibration Data

Reference Point[1]	Reference Temp.	Test Thermocouple Calibrations					Reference Point Status[2]
		Stack	Probe	Filter	Exit	Aux	
#	°C	°C	°C	°C	°C	°C	*Pass/Fail*
1	-18	-17	-17	-17	-17	-17	PASS
2	38	37	36	37	37	37	PASS
3	93	93	93	93	93	92	PASS
4	149	149	149	149	149	149	PASS
5	260	259	258	258	259	259	PASS
6	371	371	371	371	371	371	PASS
7	482	482	482	482	481	481	PASS
8	593	593	593	593	592	592	PASS
9	816	815	815	816	815	815	PASS
10	1038	1038	1037	1037	1037	1038	PASS
							PASS
							Overall Audit Status

NIST Reference Thermocouple ID: 12702001

	Ref Point	Theoretical Temp.	DGM Thermocouple Sensor Reading	ΔT_{abs}[4]
	#	°C	°C	°C
Ice Water	1	0.9	1	0.04%
Ambient[3]	2	26.4	25	0.29%
			Maximum[2]	0.29%
			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: Appproved By: Date: 9 Apr 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)

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

neediss

Needles Supply Instrument Co [redacted]

neediss *Console Sensor Calibration Data Sheet*

Console Information

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

Calibration Conditions

Pbar (mm Hg): 753.5
Humidity (%): 54.0
Tamb (°C): 25.4
Corr. Pbar (mm Hg): 753.3

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[8]
#	*in. Hg*	*in. Hg*	*Pass/Fail*
1	-5.0	-4.5	PASS
2	-15.0	-14.5	PASS
3	-20.0	-19.5	PASS

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

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

Calibrate By: [signature] Appproved By: [signature] Date: 9 Apr 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

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

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

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

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

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

I certify that the above Thermocouple Sensors were calibrated in accordance with US EP[redacted]

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neediss *Console Sensor Audit QA Sheet*

Meter Console Information (UUT)		Calibration Conditions		Reference Devices	
Model #:	800-STACKS-5	Pbar (mm. Hg):	758.5	TC Simulator Model:	CC-VTR-SH
Serial #:	1837	Humidity (%):	54	Reference #:	91109269
Units:	Metric	Amb. Temp. (°C):	26.4	Barometer Model:	369307
		Altitude (m):	1.8	Reference #:	EBARODIALSPE01
		Corrected Pbar (mm. Hg):	758.3	DP Calibrator Model:	718 30G
				Reference #:	9543013

Audit Data

Reference Point	Reference Temp.	Thermocouple Probe Audit					Reference Point Status[1]
		Stack	Probe	Filter	Exit	Aux	
	°C	°C	°C	°C	°C	°C	*Pass/Fail*
Room	26.4	26	26	26	26	26	PASS
Ice Water	0.9	1	1	1	1	1	PASS

Console Vacuum Audit			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status[3]
#	*in. Hg*	*in. Hg*	*Pass/Fail*
1	17.0	16.5	PASS

Calibrate By: [signature] Appproved By: [signature] Date: 9 Apr 24

Notes

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

[2]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)

[3]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)

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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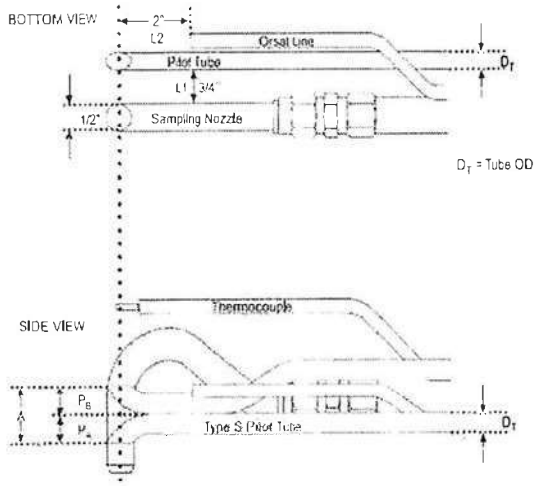
[redacted]

EnviLab Co.,Ltd.

neediss Sampling Probe and Pitot Validation

Samplig System Equipment Information	
Probe Sheat	Apex 1 in., 3 ft.
Probe Number	-
Pitot tube Number	-
Pitot tube Type	S Type 3/8 Inc.
Validation method	Standard Probe 1 in. and 1/2 in. Sampling Nozzle

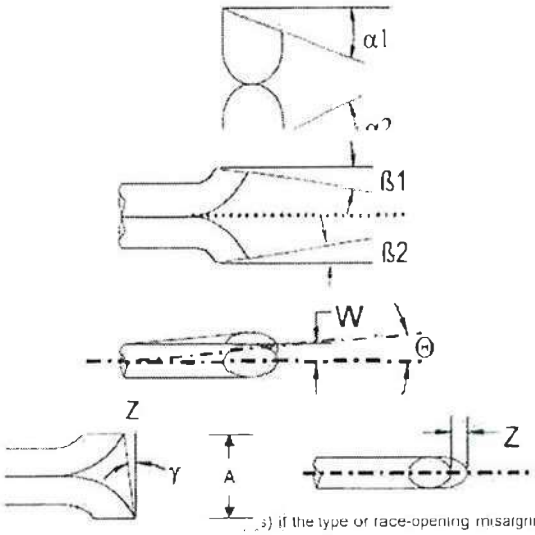
Valibration Conditions and Equipment		
Digital Calipers	CD-15APX	
Reference No.	A22070181	
Digital Inclinometer	BASELINE	
Reference No.	FEI 12-1057	
Temperatute	26.4	°C±3
Barometric Pressure	758.5	mm Hg



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 =	4.99 cm.	(5.08 cm. or 2.0 in.)
D_T =	0.961 cm.	(3/8 in.)
A =	2.18 cm.	($2.1\ D_T \le A \le 3D_T$)
$A/2D_T$ =	1.134 cm.	($1.05\ P_A / D_T \le A \le 1.5$)



Pitot Tube Validations and Engles measurement Result

☑ : Measure Result after Maintanance and Adjustable

P_B Size			Standard Range
α_1	=	-0.30 °	≤ 10°
β_1	=	2.20 °	≤ 5°
P_A Size			
α_2	=	-0.50 °	≤ 10°
β_2	=	1.70 °	≤ 5°

Engles measurement		Calculated Result	Standard Range
W =	0.40 °	0.015 cm.	W < 0.08 cm (1/32 in.)
Z =	1.60 °	0.061 cm.	Z < 0.032 cm (1/8 in.)

...s) if the type or face-opening misalgriment show above with not affect the base line value of Cp(s) Solong as standard range

Validation By: Pattanapon P. Appproved By: Tawin Date: 9 Apr 24

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[redacted]

EnvilaB Co.,Ltd.

neediss Nozzle Validation

Samplig System Equipment Information	
Console Model	XC-572-V
Console Number	A1912535
DGM Model	SK25EX
DGM Number	00006056

Validation Conditions		
Digital Calipers	CD-15APX	
Reference No	A22070181	
Temperatute	24.8	°C±3
Barometric Pressure	759.8	mm Hg

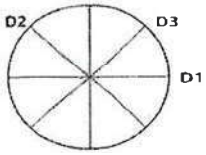
Validation Data					Results	
Nozzle ID	Nozzle Diameter				Different	$(D_1 + D_2 + D_3) / 3$
Sizes		D_1	D_2	D_3	ΔD	Davg
	mm	mm	mm	mm	mm	mm
NS-4	3.17	3.18	3.18	3.17	0.006	3.177
NS-7	5.30	5.32	5.32	5.32	0.000	5.320
NS-9	7.13	7.11	7.12	7.12	0.006	7.117
NS-10	7.92	7.95	7.95	7.94	0.006	7.947
NS-12	9.52	9.53	9.52	9.53	0.006	9.527
NS-14	11.09	11.11	11.10	11.11	0.006	11.107
NS-16	12.70	12.70	12.68	12.70	0.012	12.693

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 = $(D_1 + D_2 + D_3) / 3$



Validation By: Pattamaporn P. Appproved By: Tom's Date: 9 Apr 24

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[redacted]

Certificate of Calibration

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

UUT Meter Console Information		Calibration Conditions		Factors/Conversions		Reference Equipment	
Model #:	XD-502-MV	Bar. Pressure (mb):	1012.9	Std. Temp. (K):	293.15	Calibration Meter Model:	DGMR-200H
Serial #:	1810007	Ambient Temperature(°C):	25.6	Std. Press. (mm Hg):	760	Cal Due Date:	25 Jun 24
DGM Model #:	SK-25-EX	Relative Humidity (%):	65	K_1 (K/mm Hg):	0.3857	Serial #:	0000026
DGM Serial #:	20229137	Altitude (m):	1.8			Gamma:	1.0000
		Bar. Pressure Corr. (mm Hg):	759.6				

UUT Meter (DGM)							Reference Meter					
Run Time (seconds)	Orifice, ΔH (mm H_2O)	Pulse Count			Meter Temperature (°C)		Meter Pressure (in H_2O)	Volume (L)			Outlet Temperature (°C)	
		Initial	Final	Total	Initial	Final		Initial	Final	Total	Initial	Final
θ	$P_{m(g)}$	C_{init}	C_{final}	C_{total}	t_{mi}	t_{mf}	P_w	V_{wi}	V_{wf}	V_w	t_{wi}	tmf
280.76	120.00	0	94121	94121	25.0	26.0	-14.0	0.0	168.5	168.5	25.0	25.0
340.80	80.00	0	93862	93862	26.0	27.0	-10.0	0.0	166.9	166.9	25.0	25.0
430.60	50.00	0	93695	93695	27.0	28.0	-7.0	0.0	165.8	165.8	25.0	25.0
621.57	25.00	0	94406	94406	28.0	28.0	-4.0	0.0	164.6	164.6	25.0	25.0
860.84	13.00	0	92975	92975	28.0	29.0	-2.0	0.0	161.1	161.1	25.0	25.0

Standardized Data		Scaling Factor			Calibration Results			
Reference Meter		Test Meter	Volume Conversion		Correction Factor		ΔH @ (mm H_2O)	
Std. Volume	Std. Flow Rate	Totalizer	Scaling Fac.	Std. Vol.	Value	Variation	0.0212 SCMM	Variance
Vw_{std} (L)	Qw_{std} (L/min)	$Counts_{(std)}$	Y_{sc}	Vm_{std} (L)	Y	ΔY	ΔH@	ΔΔH@
159.895	34.170	93410	1.71E-03	161.9	0.9874	-0.0126	42.9	-1.182
159.996	28.168	92487	1.73E-03	160.3	0.9979	-0.0021	42.6	-1.440
160.089	22.307	91750	1.74E-03	159.1	1.0065	0.0065	42.9	-1.208
160.121	15.456	92071	1.74E-03	159.6	1.0032	0.0032	45.1	1.057
157.515	10.979	90420	1.74E-03	156.7	1.0049	0.0049	46.9	2.773
			1.73E-03	= Avg.	1.0000	= Y Avg.	44.08 Metric	= 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 $\Delta H_@$, orifice pressure differential that equates to 0.0212m^3/min at standard temperature and pressure, acceptable tolerance of individual values from the average is +-0.2inches (5.1mm) H_2O.

Pass/Fail Result: **Pass**

Console Input Value: 1.7335 Metric

Calibrate By; Pattanayan P.

Approved By: Mr.

Date: 4 Mar 24

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

Neediss Supply Instrument Co.,Ltd

[redacted]

Certificate of Calibration - Supplemental

METHOD 5 PRE-TEST CONSOLE CALIBRATION

Nomenclature

- P_b - Barometric Pressure
- DGM - Dry Gas Meter
- K_1 - Constant based on standard temp and press
- Θ - Run time, in minutes
- P_m - ΔH (Meter Pressure, gauge)
- V_m - Volume collected by test meter, corrected for STP
- $Q_{m(std)}$ - Calculated flow rate of test meter
- K' - Critical orifice coefficient
- P_w - Measured pressure of reference meter
- t_w - Temperature measured in reference meter
- t_m - Temperature measured in test meter
- Y - Ratio of volume collected from test meter and orifice
- sc - Scaling Factor
- $Counts_{std}$ - Number of pulse counts, standardized
- C_{total} - Number of raw pulse counts of a calibration run

Equations

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

$$V_{m(std)} = Counts_{std} * Y_{sc(avg)}$$

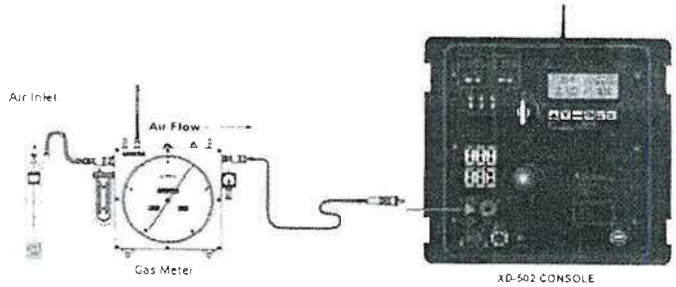
$$Counts_{std} = K_1 \frac{C_{total} * (P_{bar} + \frac{P_{m(gd)}}{13.6})}{T_m}$$

$$Q_{m(std)} = \frac{V_{m(std)}}{\Theta} \qquad Y_{sc} = \frac{V_{w(std)}}{Counts_{std}}$$

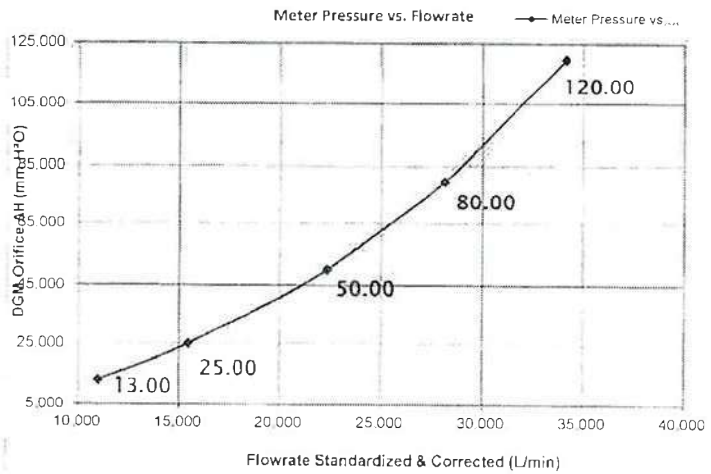
$$K_1 = \frac{T_{std}}{P_{std}} \qquad Y = \frac{V_{w(std)}}{V_{m(std)}}$$

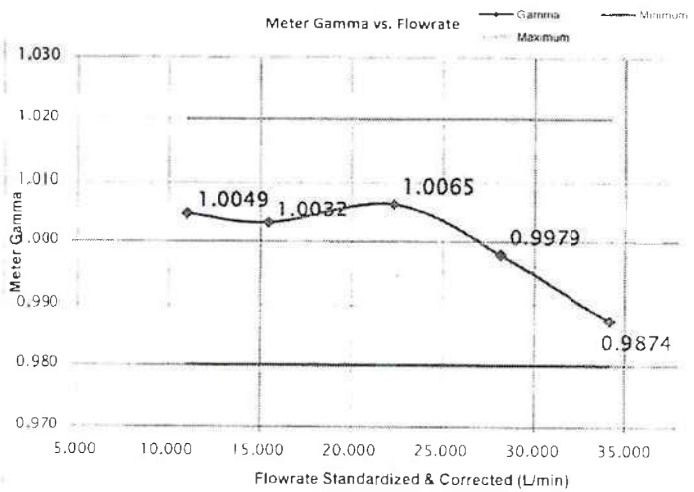
$$Metric\ \Delta H_@ = \frac{P_{m(gd)} * 0.0011696 * (P_{bar} + \frac{P_{m(gd)}}{13.6})}{T_m} * \left(\frac{T_w * \Theta}{V_w * P_{bar}}\right)^2$$

Calibration Train



Calibration Graphs





neediss

Certificate of Calibration

Method 5 Console Temperature Calibration - Metric Units

Console Information		Calibration Conditions		Reference Devices			
Model #:	XD-502-MV	Pbar (mm. Hg):	759.6	TC Calibrator Model:	CC-VTR-SH	Reference #	91109269
Serial #:	1810007	Humidity (%):	65	Pressure Calibrator Model:	718 30G	Reference #	9543013
Units:	Metric	Tamb (°C):	25.6	Barometer Model:	736930	Reference #	EBARODIALSPE01
		Elevation (m):	1.8				
		Corr. Pbar (mm. Hg):	759.6				

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	92	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	371	371	PASS
7	482	482	482	482	482	482	482	PASS
8	593	593	593	593	593	592	593	PASS
9	816	816	816	816	816	816	816	PASS
10	1038	1038	1038	1038	1038	1038	1038	PASS
							TC Measure Overall Audit Status	**PASS**

NIST Reference Temperature Probe ID: 12702001

	Ref Point	Theoretical Temp	DGM Thermocouple Sensor Reading	ΔT_{abs}[4]
	#	°C	°C	°C
Ice Water	1	1.1	1	0.04%
Ambient[3]	2	25.6	26	0.08%
			Maximum[2]	0.08%
			Status	PASS

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

Vacuum Gauge Calibration Data

Console Vacuum Calibration			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status[6]
#	mm. Hg	mm. Hg	Pass/Fail
1	50.0	50.0	PASS
2	100.0	100.0	PASS

Dual Inclined/Vertical Manometer

Reference Pressure	Pressure audit with Console System testing for Inclined Range of 0-26 and Vertical Range of 26-150mm H_2O			
	ΔH Loop (Backside)		Δp Loop (Frontside)	
mm H2O	mm H2O	Pass/Fail	mm H2O	Pass/Fail
0.0	0.0	PASS	-0.7	PASS
50.0	50.4	PASS	50.2	PASS
70.0	70.0	PASS	70.2	PASS
80.0	80.0	PASS	80.4	PASS
90.0	90.2	PASS	90.1	PASS
100.0	100.4	PASS	100.2	PASS
110.0	110.1	PASS	110.1	PASS
120.0	120.2	PASS	120.1	PASS
130.0	130.1	PASS	130.4	PASS
140.0	140.2	PASS	140.4	PASS
150.0	150.2	PASS	150.2	PASS
	ΔH Overall Audit Status	**PASS**	Δp Overall Audit Status	**PASS**

Calibrate By: Pattanapan P. Appproved By: Date: 4 Mar 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 °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 [illegible]).

[3] Do not change this cell value, it is linked based on input from cell [illegible] 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 t[illegible]

[5] For valid test results, the maximum difference between console and reference barometric pressure readings should be less tha[illegible]

[6] For valid test results, the maximum difference between console and reference vacuum readings should be less than [illegible]

I certify that the above Thermocouple Sensors were calibrated in accordance with US EPA Metho[illegible]

[redacted]

Neediss Supply Instrument Co., Ltd.

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Console Sensor Audit QA Sheet

Meter Console Information (UUT)

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

Calibration Conditions

Pbar (mm. Hg):	759.6
Humidity (%):	65
Amb. Temp. (°C):	25.6
Altitude (m):	1.8
Corrected Pbar (mm. Hg):	759.6

Reference Devices

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

Audit Data

Reference Point	Reference Temp.	Console Thermocouple Audit						Reference Point Status[1]
		Aux	Stack	Probe	Oven	Filter	Exit	
#	°C	°C	°C	°C	°C	°C	°C	*Pass/Fail*
1	25.6	25	26	26	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	759.6	758.9	PASS

Console Vacuum Audit			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status[3]
#	*mm. Hg*	*mm. Hg*	*Pass/Fail*
1	75.0	75.00	PASS

Calibrate By; Pattanapan P. Approved By; Date; 4 Mar 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

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

[2]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)

[3]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)

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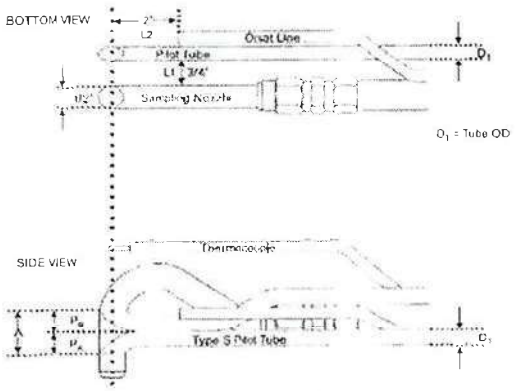
[redacted]

neediss Sampling Probe and Pitot Validation

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

Validation Conditions and Equipment		
Digital Calipers:	ET123456	
Reference No:	A22070181	
Digital Inclinometer:	BASELINE	
Reference No:	12-1057	
Temperatute:	25.6	°C±3
Barometric Pressure:	759.6	mm Hg



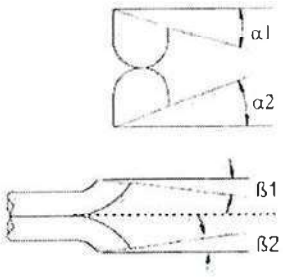
Sampling Probe Validation with Tune up

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

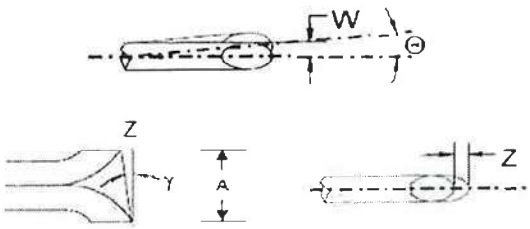
	Measured	Standard Range
L_1 =	1.91 cm.	(1.905 cm. or 3/4 in.)
L_2 =	5.06 cm.	(5.08 cm. or 2.0 in.)
D_T =	0.952 cm.	(3/8 in.)
A =	2.11 cm.	($2.1\ D_T \le A \le 3D_T$)
$A/2D_T$ =	1.106 cm.	($1.05\ P_A / D_T \le A \le 1.5$)

Pitot Tube Validations and Engles measurement Result

☑ : Measure Result after Maintanance and Adjustable



P_B Size			Standard Range
α_1	=	-1.70 °	≤ 10°
β_1	=	1.90 °	≤ 5°
P_A Size			
α_2	=	2.10 °	≤ 10°
β_2	=	-1.20 °	≤ 5°



	Engles measurement	Calculated Result	Standard Range
W =	0.10 °	0.004 cm.	W < 0.08 cm (1/32 in.)
Z =	0.20 °	0.007 cm.	Z < 0.032 cm (1/8 in.)

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

Validation By; Pattanapan P. Approved By; Date; 4 Mar 24

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neediss Nozzle Validation

Samplig System Equipment Information

Console Model Number	XD-502-MV
Console Serial Number	1810007
DGM Model Number	SK-25-EX
DGM Serial Number	20229137

Valibration Conditions

Digital Calipers	CD-15APX	
Reference No	A22070181	
Temperatute	25.6	°C±3
Barometric Pressure	759.6	mm Hg

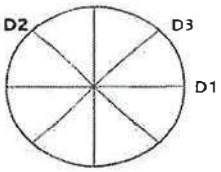
Calibration Data					Results	
Nozzle ID	Nozzle Diameter				Different	$(D_1 + D_2 + D_3) / 3$
Sizes		D_1	D_2	D_3	ΔD	Davg
	mm	mm	mm	mm	mm	mm
NS-4	**3.17**	3.18	3.17	3.17	0.006	3.173
NS-6	**4.77**	4.77	4.77	4.77	0.000	4.770
NS-8	**6.35**	6.35	6.35	6.35	0.000	6.350
NS-10	**7.92**	7.91	7.92	7.93	0.010	7.920
NS-12	**9.52**	9.53	9.53	9.52	0.006	9.527
NS-14	**11.09**	7.13	7.13	7.13	0.000	7.130
NS-16	**12.70**	12.71	12.69	12.70	0.010	12.700

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 = $(D_1 + D_2 + D_3) / 3$



Validation By; Pattanapon P. Approved By; Date: 4 Mar 24

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Certificate of Calibration

Method 5 Pre-Test Calibration - Liters (L)

UUT Meter Console Information

Model #:	XC-572-V
Serial #:	1108048
DGM Model #:	GB/T6968-2011
DGM Serial #:	L1500033220

Calibration Conditions

Bar. Pressure (mm Hg):	759.8
Ambient Temperature (°C):	25.3
Relative Humidity (%):	52
Altitude (m):	1.83
Bar. Pressure Corr. (mm Hg):	759.7

Factors/Conversions

Std. Temp. (K):	293.15
Std. Press. (mm Hg):	760
K_1 (K/mm Hg):	0.3857

Reference Equipment

Calibration Meter Model:	DGMR-200H
Cal. Date:	25 Jun 23
Serial No.:	0000026
Gamma:	1.0000

UUT Meter (DGM)							Reference Meter (WTM)				
Run Time (seconds)	Orifice, ΔH (mm H2O)	Volume			Meter Temperature (°C)		Meter Pressure (in H2O)	Volume (L)			Outlet Temperature (°C)	
		Initial (L)	Final (L)	Total (L)	Initial	Final		Initial	Final	Total	Initial	0.00
θ	$P_{m(g)}$	V_{mi}	V_{mf}	V_m	t_{mi}	t_{mf}	P_w	V_{wi}	V_{wf}	V_w	t_{wi}	t_{wf}
840.00	13.00	295908.5	296063.5	155.0	25.0	25.0	0.3	0.00	156.39	156.39	25.0	25.0
630.00	25.00	296063.5	296227.0	163.5	26.0	27.0	0.5	0.00	164.53	164.53	25.0	25.0
450.00	50.00	296227.0	296391.0	164.0	27.0	28.0	0.6	0.00	164.36	164.36	25.0	25.0
360.00	80.00	296391.0	296559.8	168.8	28.0	29.0	2.0	0.00	169.18	169.18	25.0	25.0
300.00	120.00	296559.8	296733.7	173.9	29.0	30.0	2.4	0.00	176.25	176.25	25.0	25.0

Standardized Data

Reference Meter (L)		UUT Meter (L)		Correction Factor		ΔH @ (mm H2O)	
Std. Vol	Std. Flow	Std. Vol.	Std. Flow	Value	Variation	0.0212 SCMM	Variance
$V_{w(std)}$	$Q_{w(std)}$	$V_{m(std)}$	$V_{w(std)}$	Y	ΔY	ΔH@	ΔΔH@
153.81	10.99	152.52	11.0	1.0084	-0.0036	47.9	1.421
161.90	15.42	160.27	15.4	1.0102	-0.0018	46.6	0.155
161.77	21.57	160.61	21.6	1.0072	-0.0048	47.6	1.161
167.09	27.85	165.24	27.8	1.0112	-0.0008	46.0	-0.455
174.24	34.85	170.32	34.8	1.0230	0.0110	44.2	-2.282
				1.0120	= Y Avg.	46.5	= ΔH@ Avg. Metric

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 $\Delta H_@$, orifice pressure differential that equates to 0.0212m^3/min at standard temperature and pressure, acceptable tolerance of individual values from the average is +-0.2inches (5.1mm) H_2O

Pass/Fail Judgment : **Pass**

Calibrate By : Pattarapon P. Appproved By: _____ Date: 9 Jan 24

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

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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
Θ - Run time, in minutes
P_{m} - ΔH (Meter Pressure, gauge)
V_m - Volume collected by test meter, corrected for STP
$Q_{m(std)}$ - Calculated flow rate of test meter
K' - Critical orifice coefficient
P_{bv} - Measured pressure of reference meter
t_{bv} - Temperature measured in reference meter

Equations

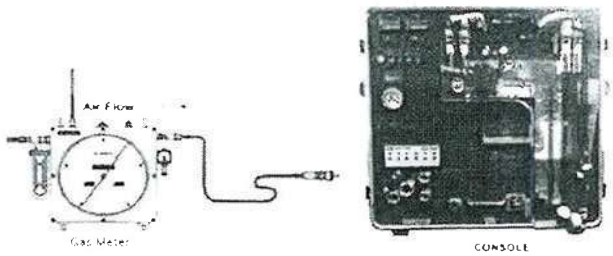
$$V_{m(std)} = Y * K_1 \frac{V_m * (P_{bar} + \frac{P_{meter}}{13.6})}{T_m}$$

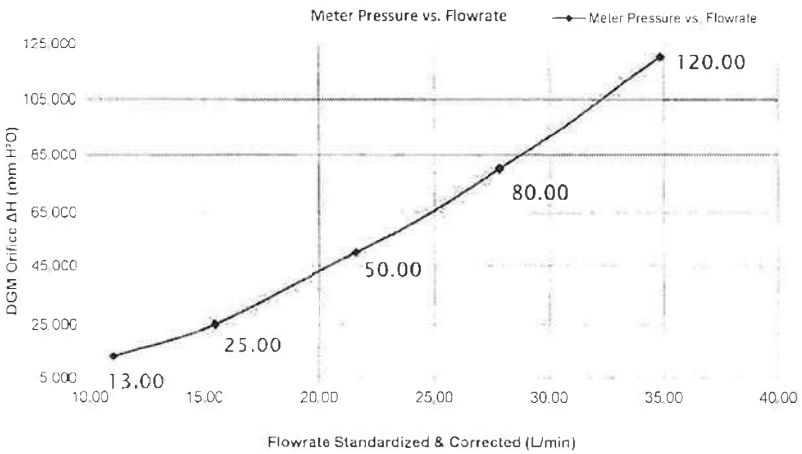
$$P_{meter(std)} = \frac{K' V_m (P_{bar} + \frac{\Delta H}{13.6})}{T_m}$$

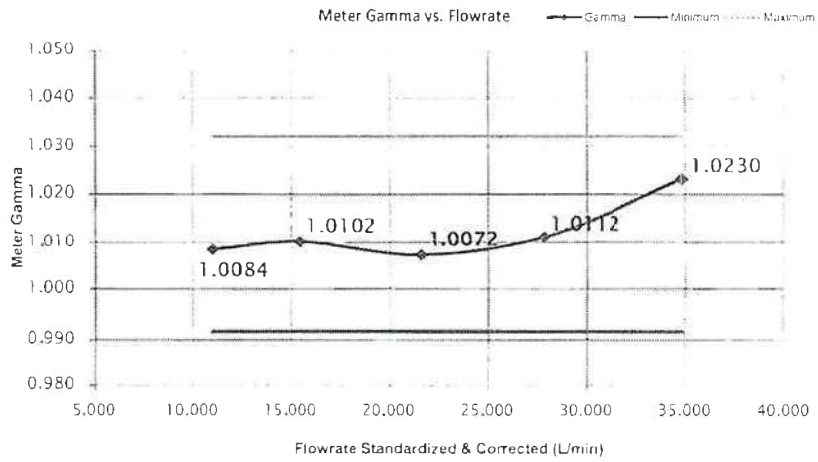
$$K_1 = \frac{T_{std}}{P_{std}} \qquad Y = \frac{V_{cr(std)}}{V_{m(std)}} \qquad Q_{m(std)} = \frac{V_{m(std)}}{\Theta}$$

$$Metric\ \Delta H_a = \frac{P_{m(g)} * 0.0011696 * (P_{bar} + \frac{P_{meter}}{13.6})}{T_m} * \left(\frac{T_m * \Theta}{V_m * P_{bar}}\right)^2$$

Calibration Train







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Certificate of Calibration

Method 5 Console Sensor Calibration - Metric Units

Console Information

Model #:	XC-572-V
Serial #:	1108048
Units:	Metric

Calibration Conditions

Pbar (mm. Hg):	759.8
Humidity (%):	52
Tamb (°C):	25.3
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 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	-17	-16	-17	-18	-17	-17	PASS
2	38	37	38	38	38	38	37	PASS
3	93	93	93	94	93	93	93	PASS
4	149	149	150	149	148	148	149	PASS
5	260	259	259	260	259	259	259	PASS
6	371	372	372	372	372	371	372	PASS
7	482	482	483	483	483	483	483	PASS
8	593	594	594	594	594	593	594	PASS
9	816	816	816	816	816	816	816	PASS
10	1038	1039	1039	1039	1039	1039	1039	PASS
								PASS
								Overall Audit Status

NIST Reference Thermocouple ID: 12702001

	Ref Point	Theoretical Temp.	DGM Thermocouple Sensor Reading	ΔT_{abs}[4]
	#	°C	°C	°C
Ice Water	1	1.4	1	0.15%
Ambient[3]	2	25.3	25	0.06%
			Maximum[2]	0.15%
			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: Pattarapan P. Appproved By: Date: 9 Jan 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

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neediss *Console Sensor Calibration Data Sheet*

Console Information

Model #: XC-572-V
Serial #: 1108048
Units: Metric
Type: "English"

Calibration Conditions

Pbar (mm. Hg):	759.8
Humidity (%):	52.0
Tamb (°C):	25.3
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[6]
#	*in. Hg*	*in. Hg*	*Pass/Fail*
1	-5.0	-5.1	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 (+) Pitot	Negative (-) Pitot	
#	*mm H2O*	*mm H2O*	*mm H2O*	*Pass/Fail*
1	-200.000	0.0	-200.0	PASS
2	-150.000	0.0	-150.0	PASS
3	-100.000	0.0	-100.0	PASS
4	-80.000	0.0	-80.0	PASS
5	-50.000	0.0	-50.0	PASS
6	0.000	0.0	0.0	PASS
7	50.000	50.0	0.0	PASS
8	80.000	80.0	0.0	PASS
9	100.000	100.0	0.0	PASS
10	150.000	150.0	0.0	PASS
11	200.000	200.0	0.0	PASS
			ΔH Overall Audit Status	PASS

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

Calibrate By: Pattanapan P. Appproved By: _____ Date: 9 Jan 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 stack thermocouple which should be less than ±2°F (±1 °C) from the reference reading (EPA

[3] Do not change this cell value. It is instead based on input from Cell [illegible] of the sheet under "Calibration Conditions"

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

[5] For valid test results, the maximum difference between console and reference barometric pressure readings should [illegible]

[6] For valid test results, the maximum difference between console and reference vacuum readings [illegible]

[6] For valid test results, the maximum difference between console and reference vacuum readings should [illegible]

I certify that the above Thermocouple Sensors were calibrated in accordance with U[redacted]

Neediss Sunray Instrument Co., Ltd.

neediss

Console Sensor Audit QA Sheet

Meter Console Information (UUT)

Model #:	XC-572-V
Serial #:	1108048
Units:	Metric

Calibration Conditions

Pbar (mm. Hg):	759.8
Humidity (%):	70%
Amb. Temp. (°C):	24.7
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	Exit	
	°C	°C	°C	°C	°C	°C	°C	*Pass/Fail*
Room	24.7	24	25	25	25	25	24	PASS
Ice Water	1	0	1	1	1	0	0	PASS

Console Vacuum Audit			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status[3]
#	*in. Hg*	*in. Hg*	*Pass/Fail*
1	17.0	17.0	PASS

Calibrate By: _____ Appproved By: _____ Date: 9 Jan 24

Notes

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

[2]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)

[3]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)

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

neediss

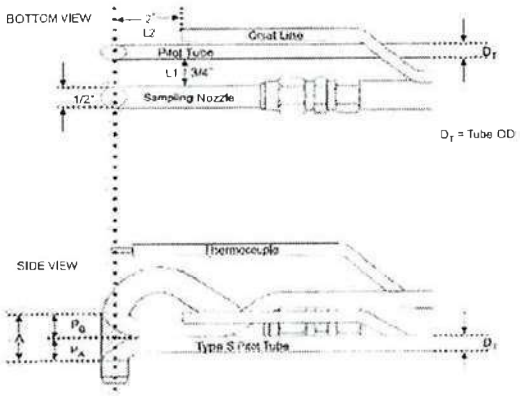
Neediss Supply Instrument Co.,Ltd

[redacted]

neediss Sampling Probe and Pitot Validation

Samplig System Equipment Information	
Probe Sheat	Apex 1 in. , 3 ft.
Probe Number	W1906153
Pitot tube Number	-
Pitot tube Type	S Type 3/8 Inc.
Validation method	Standard Probe 1 in. and 1/2 in. Sampling Nozzle

Valibration Conditions and Equipment		
Digital Calipers	CD-15APX	
Reference No.	A22070181	
Digital Inclinometer	BASELINE	
Reference No.	FEI 12-1057	
Temperatute	25.3	°C±3
Barometric Pressure	759.8	mm Hg



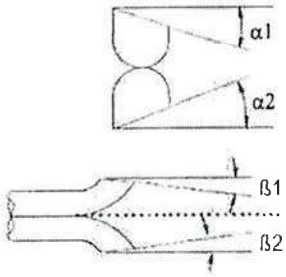
Sampling Probe Validation with Tune up

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

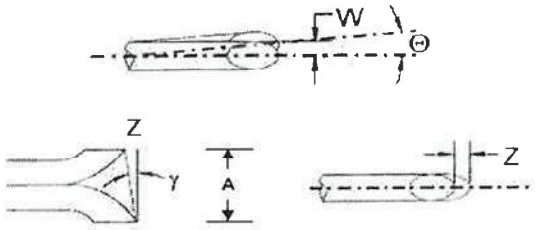
Measured		Standard Range
L_1 =	1.94 cm.	(1.905 cm. or 3/4 in.)
L_2 =	5.08 cm.	(5.08 cm. or 2.0 in.)
D_T =	0.948 cm.	(3/8 in.)
A =	2.44 cm.	($2.1\ D_T \le A \le 3D_T$)
$A/2D_T$ =	1.289 cm.	($1.05\ P_A / D_T \le A \le 1.5$)

Pitot Tube Validations and Engles measurement Result

☑ : Measure Result after Maintanance and Adjustable



P_B Size			Standard Range
α_1	=	-2.70 °	≤ 10°
β_1	=	1.80 °	≤ 5°
P_A Size			
α_2	=	2.80 °	≤ 10°
β_2	=	-1.90 °	≤ 5°



	Engles measurement	Calculated Result	Standard Range
W =	0.20 °	0.009 cm.	W < 0.08 cm (1/32 in.)
Z =	0.59 °	0.025 cm.	Z < 0.032 cm (1/8 in.)

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

Validation By: _____ Appproved By: _____ Date: 9 Jan 24

neediss

Neediss Supply Instrument [redacted]

Enviab Co.,Ltd.

neediss Nozzle Validation

Samplig System Equipment Information	
Console Model	XC-572-V
Console Number	1108048
DGM Model	GB/T6968-2011
DGM Number	L1500033220

Validation Conditions		
Digital Calipers	CD-15APX	
Reference No	A22070181	
Temperatute	25.2	°C±3
Barometric Pressure	759.8	mm Hg

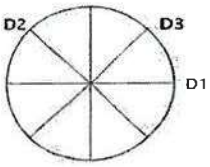
Validation Data					Results	
Nozzle ID	Nozzle Diameter				Different	$(D_1 + D_2 + D_3) / 3$
Sizes		D_1	D_2	D_3	ΔD	Davg
	mm	mm	mm	mm	mm	mm
4	**3.17**	3.17	3.17	3.17	0.000	3.170
6	**4.77**	4.77	4.77	4.77	0.000	4.770
8	**6.35**	6.34	6.35	6.36	0.010	6.350
10	**7.92**	7.92	7.92	7.92	0.000	7.920
12	**9.52**	9.52	9.51	9.51	0.006	9.513
14	**11.09**	11.05	11.05	11.06	0.006	11.053
16	**12.70**	12.70	12.71	12.71	0.006	12.707

Where :

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

ΔD = Maximum difference between any two diameters, must be $\leq$ 0.100 mm

D avg = $(D_1 + D_2 + D_3) / 3$



Validation By: Pattamaporn P. Appproved By: Date: 9 Jan 24

neediss
Neediss Supply Instrument Co.,Ltd

[redacted]

Certificate of Calibration

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

UUT Meter Console Information		Calibration Conditions		Factors/Conversions		Reference Equipment	
Model #:	XD-502-MV	Bar. Pressure (mb):	1013	Std. Temp. (K):	293.15	Calibration Meter Model:	DGMR-200H
Serial #:	1903024	Ambient Temperature(°C):	24.5	Std. Press. (mm Hg):	760	Cal Due Date:	25 Jun 23
DGM Model #:	SK-25-EX	Relative Humidity (%):	45	K_1 (K/mm Hg):	0.3857	Serial #:	0000026
DGM Serial #:	20193918	Altitude (m):	1.8			Gamma:	1.0000
		Bar. Pressure Corr. (mm Hg):	759.7				

UUT Meter (DGM)							Reference Meter					
Run Time (seconds)	Orifice, ΔH (mm H_2O)	Pulse Count			Meter Temperature (°C)		Meter Pressure (in H_2O)	Volume (L)			Outlet Temperature (°C)	
		Initial	Final	Total	Initial	Final		Initial	Final	Total	Initial	Final
Θ	$P_{m(g)}$	C_{init}	C_{final}	C_{total}	t_{mi}	t_{mf}	P_w	V_{wi}	V_{wf}	V_w	t_{wi}	t_{wf}
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

Standardized Data			Scaling Factor		Calibration Results			
Reference Meter		Test Meter	Volume Conversion		Correction Factor		ΔH @ (mm H_2O)	
Std. Volume	Std. Flow Rate	Totalizer	Scaling Fac	Std. Vol.	Value	Variation	0.0212 SCMM	Variance
Vw_{std} (L)	Qw_{std} (L/min)	$Counts_{(std)}$	Y_{sc}	Vm_{std} (L)	Y	ΔY	ΔH@	ΔΔH@
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
			1.71E-03	= Avg.	1.0000	= Y Avg.	45.30 Metric	= 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 $\Delta H_@$, orifice pressure differential that equates to 0.0212 m^3/min at standard temperature and pressure, acceptable tolerance of individual values from the average is +-0.2inches (5.1mm) H_2O.

Pass/Fail **Result:** Pass

Console Input Value: 1.7079 Metric

[redacted]

Calibrate By: Pattanayan

Approved By:

Date: 25 Jan 24

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

neediss Supply Instrument Co., Ltd

Certificate of Calibration - Supplemental

METHOD 5 PRE-TEST CONSOLE CALIBRATION

Nomenclature

P_b - Barometric Pressure

DGM - Dry Gas Meter

K_1 - Constant based on standard temp and press

Θ - Run time, in minutes

P_m - ΔH (Meter Pressure gauge)

V_m - Volume collected by test meter, corrected for STP

$Q_{m(std)}$ - Calculated flow rate of test meter

K' - Critical orifice coefficient

P_w - Measured pressure of reference meter

t_w - Temperature measured in reference meter

t_m - Temperature measured in test meter

Y - Ratio of volume collected from test meter and orifice

sc - Scaling Factor

$Counts_{std}$ - Number of pulse counts, standardized

C_{total} - Number of raw pulse counts of a calibration run

Equations

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

$$V_{m(std)} = Counts_{std} * Y_{sc(avg)}$$

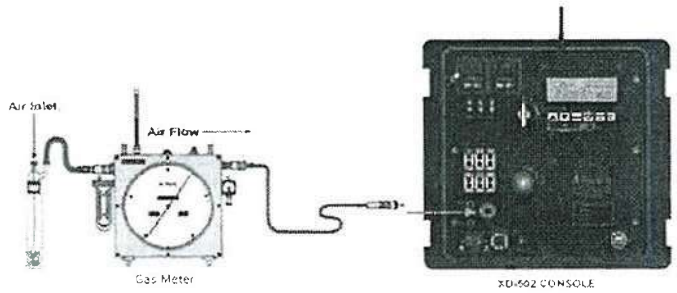
$$Counts_{std} = K_1 \frac{C_{total} * (P_{bar} + \frac{P_{m(g)}}{13.6})}{T_m}$$

$$Q_{m(std)} = \frac{V_{m(std)}}{\Theta} \qquad Y_{sc} = \frac{V_{w(std)}}{Counts_{std}}$$

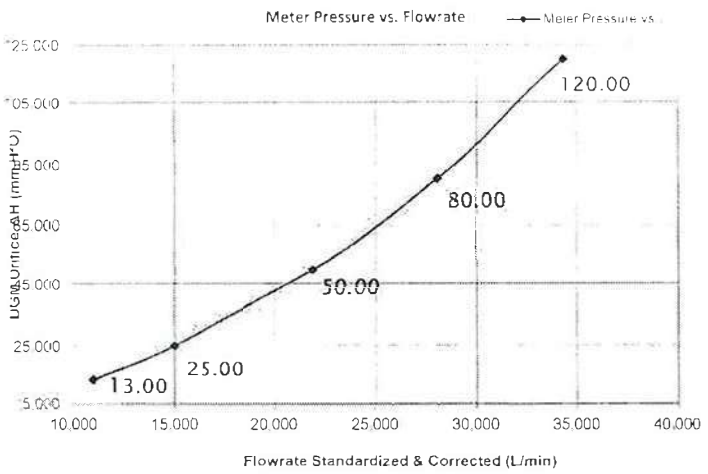
$$K_1 = \frac{T_{std}}{P_{std}} \qquad Y = \frac{V_{w(std)}}{V_{m(std)}}$$

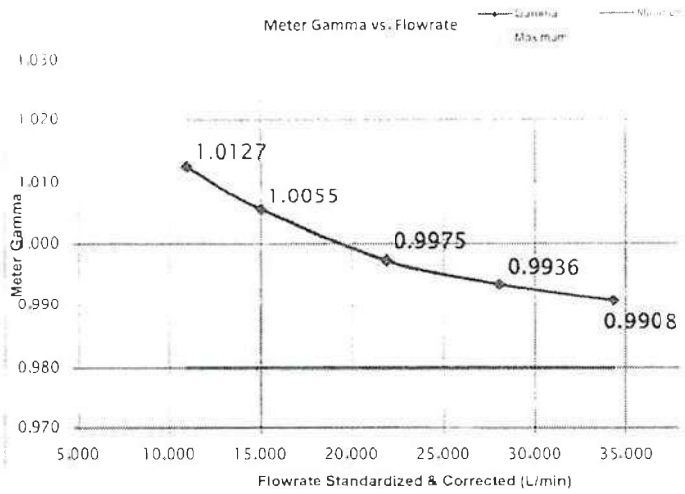
$$Metric\,\Delta H_w = \frac{P_{m(g)} * 0.0011696 * (P_{bar} + \frac{P_{m(g)}}{13.6})}{T_m} * \left(\frac{T_w * \Theta}{V_w * P_{bar}}\right)^2$$

Calibration Train



Calibration Graphs





[redacted]

[redacted]

Certificate of Calibration

Method 5 Console Temperature Calibration - Metric Units

Console Information		Calibration Conditions		Reference Devices			
Model #:	XD-502-MV	Pbar (mm. Hg):	759.7	TC Calibrator Model:	CC-VTR-SH	Reference #	91109269
Serial #:	1903024	Humidity (%):	45	Pressure Calibrator Model:	718 30G	Reference #	9543013
Units:	Metric	Tamb (°C):	24.5	Barometer Model:	736930	Reference #	EBARODIALSPE01
		Elevation (m):	1.8				
		Corr. Pbar (mm. Hg):	759.7				

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	1	0.00%
Ambient[5]	2	24.5	25	0.10%
			Maximum[7]	**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[6]
#	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 26-150mm H-O			
	ΔH Loop (Backside)		Δp Loop (Frontside)	
mm H2O	mm H2O	Pass/Fail	mm H2O	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
150.0	150.2	PASS	149.9	PASS
	ΔH Overall Audit Status	**PASS**	Δp Overall Audit Status	**PASS**

Calibrate By: [illegible] Appproved By: [illegible] Date: 25 Jan 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] [illegible] 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 [illegible] deviation 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 6.0 and EPA Method 5, Sections 6.1.1 & 6.1.8)

[3] [illegible] "No [illegible] average [illegible] cell value, it is instead based on input [illegible] on the sheet under "Calibration Conditions"

[4] [illegible] "Absolute [illegible] other [illegible] on the top of this sheet under "Meter Console Information"

[5] [illegible] The maximum difference between [illegible] less than [illegible] °F (± [illegible] °C) (EPA Method 5, Section 6.1.2)

[6] [illegible] The maximum difference between [illegible] reference vacuum gauges [illegible] less than [illegible] mm H2O (± [illegible] mm H2O) or [illegible] of full scale

[7] [illegible] Method [illegible] CFR 40 [illegible]

Neediss
Neediss Supply Instrument Co.,Ltd.

neediss Console Sensor Audit QA Sheet

Meter Console Information (UUT)

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.	Console Thermocouple Audit						Reference Point Status[1]
		Aux	Stack	Probe	Oven	Filter	Exit	
#	°C	°C	°C	°C	°C	°C	°C	*Pass/Fail*
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

Calibrate By; Pattanapon P. Approved By; 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

[1]For 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 ± 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)

[2]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)

[3]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)

neediss

Neediss Supply Instrument Co.,Ltd.

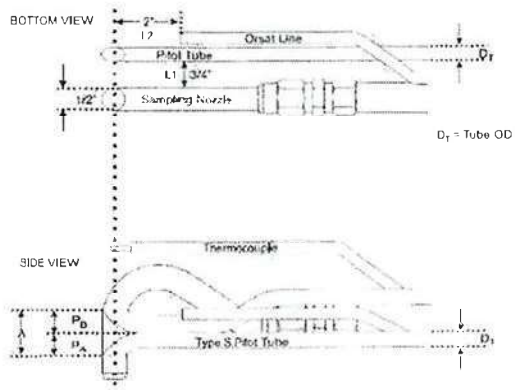
[redacted]

Enviab Co.,Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

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 Inclinometer:	BASELINE	
Reference No:	12-1057	
Temperatute:	24.9	°C±3
Barometric Pressure:	759.7	mm Hg



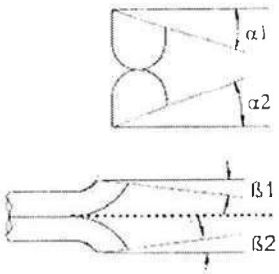
Sampling Probe Validation with Tune up

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

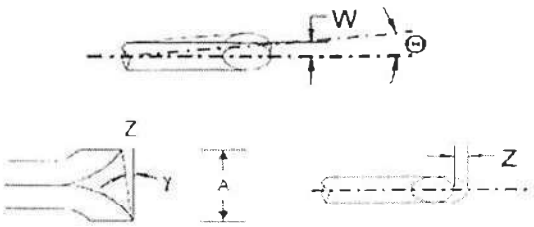
	Measured	Standard Range
L_1 =	1.91 cm.	(1.905 cm. or 3/4 in.)
L_2 =	5.07 cm.	(5.08 cm. or 2.0 in.)
D_T =	0.958 cm.	(3/8 in.)
A =	2.12 cm.	(2.1 $D_T \le A \le 3D_T$)
$A/2D_T$ =	1.107 cm.	(1.05 $P_A / D_T \le A \le 1.5$)

Pitot Tube Validations and Engles measurement Result

☑ : Measure Result after Maintanance and Adjustable



P_B Size			Standard Range
α_1	=	-1.00 °	≤ 10°
β_1	=	1.40 °	≤ 5°
P_A Size			
α_2	=	1.00 °	≤ 10°
β_2	=	-0.70 °	≤ 5°



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

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

Validation By; _____ Approved By; _____ Date; 25 Jan 24

neediss

Neediss Supply Instrument Co [redacted]

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

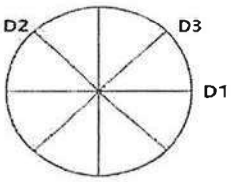
Calibration Data					Results	
Nozzle ID	Nozzle Diameter				Different	$(D_1 + D_2 + D_3) / 3$
Sizes		D_1	D_2	D_3	ΔD	Davg
	mm	mm	mm	mm	mm	mm
NS-4	**3.17**	3.17	3.17	3.17	0.000	3.170
NS-6	**4.77**	4.76	4.76	4.76	0.000	4.760
NS-8	**6.35**	6.35	6.35	6.35	0.000	6.350
NS-10	**7.92**	7.93	7.92	7.92	0.006	7.923
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

ΔD = Maximum difference between any two diameters, must be $\leq$ 0.100 mm

D avg = $(D_1 + D_2 + D_3) / 3$



Validation By: Pattamaporn P. Approved By: Date: 25 Jan 24

neediss

Neediss Supply Instrument Co.,Ltd.

[redacted]

[redacted]

บริษัท นีดิส ซัพพลาย อินสตรูเม้นท์ จำกัด
Neediss Supply Instrument Co., Ltd.
536 Soi Bangkhae 7 Bangkhae Bangkhae Bangkok
Tel. 02 802-3990 2 Fax. 02 802-[illegible] info@neediss.com

Vertification Test Report

Instruments Information

Analyzer Type:	Flue Gas Analyser	**Manufacturer:**	MRU
Model:	Optima7	**Serial No.:**	320779

Calibration Gas information

Standard Gas Mid Range			Standard Gas High Range		
O2 Conc	2.2	%vol.	**O2 Conc**	10.22	%vol.
Cd/Ex:	343014/Jul 24,2025		**Cd/Ex:**	343018/Jan 10,2025	
CO Conc	99.94	ppm	**CO Conc**	594.5	ppm
NO Conc	99.69	ppm	**NO Conc**	197.2	ppm
NOX Conc	99.76	ppm	**NOX Conc**	197.2	ppm
SO2 Conc	100.5	ppm	**SO2 Conc**	200.9	ppm
CO2 Conc	8.054	%	**CO2 Conc**	16.02	%
Cd/Ex:	ED5716/May 16,2030		**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	8.07	0.0	0.2
Hight	16.0	17.68	15.97	0.0	-0.3

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We know the best thing to save environment

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Neediss Supply Instrument Co., Ltd.
535 ซอยบางนอก 7 แขวงบางนอก เขตบางพลัด กรุงเทพฯ 10160 535 Soi Bangkhoe 7 Bangkhoe Bangkhoe Bangkok
Tel. 02-807-3910-2 Fax. 02-807-3988 | info@neediss.com

Vertification Test Report

Instruments Information

Analyzer Type:	Flue Gas Analyser	**Manufacturer:**	MRU
Model:	Optima7	**Serial No.:**	320779

Calibration Gas information

Standard Gas Mid Range			Standard Gas High Range		
O2 Conc	2.2	%vol.	**O2 Conc**	10.22	%vol.
Cd/Ex:	343014/Jul 24,2025		**Cd/Ex:**	343018/Jan 10,2025	
CO Conc	99.94	ppm	**CO Conc**	594.5	ppm
NO Conc	99.69	ppm	**NO Conc**	197.2	ppm
NOX Conc	99.76	ppm	**NOX Conc**	197.2	ppm
SO2 Conc	100.5	ppm	**SO2 Conc**	200.9	ppm
CO2 Conc	8.054	%	**CO2 Conc**	16.02	%
Cd/Ex:	ED5716/May 16,2030		**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 : Pitthayapon P. Approve By : Date: 26 Feb 24

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CAL
Calibratech Co.,Ltd.
7/106-7 Moo 2, Sukhaprachasan 3 Rd., Bangpood, Pakkred, Nonthaburi 11120
Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech_cal@yahoo.com, calibratech_cal@hotmail.com

ilac-MRA

NSC-TIS-CS 1/024
CALIBRATION 0076

Certificate of Calibration

Certificate No. : **67-200060-1**

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

Equipment : Electronic Balance

Manufacturer :	Sartorius	Model :	SECURA125-1S
Serial No. :	0034606552	ID No. :	ELABBALANCEN05
Capacity :	120 g	Resolution :	0.0001 g

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

Ambient Temperature :	(20.0 to 20.7)	°C
Relative Humidity :	(56.2 to 60.3)	%
Air Pressure :	1013.0	mbar

Date of Received : 20 February 2024

Date of Calibration : 20 February 2024

Date of Issue : 21 February 2024

Calibrated by : Satja Sangkhum

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

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02232088	08 Nov 2024	National Institute of Metrology (Thailand), (NIMT)

Approved by :

(Surachai Promthong)
Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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CAL

Calibratech Co.,Ltd.

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

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

Certificate of Calibration

Certificate No. : 67-200060-1

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty ± (g)
0.1	0.0000	0.00011
0.5	0.0000	0.00011
1	0.0000	0.00011
2	0.0000	0.00011
5	0.0000	0.00011
10	0.0000	0.00011
20	0.0000	0.00013
50	0.0001	0.00014
100	0.0001	0.00020
120	0.0000	0.00038

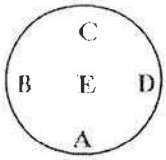
This result of calibration was found accurate as shown on date and place of calibration only.

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

Eccentric error

Load test : 20 g

A	B	C	D	E	
0.0001	0.0001	0.0000	0.0000	0.0000	g



Repeatability

Load test : 100 g

Stdev. : 0.00004 g

- o0o -

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7/106-7 Moo 2, Sukhaprachasan 3 Rd., Bangpood, Pakkred, Nonthaburi 11120
Tel.(02) 964-6211 Fax.(02) 964-5155, e-mail : calibratech_cal@yahoo.com, calibratech_cal@hotmail.com

ilac-MRA
NSC-TISI-TIS17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 67-410025-1

Submitted by : Envilab Co., Ltd.
540, 540/1 Soi Bangkhae 7, Bangkhae, Bangkok 10160

Equipment : Digital Thermo-Hygrometer

Manufacturer :	Jedto	Model :	HTC-1
Range Temperature :	N/A °C	Resolution :	0.1 °C
Range Humidity :	N/A %R.H.	Resolution :	1 %R.H.
Serial No. :	PONPE5852094	ID No. :	ELABTMHTC10003

Environment : Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 15) %

Date of Received : 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

Approved by :
(Surachai Promthong)
Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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7/106 7 Moo 2, Sukhapiban 3 Rd., Bangpood, Pakkred, Nonthaburi 11120
Tel.(02) 964-6211 Fax.(02) 9[illegible]55, e-mail : calibratech_cal@yahoo.com, calibratech_cal@hotmail.com

Certificate of Calibration

Certificate No. : 67-410025-1

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%

- o0o -

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Co.,Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

TSP High Volume Sampler Calibration

Verification Report No.
SO2400119-E001 -TSP 01

☐ PM ☑ Onsite

Site: วัดอ้อมแก้ว
UTM : N 1488388 E 728953
Sampler: ETSP#40
Recorder: ECRANG15315225

Date: 3 May 24
Technical: Kunanon P.
Approval: Wisan R.

CONDITIONS

Barometric Press. (hPa):	1002.0	Corrected Pressure (mm Hg):	751.6
Temperature (deg C):	33.0	Temperature (deg K):	306.0
Average Press. (hPa):	1013.0	Corrected Avg.Press. (mm Hg):	759.8
Average Temp. (deg C):	30.0	Average Temp. (deg K):	303.0

CALIBRATION ORIFICE

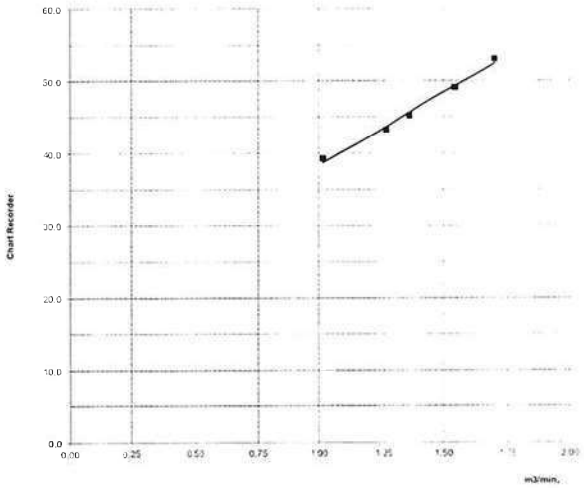
Brand:	Tisch Environmental, Inc	Qstd Slope:	2.03736
Model:	TE-5025A	Qstd Intercept:	-0.03733
Serial#:	759	Date Certified:	9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	12.13	1.696	54.0	52.99
2	10.02	1.543	50.0	49.07
3	7.78	1.362	46.0	45.14
4	6.67	1.262	44.0	43.18
5	4.30	1.017	40.0	39.25

LINEAR REGRESSION

Slope =	20.2213
Intercept =	18.1015
Corr. coeff.=	0.9946
# of Observations:	5
Range of Chart at 1.1 - 1.7 m3/min.	42 – 53



Calibrated by :
(Kunanon Phila)
3 May 2024

Approved by :
(Wisan Ritthikamon)
3 May 2024

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Envilab Co.,Ltd.

TSP High Volume Sampler Calibration

Verification Report No.
SO2400119-E001 -TSP 02

☐ PM ☑ Onsite

Site: วัดโคกท่าเจริญ
UTM : N 1490141 E 727433
Sampler: ETSP#37
Recorder: ECRANG15315234

Date: 3 May 24
Technical: Kunanon P.
Approval: Wisan R.

CONDITIONS

Barometric Press. (hPa):	1002.0	Corrected Pressure (mm Hg):	751.6
Temperature (deg C):	33.0	Temperature (deg K):	306.0
Average Press. (hPa):	1013.0	Corrected Avg.Press. (mm Hg):	759.8
Average Temp. (deg C):	30.0	**Average Temp. (deg K):**	303.0

CALIBRATION ORIFICE

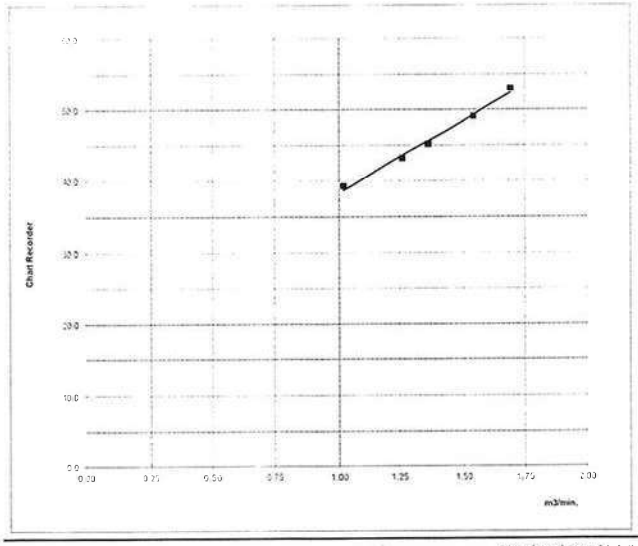
Brand:	Tisch Environmental, Inc	Qstd Slope:	2.03736
Model:	TE-5025A	Qstd Intercept:	-0.03733
Serial#:	759	Date Certified:	9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)
1	11.87	1.678	54.0	52.99
2	10.18	1.555	50.0	49.07
3	7.26	1.316	46.0	45.14
4	4.72	1.065	42.0	41.22
5	3.48	0.917	38.0	37.29

LINEAR REGRESSION

Slope =	19.2638
Intercept =	19.9803
Corr. coeff.=	0.9937
# of Observations:	5
Range of Chart at 1.1 - 1.7 m3/min.	42 – 53



Calibrated by : (Kunanon Phila)
3 May 2024

Approved by : (Wisan Ritthikamon)
3 May 2024

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Envilab Co.,Ltd.

PM10 High Volume Sampler Calibration

Verification Report No.

SO2400119-E001 -PM 01

☐ PM ☐ Onsite

Site: วัดอ้อมแก้ว

UTM : N 1488388 E 728953

Sampler: EPM#28

Recorder: ECRANG15315224

Date: 3 May 24

Technical: Kunanon P.

Approval: Wisan R.

CONDITIONS

Barometric Press. (hPa):	1002.0	Corrected Pressure (mm Hg):	751.6
Temperature (deg C):	33.0	Temperature (deg K):	306.0
Average Press. (hPa):	1013.0	Corrected Avg.Press. (mm Hg):	759.8
Average Temp. (deg C):	30.0	**Average Temp. (deg K):**	303.0

CALIBRATION ORIFICE

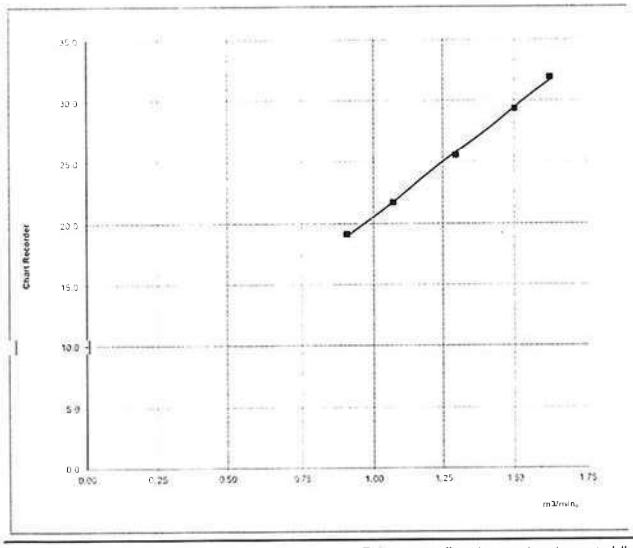
Brand:	Tisch Environmental, Inc	Qstd Slope:	1.27576
Model:	TE-5025A	Qstd Intercept:	-0.02337
Serial#:	759	Date Certified:	9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.33	1.626	50.0	31.90
2	8.80	1.502	46.0	29.35
3	6.50	1.293	40.0	25.52
4	4.40	1.067	34.0	21.69
5	3.20	0.913	30.0	19.14

LINEAR REGRESSION

Slope =	17.8034
Intercept =	2.7284
Corr. coeff.=	0.9993
SFR =	1.154
SSP =	36.47
# of Observations:	5
Range of Chart	34
at SFR ±10%	39



Calibrated by : (Kunanon Phila)

3 May 2024

Approved by : (Wisan Ritthikamon)

3 May 2024

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PM10 High Volume Sampler Calibration

Verification Report No.
SO2400119-E001 -PM 02

☐ PM ☑ Onsite

Site: วัดโคกทำเจริญ
UTM : N 1490141 E 727433
Sampler: EPM#44
Recorder: 0

Date: 3 May 24
Technical: Kunanon P.
Approval: Wisan R.

CONDITIONS

Barometric Press. (hPa):	1002.0	Corrected Pressure (mm Hg):	751.6
Temperature (deg C):	34.0	Temperature (deg K):	307.0
Average Press. (hPa):	1013.0	Corrected Avg.Press. (mm Hg):	759.8
Average Temp. (deg C):	30.0	Average Temp. (deg K):	303.0

CALIBRATION ORIFICE

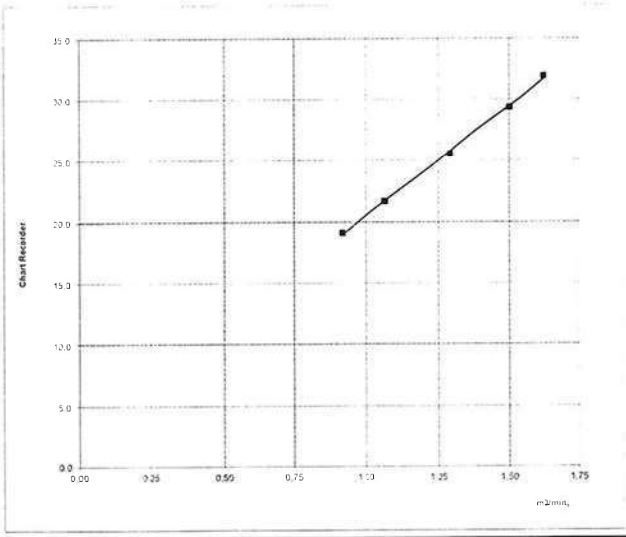
Brand:	Tisch Environmental, Inc	Qstd Slope:	1.27576
Model:	TE-5025A	Qstd Intercept:	-0.02337
Serial#:	759	Date Certified:	9 Feb 2024

CALIBRATIONS

Plate or Test #	H2O (in)	Qa (m3/min)	I (chart)	IC (corrected)
1	10.46	1.639	48.0	30.68
2	8.87	1.510	44.0	28.12
3	6.19	1.265	40.0	25.57
4	4.79	1.115	36.0	23.01
5	3.39	0.941	32.0	20.45

LINEAR REGRESSION

Slope =	14.1634
Intercept =	7.2401
Corr. coeff.=	0.9962
SFR =	1.157
SSP =	36.98
# of Observations:	5
Range of Chart	35
at SFR ±10%	39



Calibrated by : (Kunanon Phila)
3 May 2024

Approved by : (Wisan Ritthikamon)
3 May 2024

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TISCH Environmental

RECALIBRATION DUE DATE:
February 9, 2025

Certificate of Calibration

Calibration Certification Information				
Cal. Date:	February 9, 2024	Rootsmeter 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)	$\sqrt{\Delta H\left(Ta/Pa\right)}$ (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=	ΔVol((Pa-ΔP)/Pstd)(Tstd/Ta)	**Va=**	ΔVol((Pa-ΔP)/Pa)
Qstd=	Vstd/ΔTime	**Qa=**	Va/ΔTime

For subsequent flow rate calculations:

Qstd= $1/m\left(\left(\sqrt{\Delta H\left(\frac{Pa}{Pstd}\right)\left(\frac{Tstd}{Ta}\right)}\right)-b\right)$

Qa= $1/m\left(\left(\sqrt{\Delta H\left(Ta/Pa\right)}\right)-b\right)$

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg

Key

- ΔH: calibrator manometer reading (in H2O)
- ΔP: rootsmeter manometer reading (mm Hg)
- Ta: actual absolute temperature (°K)
- Pa: actual barometric pressure (mm Hg)
- b: intercept
- m: slope

RECALIBRATION

US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30

isch Environmental, Inc.
.45 South Miami Avenue
/illage of Cleves, OH 45002

www.tisch-env.com
TOLL FREE: (877)263-7610
FAX: (513)467-9009

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Neediss Supply Instrument Co., Ltd.

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6705003

Calibrated Date: 2-May-24

☑ PM ☐ Onsite

Instruments Information

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

Calibration System

Calibrator Unit	*Standard Gas*
Dilutor Model ESA MGC101 **S/N:** 792 **ZERO AIR Genearator** 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

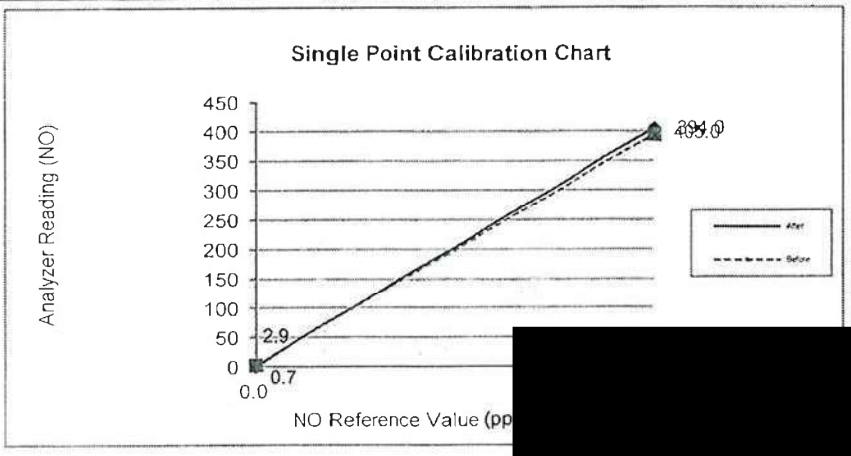
Environment: Temperature 25.1 °C Humidity: 55 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	2.5	0.0	2.5	391.0	400.0	-1.1
NO_2	0.4	0.0	0.4	3.0	0.0	0.4
NOx	2.9	0.0	2.9	394.0	400.0	-0.8

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.5	0.0	0.5	403.0	400.0	0.4
NO_2	0.2	0.0	0.2	2.0	0.0	0.2
NOx	0.7	0.0	0.7	405.0	400.0	0.6



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6705003

Page:1/1

Calibrated Date: 2-May-24

☑ PM ☐ Onsite

Page:2/2

Test Function Value		Norminal range	Unit	Before	After	Note
Date		2-May-24				
Time		10:10				
Range		0.00 - 500.00 PPB	PPB	500	500	
Stability (Zero Gas)		< 0.2	PPB	0.5	0.2	
Sample Flow		500+/- 50	cc/min	511	532	
Ozone Flow		60-90	cc/min	80	80	
PMT Detector		0-5000	mV	27.4	16.4	
AZERO		-20-150	mV	54.2	54.2	
HVPS		400-900 constant	V	819	819	
DCPS		2500 +/- 200	mV	-	-	
RCELL TEMP		50+/- 1	Dreegee C	50	50	
BOX TEMP		20-35	Dreegee C	33.7	32.9	
PMT TEMP		7 +/-1	Dreegee C	7.1	7.1	
IZS TEMP		50+/- 4	Dreegee C	-	-	
MOLY Temp		315 +/- 5	Dreegee C	314.4	315.0	
RCEL PRES		4-10 contant	IN-Hg-A	10	10	
SAMP PRES		20-30 contant	IN-Hg-A	29.0	29.4	
NO Slope		1 +/- 0.3		0.820	0.801	
Nox Slope		1 +/- 0.3		0.848	0.813	
NO Offset		-10 to + 150	mV	10.2	15.3	
NOx Offset		-10 to + 150	mV	-2.0	-3.4	
Span and Cal Values						
Zero Value	NO	0	ppb	2.5	0.5	
	NOx	0	ppb	2.9	0.7	
Span Value	NO	400	ppb	391.0	403.0	
	NOx	400	ppb	394.0	405.0	

Calibrate By : Sirirat Poonlak

Date: 2-May-24

Approve By : Sarawut Keawsrinual

Date: 2-May-24

neediss

Needise Supply Instrument Co.,Ltd.

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neediss Neediss Supply Instru[illegible] Ltd.

NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6705002

Page:1/1

Calibrated Date: 2-May-24

☑ PM ☐ Onsite

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer **Model:** 200E	**Manufacturer** API **S/N:** ENOAI200E00579

Calibration System

Calibrator Unit	*Standard Gas*
Dilutor Model ESA MGC101 **S/N:** 792 **ZERO AIR Genearator** 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

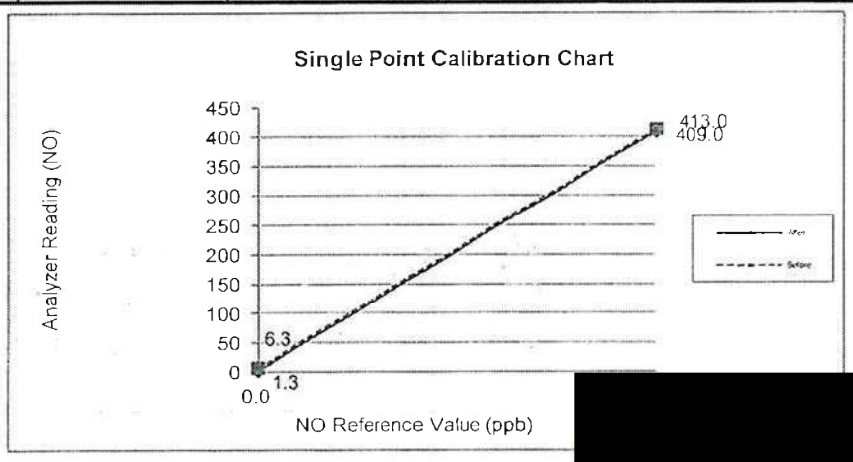
Environment: Temperature 25.2 °C Humidity: 55 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	5.5	0.0	5.5	410.0	400.0	1.2
NO_2	0.8	0.0	0.8	3.0	0.0	0.4
NOx	6.3	0.0	6.3	413.0	400.0	1.6

Calibration Check (After adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.7	0.0	0.7	406.0	400.0	0.7
NO_2	0.6	0.0	0.6	3.0	0.0	0.4
NOx	1.3	0.0	1.3	409.0	400.0	1.1



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NOx Analyzer Verification Test Report

Calibration Report No.: AP-N6705002

Page:1/1

Calibrated Date: 2-May-24

☑ PM ☐ Onsite

Page:2/2

Test Function Value		Norminal range	Unit	Before	After	Note
Date		2-May-24				
Time		13:25				
Range		0.00 - 500.00 PPB	PPB	500.0	500.0	
Stability (Zero Gas)		< 0.2	PPB	0.5	0.2	
Sample Flow		500+/- 50	cc/min	474.0	441.0	
Ozone Flow		60-90	cc/min	76.0	76.0	
PMT Detector		0-5000	mV	24.5	62.2	
AZERO		-20-150	mV	8.6	67.5	
HVPS		400-900 constant	V	839.0	836.0	
DCPS		2500 +/- 200	mV	-	-	
RCELL TEMP		50+/- 1	Dreegee C	50.0	50.0	
BOX TEMP		20-35	Dreegee C	34.5	30.5	
PMT TEMP		7 +/-1	Dreegee C	7.0	7.1	
IZS TEMP		50+/- 4	Dreegee C	-	-	
MOLY Temp		315 +/- 5	Dreegee C	315.0	314.4	
RCEL PRES		4-10 contant	IN-Hg-A	4.20	7.90	
SAMP PRES		20-30 contant	IN-Hg-A	29.9	28.6	
NO Slope		1 +/- 0.3		1.256	1.032	
Nox Slope		1 +/- 0.3		1.232	1.048	
NO Offset		-10 to + 150	mV	4.50	6.90	
NOx Offset		-10 to + 150	mV	-5.00	-1.50	
Span and Cal Values						
Zero Value	NO	0	ppb	5.5	0.7	
	NOx	0	ppb	6.3	1.3	
Span Value	NO	400	ppb	410.0	406.0	
	NOx	400	ppb	413.0	409.0	

Calibrate By : Sirirat Poonlak
Date: 2-May-24

Approve By : Sarawut Keawsrinual
Date: 2-May-24

neediss
Neediss Supply Instrument Co.,Ltd

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neediss บริษัท นีดิส ซัพพลาย อินสตรูเมนท์ จำกัด
Neediss Supply Instrument Co., Ltd.

SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705001

Calibrated Date: 2-May-24

☑ PM ☐ Onsite

Instruments Information

Analyzer Type: SO2 Analyzer Model: 100U	Manufacturer API S/N: ESOAI100U0056

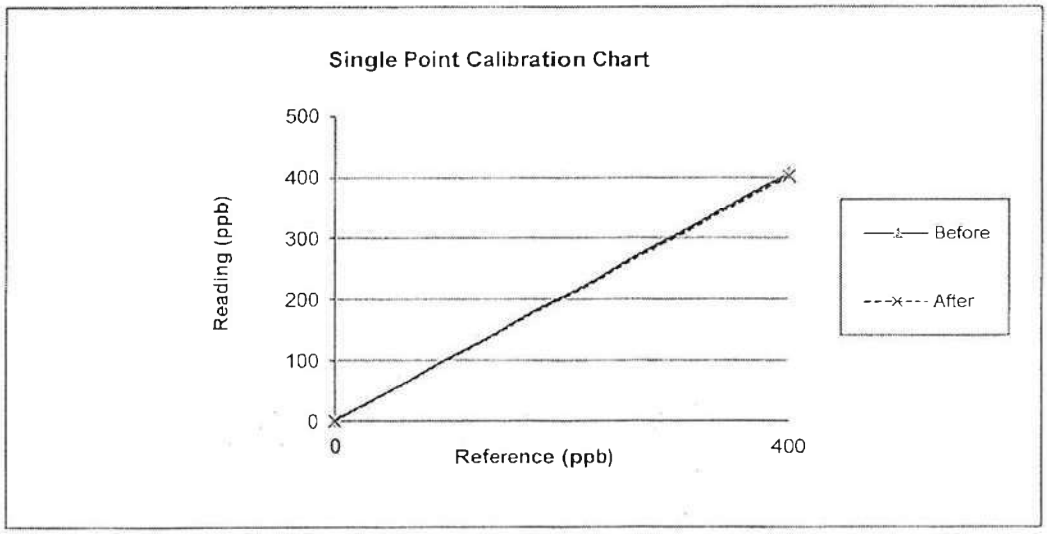
Calibration System

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

Environment: Temperature 25.4 °C Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.3	1.3	400.0	406.8	0.8
After	0.0	0.6	0.6	400.0	402.0	0.2



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705001

Calibrated Date: 2-May-24

☑ PM ☐ Onsite

Test Function Value	Norminal range	Unit	Before	After	Note
Date	2-May-24				
Time	8:30				
Range	50 - 20000	PPB	**500**	500	
Stability (Zero Gas)	< 0.2	PPB	**0.4**	0.2	
Sample Flow	650 (+/- 50)	cc/min	**666**	662	
PMT Detector	0 - 5000	mV	**24.3**	28.2	
Norm PMT Detector	0 - 5000	mV	31.4	34.3	
HVPS	400-900 constant	V	725	725	
DCPS	2500 (+/- 200)	mV	-	-	
RCELL TEMP	50 (+/- 1)	**Dreegee C**	50	50	
BOX TEMP	20-40	**Dreegee C**	32.6	35.1	
PMT TEMP	7 (+/-1)	Dreegee C	**8.3**	8.3	
UV lamp	1000-4900	mV	3251	3251	
Lamp Ratio	30-120	%	87.4	87.4	
STR. Light (Zero Gas)	<100	PPB	38.5	38.5	
Dark PMT	(-50) - (+200)	mV	27.6	27.6	
Dark lamp	(-50) - (+200)	mV	3.6	3.6	
SAMP PRES	20-30 contant	**IN-Hg-A**	26.9	27.3	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2010	2006	
SO2 Conc	1000 (+/- 250)	PPB	1005	1003	
SO2 Slope	1 (+/- 0.3)	-	1.054	1.053	
SO2 Offset	< 250	mV	94.7	90.4	
Stability at Zero	< 0.2	PPB	0.1	0.1	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.4	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	1.3	**0.6**	
Span Gas (400 PPB)	400	ppb	406.8	402.0	+ 5% of Range

Calibrate By : Sirirat Poonlak

Date: 2-May-24

Approve By : Sarawut Keawsrinual

Date: 2-May-24

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Neediss Supply Instrument Co.,Ltd.

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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705002

Calibrated Date: 2-May-24

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Instruments Information

Analyzer Type: SO2 Analyzer Model: T100	Manufacturer API S/N: ESOAIT10002034

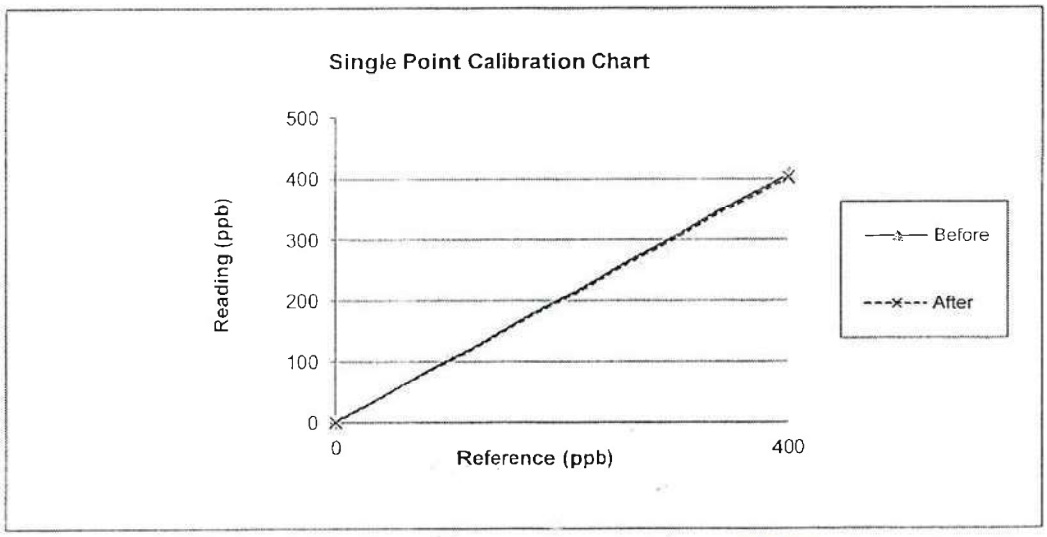
Calibration System

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

Environment: Temperature 25.4 °C Humidity: 55 %RH

Calibration Report

Status	Zero			Span		
	Reference (ppb)	Reading (ppb)	Drift (ppb)	Reference (ppb)	Reading (ppb)	Drift%
Before	0.0	1.5	1.5	400.0	408.0	1.0
After	0.0	0.3	0.3	400.0	402.5	0.3



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SO2 Analyzer Verification Test Report

Calibration Report No.: AP-S6705002

Calibrated Date: 2-May-24

☑ **PM** ☐ Onsite

Test Function Value	Norminal range	Unit	Before	After	Note
Date	2-May-24				
Time	11:50				
Range	50 - 20000	PPB	500	500	
Stability (Zero Gas)	< 0.2	PPB	0.5	0.2	
Sample Flow	650 (+/- 50)	cc/min	650	619	
PMT Detector	0 - 5000	mV	34.7	26.4	
Norm PMT Detector	0 - 5000	mV	44.0	25.9	
HVPS	400-900 constant	V	723	723	
DCPS	2500 (+/- 200)	mV	-	-	
RCELL TEMP	50 (+/- 1)	Dreegee C	50	50	
BOX TEMP	20-40	Dreegee C	35.5	33.9	
PMT TEMP	7 (+/-1)	Dreegee C	8.0	8.0	
UV lamp	1000-4900	mV	2132.0	2132.0	
Lamp Ratio	30-120	%	114.0	114.0	
STR. Light (Zero Gas)	<100	PPB	19	19	
Dark PMT	(-50) - (+200)	mV	64.5	64.5	
Dark lamp	(-50) - (+200)	mV	-15.1	-15.1	
SAMP PRES	20-30 contant	IN-Hg-A	27.4	27.8	
Electric Test/Optic Test					
PMT Volts	2000 (+/- 500)	mV	2012	2008	
SO2 Conc	1000 (+/- 250)	PPB	1006	1004	
SO2 Slope	1 (+/- 0.3)	-	0.959	0.959	
SO2 Offset	< 250	mV	30.3	1	
Stability at Zero	< 0.2	PPB	0.1	17.7	
Stability at Span	< 2 ppb @ 400 ppb	PPB	0.5	0.2	
Gas Test Response					
Zero Gas (0.00 PPB)	0	ppb	1.5	0.3	
Span Gas (400 PPB)	400	ppb	408.0	402.5	± 5% of Range

Calibrate By : Sirirat Poonlak

Date: 2-May-24

Approve By : Sarawut Keawsrinual

Date: 2-May-24

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Neediss Supply Instrum[redacted]

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Airgas
an Air Liquide company

Airgas Specialty Gases
Airgas USA LLC
6141 Easton Road
Plumsteadville, PA 18949
Airgas.com

CERTIFICATE OF ANALYSIS

Grade of Product: EPA PROTOCOL STANDARD

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

Approved for Release

ACCREDITED
CERT 3092.05

[redacted]

THAI METEOROLOGICAL DEPARTMENT

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

Calibration Certificate

Issued by : Calibration & Test Section : Meteorological Instruments Bureau

Date of Issue 2 October, 2023 Certification No. 340/23

Object : เครื่องมือตรวจวัดอุตุนิยมวิทยา

Manufacturer : DYACON

Type : Data Logger CM-1

Serial No. : 130129 ID No. : NWSDCMS1200129

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

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1008.7 hPa

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

: HOOK GAGE NO 1425 : Wind Aloft Plotting Board

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

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

Serial Number 110730029 (sensor 120629586)

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

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

: Thermoschneider No.918802

STANDARD BAROMETER : Digital Barometer Vaisala Type PTB220 No. V1220015

Calibrated by : Watcharapol Signed : (Authorised Signatory)

Mr. Watcharapol Subwat Mr. Pisood Pornsut for the Chief

Mechanical Engineer

[redacted]

EnvLab Co.,Ltd.

THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Sensor model NWSDCMS1200129 Certification No. 340/23

2 October, 2023 Serial No. 1198

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

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

Calibrated by : Watcharapol

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

[redacted]

THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Sensor Presure Model TPH-1 C

Serial No. 6235 Certification No. 340/23

2 October, 2023

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

Calibrated by : Watcharapol C

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

[redacted]

THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Sensor Temperature Model TPH-1 C Certification No. 340/23

2 October, 2023 Serial No. 6235 Page : 4 of 6

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

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

[redacted]

THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Sensor Humidity Model TPH-1 C — Certification No. 340/23

2 October, 2023 — Serial No. 6235 —

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

Calibrated by :

Mr. Watcharapol Subwat

Mechanical Engineer

Calibration & Test Section

Meteorological Instruments Bureau

[redacted]

Date of Issue 2 October, 2023

Certification No. 340/23

ใบรับรอง

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

ลงชื่อ.....

(นายวัชรพล ทรัพย์วัฒน์)

วิศวกรชำนาญการ

[redacted]

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0391 **MTC No.** EEL. BP. 30/0467

CALIBRATION CERTIFICATE

Submitted by : Envilab Co.,Ltd.

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

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

Instrument Calibrated :

Description : Sound Level Calibrator

Manufacturer : Bruel & Kjaer

Model : 4230

Serial No. : 1351075

Ambient Environment

Temperature : (23 + 3) °C

Relative Humidity : (50 ± 15) %

Ambient Pressure : (101.325 ± 1.500) kPa

Standards used :

1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
4. Digital Multimeter Agilent 34401A S/N MY44005560.
5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
6. Audio Analyzer Keithley 2015-P S/N4106495.
7. Condenser Microphone B&K 4180 S/N 2889871.

Calibration Procedure: CP-102-04 based on IEC 60942-2003; The sound pressure level generated by sound calibrator under test shall be measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 9 Apr. 2024

Date of Calibration : 10 Apr. 2024

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 9036
Fax. (66) 0 2577 9009

Office/Laboratory
668 Mu 2 Tambon Bangpoomai, Amphoe Muang S
Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
(66) 08 3219 9440
E-mail : mtc@tistr.or.th Website : www.tistr.or.th

Office
[redacted]

Envilab Co.,Ltd.

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0391 **MTC No.** EEL. BP. 30/0467

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.72	-0.28	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	994.9	-5.1	± 1.5	±1.0%

3. Total Distortion

Standard Microphone Type	Measured Total Distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1.25	± 0.50	±3.0%

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :

(Mr.Weerachai Deechaiyae)

Approved by :

(Mr.Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 10 Apr. 2024

Date of Issue : 11 Apr. 2024

Ref : 201126704090137400 1

End of Certificate

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9036
Fax. (66) 0 2577 9009

Office/Laboratory
668 Mu 2 Tambon Bangpoomai, Amphoe Muang Samut
Changwat Samutprakan 10280, Thailand
Tel. (66) 0 2323 1672-80 ext. 115, 116
(66) 08 3219 9440
E-mail : mtc@tistr.or.th Website : www.tistr.or.th

[redacted]

Envilab Co.,Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

CALIBRATION LABORATORY CO., LTD.
[illegible] 1,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
Tel. 02-978-0353-4 Fax. 02-978-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com

CLC
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ANAB
ANSI National Accreditation Board
ACCREDITED
CALIBRATION AND DIMENSIONAL MEASUREMENT
[illegible]314

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCE010015[EHEMTHS3210015]
CLID. NO.	:	232400805
JOB CONTROL NO.	:	240227021067
CALIBRATION SERVICE	:	☑ IN-LABORATORY ☐ ON-SITE

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

DATE OF RECEIVED : 27 February 2024 DATE OF ISSUED : 29 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 : Mongkol Yotsoontorn
Authorized Signatory
29 February 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q24021067

F3-011-05/12-23

[redacted]

CALIBRATION LABORATORY CO., LTD.
2/10-11,14,55 Soi Prasert Manukit 4, Yaek 4 Prasert Manukit Rd., Ladprao, Bangkok 10230
Tel. 02-578-0353-4 Fax. 02-578-[illegible] www.calibrationlaboratory.com E-mail: sale@cal-laboratory.com

CLC Accredited ISO/IEC 17025

REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCE010015[EHEMTHS3210015]
DATE OF CALIBRATION	:	28 February 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPTH-11.** The calibration was performed by using Chilled Mirror Hygrometer 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 (EA-4/02 M:2022)"

Certificate No. Q24021067

F3-011-05/12-23

[redacted]

CALIBRATION LABORATORY CO., LTD.
2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd.
Tel. 02-578-0353-4 Fax: 02-578-2672 www.calilabpatory.com

CLC
Accredited
ISO/IEC 17025

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 ±(°C)
20.0	20.00	19.8	+0.20	0.27
30.0	30.00	29.8	+0.20	
40.0	39.99	39.8	+0.19	

2. CORRECTION OF TEMPERATURE : DRY

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.00	19.8	+0.20	0.27
30.0	30.00	29.8	+0.20	
40.0	39.99	39.8	+0.19	

3. CORRECTION OF TEMPERATURE : GLOBE

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.00	19.8	+0.20	0.27
30.0	30.00	29.7	+0.30	
40.0	39.99	39.6	+0.39	

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. Q24021067

F3-011-05/12-23

[redacted]

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

CLC
Accredited
ISO/IEC 17025

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCH110028[EHEMTHS3211028]
CLID. NO.	:	232400815
JOB CONTROL NO.	:	240227021071
CALIBRATION SERVICE	:	☑ IN-LABORATORY ☐ ON-SITE

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

DATE OF RECEIVED : 27 February 2024 DATE OF ISSUED : 29 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 : Mongkol Yotsoontorn
Authorized Signatory
29 February 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q24021071

F3-011-05/12-23

[redacted]

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

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REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCH110028[EHEMTHS3211028]
DATE OF CALIBRATION	:	28 February 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPTH-11. The calibration was performed by using Chilled Mirror Hygrometer 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 (EA-4/02 M:2022)"

Certificate No. Q24021071

F3-011-05/12-23

[redacted]

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

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ANAB
ACCREDITED
CALIBRATION
ACDM-2814

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 ±(°C)
20.0	20.00	19.8	+0.20	0.27
30.0	30.00	29.8	+0.20	
40.0	39.99	39.9	+0.09	

2. CORRECTION OF TEMPERATURE : DRY

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.00	19.8	+0.20	0.27
30.0	30.00	29.9	+0.10	
40.0	39.99	40.2	-0.21	

3. CORRECTION OF TEMPERATURE : GLOBE

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.00	19.9	+0.10	0.27
30.0	30.00	29.8	+0.20	
40.0	39.99	39.8	+0.19	

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. Q24021071

F3-011-05/12-23

[redacted]

CALIBRATION LABORATORY CO., LTD.
Prasert Manukit 23 Yaek 4, Prasert Manukit Rd., Ladprao, Bangkok 10230
Tel. 02-[illegible]-4 Fax. 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com

CLC Accredited ISO/IEC [illegible]

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ANAB

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCH110039[EHEMTHS3211039]
CLID. NO.	:	232400807
JOB CONTROL NO.	:	240227021068
CALIBRATION SERVICE	:	☑ IN-LABORATORY ☐ ON-SITE

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

DATE OF RECEIVED : 27 February 2024 DATE OF ISSUED : 29 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 : Mongkol Yotsoontorn
Authorized Signatory
29 February 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q24021068

F3-011-05/12-23

[redacted]

CALIBRATION LABORATORY CO., LTD.
2/10-11,14,55 Soi Praset [illegible] Mangkit Rd., Laopbrao, Bangkok 10230
Tel. 02-578-0353-4 Fax. [illegible] [illegible].com E-mail:sale@ca-laboratory.com

CLC
Accredited
ISO/IEC 17025

REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCH110039[EHEMTHS3211039]
DATE OF CALIBRATION	:	28 February 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. CLC-CPTH-11. The calibration was performed by using Chilled Mirror Hygrometer 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 (EA-4/02 M:2022)"

Certificate No. Q24021068

F3-011-05/12-23

[redacted]

CALIBRATION LABORATORY CO., LTD.
2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Lad[illegible]
Tel. 02-578-0353-4 Fax 02-578-2672 www.cal-laboratory.com E-mail [illegible]

CLC Accredited ISO/IEC 17025

ilac-MRA

ANAB ANSI National Accreditation Board ACCREDITED CALIBRATION AND DIMENSIONAL MEASUREMENT ACDM-2814

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 ±(°C)
20.0	20.00	19.9	+0.10	0.27
30.0	30.00	29.9	+0.10	
40.0	39.99	40.1	-0.11	

2. CORRECTION OF TEMPERATURE : DRY

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.00	19.8	+0.20	0.27
30.0	30.00	29.8	+0.20	
40.0	39.99	40.2	-0.21	

3. CORRECTION OF TEMPERATURE : GLOBE

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.00	19.9	+0.10	0.27
30.0	30.00	29.9	+0.10	
40.0	39.99	39.7	+0.29	

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. Q24021068

F3-011-05/12-23

[redacted]

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

CLC
Accredited
ISO/IEC 17025

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCH110040[EHEMTHS3211040]
CLID. NO.	:	232400811
JOB CONTROL NO.	:	240227021069
CALIBRATION SERVICE	:	☑ IN-LABORATORY ☐ ON-SITE

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

DATE OF RECEIVED : 27 February 2024 DATE OF ISSUED : 29 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 : Mongkol Yotsoontorn
Authorized Signatory
29 February 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q24021069

F3-011-05/12-23

[redacted]

CALIBRATION LABORATORY CO., LTD.
2/10-11,14,55 Soi Prasert Manukit 23 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

CLC
Accredited
ISO/IEC 17025

REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCH110040[EHEMTHS3211040]
DATE OF CALIBRATION	:	28 February 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPTH-11.** The calibration was performed by using Chilled Mirror Hygrometer 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 (EA-4/02 M:2022)"

Certificate No. Q24021069

F3-011-05/12-23

[redacted]

@clccalibration

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

CLC Accredited ISO/IEC 17025

ilac-MRA

ANAB ACCREDITED CALIBRATION AND DIMENSIONAL MEASUREMENT ACDM 2814

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 ±(°C)
20.0	20.00	20.2	-0.20	0.27
30.0	30.00	30.2	-0.20	
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 ±(°C)
20.0	20.00	19.9	+0.10	0.27
30.0	30.00	30.1	-0.10	
40.0	39.99	40.2	-0.21	

3. CORRECTION OF TEMPERATURE : GLOBE

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.00	19.9	+0.10	0.27
30.0	30.00	29.9	+0.10	
40.0	39.99	39.7	+0.29	

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

[redacted]

@clccalibration

METROLOGY SYSTEM (THAILAND) CO.,LTD.

ID LINE : IEC17025

Certificate of Calibration

Certificate Number : SPR24030284-2

Customer : Envilab Co., Ltd.

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

Equipment Name	:	Sound Level Meter			
Manufacturer	:	Pulsar			
Model	:	45			
Serial Number	:	PP0013			
ID. Number	:	ESMPUMD45N0013			
Environmental Conditions					
Ambient Temperature	:	23 °C ± 3 °C	Received Date	:	19 Mar 2024
Relative Humidity	:	50 % ± 15 %	Calibration Date	:	21 Mar 2024
Location of Calibration	:	In-Lab	Recommend Due Date	:	21 Mar 2025
Calibration Procedure	:	SP-CPE-04-01	Date of Issue	:	22 Mar 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.Karoon Pengsalung

Calibration Officer

Approved by :

(Mr. Sombut Srikampa)

[redacted]

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 (Thailand) Tel: (662) 193-2220 5 ,www.spmetrology.com

ID LINE : IEC17025

Calibration Report

Certificate Number : SPR24030284-2

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 140/0167	26 Jan 2025

Traceability

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

TISTR - Thailand Institute of Scientific and Technological Research

69/29 Moo 1 Klongsi Klongluang Pathumthani 12120 (Thailand) Tel: (662) 193-2220 5 ผู้สาย www.สอบเทียบเครื่องมือวัด.com

[redacted]

METROLOGY SYSTEM (THAILAND) CO.,LTD.

ID LINE : IEC17025

69/3 Moo 1 Klongsi Klongluang Pathumthani 12120 (Thailand) Tel: (662) 193-2220 5 ต่อ www.สอบเทียบเครื่องมือวัด.com

Result of Calibration

Certificate No. : SPR24030284-2

Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.1	114.1	0.1	0.1	0.15

Select C

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.1	114.1	0.1	0.1	0.15

Select Z

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.1	114.1	0.1	0.1	0.15

Note :

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

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor k = 2.00, pro[redacted]95%.

– End of Certific[redacted]

METROLOGY SYSTEM (THAILAND) CO., LTD.

ID LINE : IEC17025

Certificate of Calibration

Certificate Number : SPR24030284-4

Customer : Envilab Co., Ltd.

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

Equipment Name	:	Sound Level Meter			
Manufacturer	:	Pulsar			
Model	:	45			
Serial Number	:	PP0016			
ID. Number	:	ESMPUMD45N0016			
Environmental Conditions					
Ambient Temperature	:	23 °C ± 3 °C	Received Date	:	19 Mar 2024
Relative Humidity	:	50 % ± 15 %	Calibration Date	:	21 Mar 2024
Location of Calibration	:	In-Lab	Recommend Due Date	:	21 Mar 2025
Calibration Procedure	:	SP-CPE-04-01	Date of Issue	:	22 Mar 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.Karoon Pengsalung

Calibration Officer

Approved by : (Mr. Sombut Srikampa)

[redacted]

59/28 Moo 1 Bangkhae Pathumthani 12120 (Thailand) Tel. (662) 193-2220 5 6 8 9 www.spmetrologyservice.com

Calibration Report

Certificate Number : SPR24030284-4

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 140/0167	26 Jan 2025

Traceability

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

TISTR - Thailand Institute of Scientific and Technological Research

www.metrologysystem.com Tel. (662) 192 2220 5 Thailand 12120 Klongluang Pathumthani Klongluang 9/1 Moo 1 Soi Phahonyothin 65

[redacted]

ID LINE : IEC17025

Result of Calibration

Certificate No. : SPR24030284-4

Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.0	114.0	0.0	0.0	0.15

Select C

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.0	114.0	0.0	0.0	0.15

Select Z

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.0	114.0	0.0	0.0	0.15

Note :

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

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor k = 2.00, pr[redacted] 95%.

- End of Certifi[redacted]

Envilab Co.,Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

METROLOGY SYSTEM (THAILAND) CO.,LTD.

ID LINE : IEC17025

99/26 Moo 1 Klongsi Klongluang Pathumthani 12120 (Thailand) Tel. (662) 193-2220 5 ต่อ 8 www.สอบเทียบเครื่องมือวัด.com

Certificate of Calibration

Certificate Number : SPR24030284-1

Customer : Envilab Co., Ltd.

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

Equipment Name	:	Sound Level Meter
Manufacturer	:	Pulsar
Model	:	45
Serial Number	:	PP0018
ID. Number	:	ESMPUMD45N0018

Environmental Conditions

Ambient Temperature	:	23 °C ± 3 °C	Received Date	:	19 Mar 2024
Relative Humidity	:	50 % ± 15 %	Calibration Date	:	21 Mar 2024
Location of Calibration	:	In-Lab	Recommend Due Date	:	21 Mar 2025
Calibration Procedure	:	SP-CPE-04-01	Date of Issue	:	22 Mar 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.Karoon Pengsalung

Calibration Officer

Approved by :

(Mr. Sombut Srikampa)

[redacted]

ID LINE : IEC17025

Calibration Report

Certificate Number : SPR24030284-1

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 140/0167	26 Jan 2025

Traceability

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

TISTR - Thailand Institute of Scientific and Technological Research

55/79 Moo 1 Klongsi Klongluang Pathumthani 12120 (Thailand) Tel. (662) 193-2220 5 สายงาน www.สอบเทียบเครื่องมือวัด.com

[redacted]

ID LINE : IEC17025

Result of Calibration

Certificate No. : SPR24030284-1

Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

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

Select C

Unit : dB

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

Select Z

Unit : dB

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

Note :

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

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor k = 2.00, provi[redacted]%.

– End of Certifica[redacted]5 REV.0

Envilab Co.,Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

Klongsi Klongluang Pathumthani 12120 (Thailand) Tel. (662) 193-2220 5 ซอย 10 www.metrologysystem.com

METROLOGY SYSTEM (THAILAND) CO.,LTD.

ID LINE : IEC17025

Certificate of Calibration

Certificate Number : SPR24030284-3

Customer : Envilab Co., Ltd.

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

Equipment Name	:	Sound Level Meter			
Manufacturer	:	Pulsar			
Model	:	45			
Serial Number	:	PP0022			
ID. Number	:	ESMPUMD45N0022			
Environmental Conditions					
Ambient Temperature	:	23 °C ± 3 °C	Received Date	:	19 Mar 2024
Relative Humidity	:	50 % ± 15 %	Calibration Date	:	21 Mar 2024
Location of Calibration	:	In-Lab	Recommend Due Date	:	21 Mar 2025
Calibration Procedure	:	SP-CPE-04-01	Date of Issue	:	22 Mar 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.Karoon Pengsalung

Calibration Officer

Approved by :

(Mr. Sombut Srikampa)

[redacted]

rev.0

ID LINE : IEC17025

Calibration Report

Certificate Number : SPR24030284-3

Reference Standards

Equipment Name	Model	Serial No.	Certificate No.	Due. Date
Sound Level Calibrator	ST-120	211203773	EEL.BP. 140/0167	26 Jan 2025

Traceability

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

TISTR - Thailand Institute of Scientific and Technological Research

59/29 Moo 1 Klongsi Klongluang Pathumthani 12120 (Thailand) Tel: (662) 193-2220 5 สาย www.metrologysystem.com

[redacted]

ID LINE : IEC17025

Result of Calibration

Certificate No. : SPR24030284-3

Range : 94 to 114 dB

Function : @1kHz

Select A

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.0	114.0	0.0	0.0	0.15

Select C

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.0	114.0	0.0	0.0	0.15

Select Z

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.1	94.1	0.1	0.1	0.15
114	114.0	114.0	0.0	0.0	0.15

Note :

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

Measurement Uncertainty

The reported uncertainty of measurement is the expanded uncertainty obtained by multiplying the standard uncertainty with the coverage factor k = 2.00, provi[redacted]%.

- End of Certificat[redacted]

NSC-TISI-TIS 17025
CALIBRATION 0015

Request No. 22-67 / 0140 MTC No. PSL-H 0035 / 67

Certificate of Calibration

Customer :	Neediss Supply Instrument Co., Ltd.
	536 Soi Bangkhae 7, Bangkhae, Bangkhae, Bangkok, 10160
Item :	Thermo-Hygrometer (Area Heat Stress Monitor)
Model /Type :	hs-32
Serial Number :	MCI100003
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 :

Panit T.

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchai Singhapiwat)
Director
Photometry and Temperature Standards Laboratory

Ref. No : 2012266110904511001

Issued Date : 6 December 2023

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

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

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

Office
[redacted]

Request No. 22-67 / 0140 **MTC No.** PSL-H 0035 / 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 :	MCI100003
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

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,
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E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhu[redacted]k 10900,
Amphoe Muang, Changwat Samutprakan [redacted]5217
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 0035 / 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	20.6	-0.7	0.50
30.0	30.5	-0.5	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)
19.9	20.3	-0.4	0.50
30.0	30.3	-0.3	0.50
40.0	40.3	-0.3	0.50

P.T.

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
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Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhum[redacted]0900,
Amphoe Muang, Changwat Samutprakan 10[redacted]17
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 0035 / 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	20.7	-0.8	0.50
30.0	30.4	-0.4	0.50
40.0	40.3	-0.3	0.50

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

...end of certificate...

The results relate only to the items tested/calibrated or value assigned.
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,
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Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukh[redacted]ok 10900,
Amphoe Muang, Changwat Samutprakan
Tel. (66) 0 2323 1672-80 ext. 115, 116 5217
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Envilab Co.,Ltd.

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.calhaboratory.com E-mail:sale@calhaboratory.com

CLC Accredited ISO/IEC 17025

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ANAB ANSI National Accreditation Board ACCREDITED CALIBRATION AND DIMENSIONAL MEASUREMENT ACOM-2614

Supplement to Calibration Certificate No. Q24002402

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCG010014[NHEMTHS3210014]
CLID. NO.	:	232400056
JOB CONTROL NO.	:	240110002402
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 : Mongkol Yotsoontorn
Authorized Signatory
06 February 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q24002402A1

F3-012-05/12-23

[redacted]

CALIBRATION LABORATORY CO., LTD.
14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
578-0363-4 Fax: 02-578-2672 www.cal-laboratory.com E-mail:sale@cal-laboratory.com

CLC Accredited ISO/IEC 17025

ilac-MRA

ANAB ANSI National Accreditation Board ACCREDITED VALIDATION AND DIMENSIONAL MEASUREMENT ACCM-2814

REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCG010014[NHEMTHS3210014]
DATE OF CALIBRATION	:	16 January 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPTH-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 (EA-4/02 M:2022)"

Certificate No. Q24002402

F3-011-05/12-23

[redacted]

@clccalibration

CALIBRATION LABORATORY CO., LTD.
2/10-11,13,55 Soi Pramot [illegible] Pramuk Rd., Ladphrao, Bangkok 10230
Tel. 02-573-0353-4 Fax 02 [illegible] [illegible]laboratory.com E-mail:sale@cal-laboratory.com

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ANAB
ANSI National Accreditation Board
ACCREDITED
CALIBRATION AND DIMENSIONAL MEASUREMENT
ACDM-2814

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 ±(°C)
20.0	20.01	20.0	+0.01	0.40
30.0	30.00	30.2	-0.20	
40.0	39.99	40.3	-0.31	

2. CORRECTION OF TEMPERATURE : DRY

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.01	19.9	+0.11	0.40
30.0	30.00	30.1	-0.10	
40.0	39.99	40.2	-0.21	

3. CORRECTION OF TEMPERATURE : GLOBE

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.01	20.0	+0.01	0.40
30.0	30.00	30.1	-0.10	
40.0	39.99	40.2	-0.21	

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. Q24002402

F3-011-05/12-23

[redacted]

CALIBRATION LABORATORY CO., LTD.
2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd. [illegible]
Tel. 02-578-0353-4 Fax: 02-578-2672 www.calibrationlaboratory.com E-mail: [illegible]@[illegible].com

CLC Accredited ISO/IEC 17025

ilac-MRA

ANAB ACCREDITED CALIBRATION AND DIMENSIONAL MEASUREMENT ACCM-2814

Supplement to Calibration Certificate No. Q24021097

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCH110057[NHEMTHS3210057]
CLID. NO.	:	232400809
JOB CONTROL NO.	:	240227021097
CALIBRATION SERVICE	:	☑ IN-LABORATORY ☐ ON-SITE

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

DATE OF RECEIVED : 27 February 2024 DATE OF ISSUED : 09 March 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 : Mongkol Yotsoontorn
Authorized Signatory
09 March 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q24021097A1

F3-012-05/12-23

[redacted]

Envilab Co.,Ltd. [illegible]

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

CLC
Accredited
ISO/IEC 17025

REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCH110057[NHEMTHS3210057]
DATE OF CALIBRATION	:	28 February 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPTH-11.** The calibration was performed by using Chilled Mirror Hygrometer 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 (EA-4/02 M:2022)"

Certificate No. Q24021097

F3-011-05/12-23

[redacted]

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

CLC Accredited ISO/IEC 17025

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 ±(°C)
20.0	20.00	20.1	-0.10	0.27
30.0	30.00	29.9	+0.10	
40.0	39.99	39.8	+0.19	

2. CORRECTION OF TEMPERATURE : DRY

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.00	20.0	0.00	0.27
30.0	30.00	29.8	+0.20	
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 ±(°C)
20.0	20.00	19.9	+0.10	0.27
30.0	30.00	29.8	+0.20	
40.0	39.99	39.7	+0.29	

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. Q24021097

F3-011-05/12-23

[redacted]

TISTR

NSC-TISI-TIS 17025
CALIBRATION 0015

Request No. 22-67 / 0140 MTC No. PSL-H 0036 / 67

Certificate of Calibration

Customer :	Neediss Supply Instrument Co., Ltd.
	536 Soi Bangkhae 7, Bangkhae, Bangkhae, Bangkok, 10160
Item :	Thermo-Hygrometer (Area Heat Stress Monitor)
Model /Type :	hs-32
Serial Number :	MCF020003
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 :

Panit T.

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchai Singhapiwat)
Director
Photometry and Temperature Standards Laboratory

Ref. No : 2012266110904511002

Issued Date : 6 December 2023

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

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

[redacted]

Request No. 22-67 / 0140 MTC No. PSL-H 0036 / 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 :	MCF020003
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

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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ผู้จัดการฝ่ายควบคุมคุณภาพ

Request No. 22-67 / 0140 **MTC No.** PSL-H 0036 / 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	30.1	-0.1	0.50
40.0	40.1	-0.1	0.50

P.T.

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Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
[redacted]

Request No. 22-67 / 0140 **MTC No.** PSL-H 0036 / 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	19.9	0.0	0.50
30.0	29.9	0.1	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...

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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Office

NSC-TISI-TIS 17025
CALIBRATION 0015

Request No. 22-67 / 0140 MTC No. PSL-H 0032 / 67

Certificate of Calibration

Customer :	Neediss Supply Instrument Co., Ltd.
	536 Soi Bangkhae 7, Bangkhae, Bangkhae, Bangkok, 10160
Item :	Thermo-Hygrometer (Thermal Environment Monitor)
Model /Type :	hs-32
Serial Number :	MCG030002
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 :

Panit T.

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchai Singhapiwat)
Director
Photometry and Temperature Standards Laboratory

Ref. No : 2012266110904511004
Issued Date : 6 December 2023

The results relate only to the items tested/calibrated or value assigned.
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Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
[redacted]kok 10900,
[redacted]5, 5217

Request No. 22-67 / 0140 MTC No. PSL-H 0032 / 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 :	MCG030002
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

P.T.

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Request No. 22-67 / 0140 MTC No. PSL-H 0032 / 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	20.3	-0.3	0.50
30.1	30.3	-0.2	0.50
40.0	40.1	-0.1	0.50

Table : Temperature Measurement @ Dry Bulb

Average Measured Temperature (°C)	Average Displayed of UUC (°C)	Correction Measured of UUC (°C)	Expanded Uncertainty of Measurement (± °C)
20.0	20.3	-0.3	0.50
30.1	30.3	-0.2	0.50
40.0	40.2	-0.2	0.50

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[redacted]
E-mail : sumalee@tistr.or.th

Request No. 22-67 / 0140 MTC No. PSL-H 0032 / 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	20.5	-0.5	0.50
30.1	30.3	-0.2	0.50
40.0	40.1	-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...

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

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Amphoe Muang, Changwat Samutprakar[redacted]
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E-mail : mtc@tistr.or.th

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ACCREDITED
CALIBRATION AND DIMENSIONAL MEASUREMENT
ACDM-2614

Supplement to Calibration Certificate No. Q24002403

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCF070016[NHEMTHS3270016]
CLID. NO.	:	232400057
JOB CONTROL NO.	:	240110002403
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 : Mongkol Yotsoontorn
Authorized Signatory
06 February 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q24002403A1

F3-012-05/12-23

[redacted]

@clccalibration

CALIBRATION LABORATORY CO., LTD.
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CLC Accredited ISO/IEC 17025

REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCF070016[NHEMTHS3270016]
DATE OF CALIBRATION	:	16 January 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPTH-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 (EA-4/02 M:2022)"

[redacted]

Certificate No. Q24002403

F3-011-05/12-23

Envilab Co.,Ltd.

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CLC
Accredited
ISO/IEC 17025

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 ±(°C)
20.0	20.01	19.9	+0.11	0.40
30.0	30.00	30.2	-0.20	
40.0	39.99	40.3	-0.31	

2. CORRECTION OF TEMPERATURE : DRY

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.01	19.9	+0.11	0.40
30.0	30.00	30.2	-0.20	
40.0	39.99	40.3	-0.31	

3. CORRECTION OF TEMPERATURE : GLOBE

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.01	19.9	+0.11	0.40
30.0	30.00	30.2	-0.20	
40.0	39.99	40.3	-0.31	

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. Q24002403

F3-011-05/12-23

[redacted]

Envilab Co.,Ltd.

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ACDM-2614

Supplement to Calibration Certificate No. Q24002399

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCF070018[NHEMTHS3270018]
CLID. NO.	:	232400052
JOB CONTROL NO.	:	240110002399
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 : Mongkol Yotsoontorn
Authorized Signatory
06 February 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q24002399A1

F3-012-05/12-23

[redacted]

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ANAB ANSI National Accreditation Board ACCREDITED CALIBRATION AND DIMENSIONAL MEASUREMENT ACDM 2314

REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCF070018[NHEMTHS3270018]
DATE OF CALIBRATION	:	16 January 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPTH-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 (EA-4/02 M:2022)"

Certificate No. Q24002399

F3-011-05/12-23

[redacted]

@clccalibration

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ANAB
ANSI National Accreditation Board
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CALIBRATION AND DIMENSIONAL MEASUREMENT
ACDM-2814

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 ±(°C)
20.0	20.01	20.0	+0.01	0.40
30.0	30.00	30.2	-0.20	
40.0	39.99	40.2	-0.21	

2. CORRECTION OF TEMPERATURE : DRY

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.01	20.0	+0.01	0.40
30.0	30.00	30.3	-0.30	
40.0	39.99	40.3	-0.31	

3. CORRECTION OF TEMPERATURE : GLOBE

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.01	20.0	+0.01	0.40
30.0	30.00	30.2	-0.20	
40.0	39.99	40.2	-0.21	

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. Q24002399

F3-011-05/12-23

[redacted]

Enviab Co.,Ltd.

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CALIBRATION LABORATORY CO., LTD.
2/10-11,14,55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Road, Lat Yao, Bangkok 10230
Tel. 02-578-0353-4 Fax: 02-578-2572 www.calibrationlab.com E-mail: sale@calibrationlaboratory.com

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ANSI National Accreditation Board
ACCREDITED
CALIBRATION AND DIMENSIONAL MEASUREMENT
ACD-2814

Supplement to Calibration Certificate No. Q24002409

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCF070019[NHEMTHS3270019]
CLID. NO.	:	232400068
JOB CONTROL NO.	:	240110002409
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 : Mongkol Yotsoontorn
Authorized Signatory
06 February 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q24002409A1

F3-012-05/12-23

[redacted]

CALIBRATION LABORATORY CO., LTD.
2/10-11,14,55 Soi Prasert Manukit 23 Yaek 4, Prasert Manukit Rd., Ladprao Bangk
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CLC Accredited ISO/IEC 17025

ilac-MRA

ANAB ACCREDITED ACCTA-2814

REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	METROSONICS
MODEL / TYPE	:	hs-32
SERIAL NO.	:	MCF070019[NHEMTHS3270019]
DATE OF CALIBRATION	:	16 January 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPTH-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 (EA-4/02 M:2022)"

Certificate No. Q24002409

F3-011-05/12-23

[redacted]

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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 Email:sale@cal-laboratory.com

CLC
Accredited
ISO/IEC 17025

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 ±(°C)
20.0	20.01	20.0	+0.01	0.40
30.0	30.00	30.0	0.00	
40.0	39.99	39.9	+0.09	

2. CORRECTION OF TEMPERATURE : DRY

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°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	

3. CORRECTION OF TEMPERATURE : GLOBE

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.01	20.0	+0.01	0.40
30.0	30.00	29.9	+0.10	
40.0	39.99	39.8	+0.19	

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. Q24002409

F3-011-05/12-23

[redacted]

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TISTR

NSC-TISI-TIS 17025
CALIBRATION 0015

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, 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 %.

Calibrated by :

Panit T.

(Ms. Panit Thummasri)

Approved by :

(Mr. Kamchai Singhapiwat)
Director
Photometry and Temperature Standards Laboratory

Ref. No : 2012266110904511005

Issued Date : 6 December 2023

The results relate only to the items tested/calibrated or value assigned.
Advertising the Report/Certificate and publicity of the results except in full are prohibited unless written permission is obtained from the governor of TISTR.

FM.BL.MTC.002 Rev.4

Head Office
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Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhumvit [redacted] 0900,
Amphoe Muang, Changwat Samutprakan 1028 [redacted] 7
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Enwlab Co.,Ltd.

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

P.T.

The results relate only to the items tested/calibrated or value assigned.
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Head Office
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E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

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Soi 1C, Bangpoo Industrial Estate, Su[redacted]ngkok 10900,
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Tel. (66) 0 2323 1672-80 ext. 115, 1[redacted]
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Envilab Co.,Ltd.

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

The results relate only to the items tested/calibrated or value assigned.
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Fax. (66) 0 2577 9009
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Amphoe Muang, Changwat Samutprakan 10280
Tel. (66) 0 2323 1672-80 ext. 115, 116
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
[redacted]

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...

PT.

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
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Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
[redacted] 10900,
217

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, 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 : 20122661109045110 03

Issued Date : 6 December 2023

The results relate only to the items tested/calibrated or value assigned.
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Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

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Amphoe Muang, Changwat Samutprakan[redacted]
Tel. (66) 0 2323 1672-80 ext. 115, 116[redacted]
Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

Office
[redacted]kok 10900,
[redacted]5217

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

P.T.

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,
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E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory
Soi 1C, Bangpoo Industrial Estate, Sukhum[redacted]10900,
Amphoe Muang, Changwat Samutprakan 1[redacted]17
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

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

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Head Office
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Amphoe Muang, Changwat Samutprakan 1028[redacted]
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

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...

P.T.

The results relate only to the items tested/calibrated or value assigned.
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Head Office
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Fax. (66) 0 2323 9165
E-mail : mtc@tistr.or.th

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ANSI National Accreditation Board
ACCREDITED
CALIBRATION AND DIMENSIONAL MEASUREMENT
ACDM-2814

Supplement to Calibration Certificate No. Q24002401

CERTIFICATE OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	QUEST TECHNOLOGIES
MODEL / TYPE	:	QUESTemp°32
SERIAL NO.	:	TPD010029[NHEQUQT3210029]
CLID. NO.	:	232400055
JOB CONTROL NO.	:	240110002401
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 : Mongkol Yotsoontorn
Authorized Signatory
06 February 2024

This Calibration Certificate documents the traceability to national standards, which realize the units of measurement according to the International System of Units (SI)

Certificate No. Q24002401A1

F3-012-05/12-23

[redacted]

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CALIBRATION AND DIMENSIONAL MEASUREMENT
ACDM 2814

REPORT OF CALIBRATION

FOR

NOMENCLATURE	:	HEAT STRESS MONITOR
MANUFACTURER	:	QUEST TECHNOLOGIES
MODEL / TYPE	:	QUESTemp°32
SERIAL NO.	:	TPD010029[NHEQUQT3210029]
DATE OF CALIBRATION	:	16 January 2024

ENVIRONMENT CONDITIONS :

Temperature : (23 ± 2) °C Relative Humidity : (55 ± 10) %RH

PROCEDURE USED :

This instrument was calibrated under procedure No. **CLC-CPTH-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 (EA-4/02 M:2022)"

Certificate No. Q24002401

F3-011-05/12-23

[redacted]

Envilab Co.,Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

@clccalibration

CALIBRATION LABORATORY CO., LTD.
2/10-11,14, 55 Soi Prasert Manukit 29 Yaek 4, Prasert Manukit Rd., Ladphrao, Bangkok 10230
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CLC
Accredited
ISO/IEC 17025

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 ±(°C)
20.0	20.01	20.1	-0.09	0.40
30.0	30.00	29.9	+0.10	
40.0	39.99	39.8	+0.19	

2. CORRECTION OF TEMPERATURE : DRY

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.01	20.0	+0.01	0.40
30.0	30.00	29.9	+0.10	
40.0	39.99	39.8	+0.19	

3. CORRECTION OF TEMPERATURE : GLOBE

Test point (°C)	Actual Temperature (°C)	DUC Reading (°C)	Correction (°C)	Uncertainty ±(°C)
20.0	20.01	20.1	-0.09	0.40
30.0	30.00	30.0	0.00	
40.0	39.99	39.8	+0.19	

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. Q24002401

F3-011-05/12-23

[redacted]

Envilab Co.,Ltd. ผู้จัดการฝ่ายควบคุมคุณภาพ

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METROLOGY SYSTEM (THAILAND) CO.,LTD.

ID LINE : IEC17025

Certificate of Calibration

Certificate Number : SPR24030525-3

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	:	190600323			
ID. Number	:	N/A			
Environmental Conditions					
Ambient Temperature	:	23 °C ± 3 °C	Received Date	:	30 Mar 2024
Relative Humidity	:	50 % ± 15 %	Calibration Date	:	18 Apr 2024
Location of Calibration	:	In-Lab	Recommend Due Date	:	18 Apr 2025
Calibration Procedure	:	SP-CPE-04-32	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

Calibration Officer

Approved by :

(Ms.Pussakorn Chaikaew)

[redacted]

Head Office : 1/1 Moo 1 Klongluang Pathumthani 12120 (Thailand) Tel. (662) 193-2220 e-Mail www.spmetrologyco@gmail.com

ID LINE : IEC17025

Calibration Report

Certificate Number : SPR24030525-3

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)

[redacted]

ID LINE : IEC17025

Result of Calibration

Certificate No. : SPR24030525-3

Function: Illumination Measurement

Unit : Lux

Calibration Point	Standard Reading	UUC Reading	Error	Uncertainty (±)
100	100.0	92.6	-7.4	1.3
500	500	459.7	-40.3	6.6
1000	1000	911.2	-88.8	13
1500	1500	1355	-145	20
2000	2000	1804	-196	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 -

[redacted]

CAL
Calibratech Co.,Ltd.
7/106-7 Moo 2, Sukhaprachasan 3 Rd., [illegible] 11120
Tel.(02) 964-6211 Fax.(02) 961-5155, [illegible] calibratech_cal@hotmail.com

NSC-TISI-TIS17025
CALIBRATION 0030

Certificate of Calibration

Certificate No. : 67-200060-2

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

Equipment : Electronic Balance

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

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

Ambient Temperature : (20.0 to 20.5) °C
Relative Humidity : (54.2 to 59.1) %
Air Pressure : 1013.0 mbar

Date of Received : 20 February 2024
Date of Calibration : 20 February 2024
Date of Issue : 21 February 2024
Calibrated by : Satja Sangklum

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

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C02232088	08 Nov 2024	National Institute of Metrology (Thailand), (NIMT)

Approved by :
(Surachai Promthong)
Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full except with the prior writte[redacted]

CAL

Calibratech Co.,Ltd.

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

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

Certificate of Calibration

Certificate No. : 67-200060-2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty ± (g)
0.1	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 mutiplied 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

- o0o -

[redacted]