

ภาคผนวกที่ 4

ใบรับรองการสอบเทียบเครื่องมือ

Certificate of Calibration

Method 5 Pre-Test Calibration - Liters (L)

UUT Meter Console Information

Model #: XC-572V
Serial #: 0509047
DGM Model #: SK25EX
DGM Serial #: 0008967

Calibration Conditions

Bar. Pressure (mm Hg): 757.4
Ambient Temperature (°C): 25.6
Relative Humidity (%): 65
Altitude (m): 1.50
Bar. Pressure Corr. (mm Hg): 757.3

Calibration Reference

Work No.: SVO28131 Calibration No.: SA2023001

Reference Equipment

WTM Model: W-NK-5B Serial No.: 546321
Gamma: 0.9976 Cal.Due: 24-Mar-24
Thermometer: FLUKE714 Serial No.: 9038005

Judgment: **Pass** According to note:

Factors/Conversions

Std. Temp. (K): 298.15
Std. Press. (mm Hg): 760
K₁ (K/mm Hg): 0.3923

UUT Meter (DGM)

Reference Meter (WTM)

Run Time (seconds)	Orifice, ΔH (mm H ₂ O)	Volume			Meter Temperature (°C)		Meter Pressure (mm H ₂ O)	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}
900	13.00	1595.5	1768.5	173.0	27.0	27.0	0.8	450528.64	450696.43	167.8	24.9	24.8
600	25.00	1786.6	1945.4	158.8	27.0	27.0	1.4	450713.99	450869.84	155.9	24.8	24.7
480	50.00	1955.4	2138.1	182.7	27.0	27.0	2.4	450878.62	451058.57	180.0	24.7	24.6
420	80.00	2159.8	2365.3	205.5	27.0	27.0	3.6	451079.10	451280.70	201.6	24.6	24.5
300	120.00	2382.2	2560.5	178.3	27.0	27.0	5.2	451297.17	451472.46	175.3	24.5	24.5

Standardized Data

Calibration Results

Reference Meter (L)		UUT Meter (L)		Correction Factor		ΔH @ (mm H ₂ O)	
Std. Vol.	Std. Flow	Std. Vol.	Std. Flow	Value	Variance	0.0212 SCMM	Variance
V _{w(std)}	Q _{w(std)}	V _{m(std)}	V _{w(std)}	Y	ΔY	ΔH@	ΔΔH@
167.20	11.15	171.45	11.1	0.9752	-0.0112	47.5	1.671
155.58	15.56	157.56	15.6	0.9875	0.0011	47.1	1.251
180.14	22.52	181.71	22.5	0.9914	0.0050	45.3	-0.549
202.48	28.93	204.98	28.9	0.9878	0.0014	44.3	-1.538
176.77	35.35	178.53	35.4	0.9901	0.0037	45.0	-0.835
				0.9864	= Y Avg.	45.9	= ΔH@ Avg. (Metric)

Note1 : 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.

Note2 : For ΔH_g, orifice pressure differential that equates to 0.0212m³/min at standard temperature and pressure, acceptable tolerance of individual values from the average is ±0.2inches (5.1mm) H₂O.

บริษัท สิทธิพรบอสโซซิเอต จำกัด
SITHIPHORN ASSOCIATES COMPANY LIMITED

Calibrator:

Signature:

Date: 09/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.

Calibration Certificate Appendix

METHOD 5 PRE-TEST CONSOLE CALIBRATION

SITHIPORN
Calibration No.: **SA2023001**

UUT Meter / Console Information

Model #: XC 572-V Serial number: 0509047
DGM Model #: SK25EX Serial number: 0008967

Check the Diagnosis

Check the system before calibrating.

	Not Passed	Passed
-Visual instrument normalcy	<input type="checkbox"/>	<input checked="" type="checkbox"/>
-Electrical and Temperature Systems	<input type="checkbox"/>	<input checked="" type="checkbox"/>
-Inclined Manometer with Systems	<input type="checkbox"/>	<input checked="" type="checkbox"/>
-Pressure Gauge	<input type="checkbox"/>	<input checked="" type="checkbox"/>
-Leak Check	<input checked="" type="checkbox"/> Vacuum : Pass	<input checked="" type="checkbox"/> Pressure : Pass
<input checked="" type="checkbox"/> PM and Calibration	<input type="checkbox"/> Repairing before Calibration	

Nomenclature

Pb - Barometric Pressure
DGM - Dry Gas Meter
K₁ - 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

Equations

$$K_1 = \frac{T_{std}}{P_{std}}$$

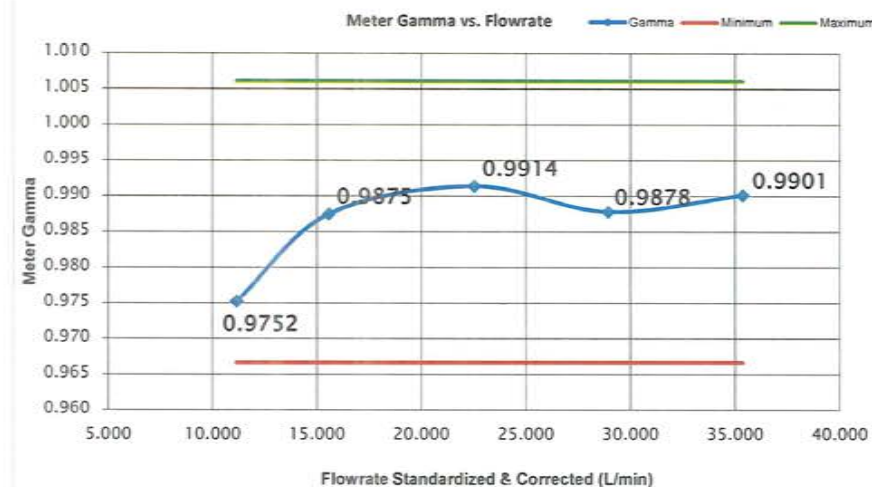
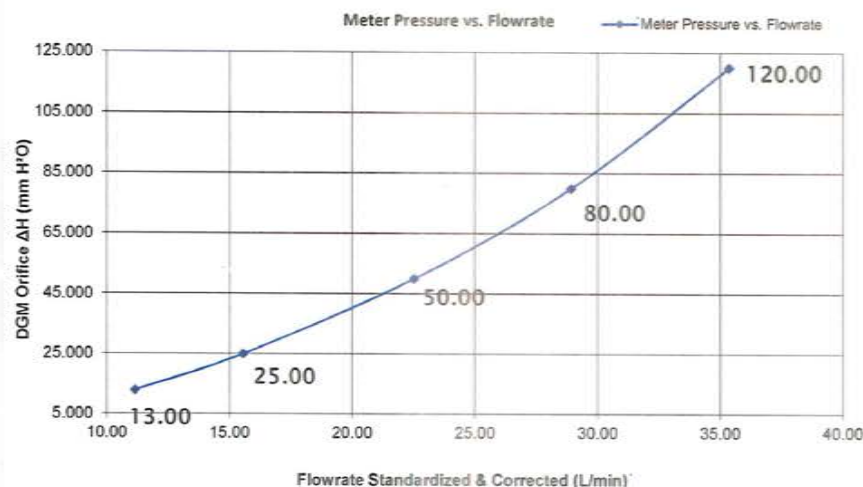
$$V_{w(std)} = Y * K_1 \frac{V_w * (P_{bar} + \frac{P_{m(g)}}{13.6})}{T_w}$$

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

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

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

Calibration Graphs



Console Sensor Audit QA Sheet

Meter Console Information (UUT)

Model #: XC-572V
Serial #: 0509047
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 30.00
Humidity (%): 65%
Amb. Temp. (°C): 25.6
Altitude (m): 100.0
Corrected Pbar (mm. Hg): 29.90

Calibration No. : SA2023001

Work No. : SVO28131

Reference Devices

TC Calibrator Model: FLUKE 714
Serial No.: 9038005
Digital Manometer Model: Dwyer DPGA-00
Serial No.: 721

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	26.5	27	27	27	27	27	27	PASS
Acceptance criteria		3.0°C, 5.4°F	1.50%	3.0°C, 5.4°F			1.0°C, 2.0°F	

Reference Thermocouple ID:

90728323

Ref Point	Reference Temp.	DGM Thermocouple Sensor Reading	ΔTabs4	Maximum	Reference Status (±1%)
#	°C	°C	°C	%	Pass/Fail
Ice Water	1.2	1	0.07%	0.08%	PASS
Ambient	25.6	26	0.08%		

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

Console Vacuum Audit			
Reference Point	Reference Vacuum	Console Vacuum	Reference Point Status ³
#	mm. Hg	mm. Hg	Pass/Fail
1	25.37	25.00	PASS

Notes

¹For valid test results, the maximum difference between test and reference readings should be 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)

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

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SITHIPORN ASSOCIATES COMPANY LIMITED

Signature: _____

Date: 09/Feb/24

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

Certificate of Calibration

Method 5 Console Sensor Calibration - Metric Units

page: 1/1

Console Information

Model #: XC-572V
Serial #: 0509047
Units: Metric

Calibration Conditions

Pbar (mm. Hg): 757.40
Humidity (%): 65
Tamb (°C): 25.6
Elevation (m): 1.5
Corr. Pbar (mm. Hg): 757.40

Calibration Reference

Calibration No.: SA2023001
Work No.: SVO28131

Reference Devices

TC Calibrator Model: FLUKE 714
Serial No.: 9038005

Temperature Sensors Calibration Data

Reference Temp.		Test Thermocouple Calibrations						Reference Point Status ²
Point	°C	Aux	Stack	Probe	Oven	Filter	Exit	Pass/Fail
1	-18	-17	-17	-18		-17	-17	PASS
2	38	38	38	38		38	38	PASS
3	93	94	94	94		94	94	PASS
4	149	151	150	150		150	150	PASS
5	260	261	261	261		261		PASS
6	371		374					PASS
7	482		484					PASS
8	593		595					PASS
9	816		821					PASS
10	1038		1051					PASS
		±3.0°C, 5.4°F	1.50%	±3.0°C, 5.4°F	±3.0°C, 5.4°F	±3.0°C, 5.4°F	±1.0°C, 2.0°F	PASS

Overall Audit Status

DGM Temperature Sensor

Ref Point	Reference Temp.	DGM Thermocouple Sensor Reading	Δt_{abs}	Maximum	Reference Status ² (±1%)
#	°C	°C	°C	%	Pass/Fail
Ice Water	1.2	1	0.07%	0.08%	PASS
Ambient	25.6	26	0.08%		

Temperature Controller

Heater Controller	Reference Measure	XC-572V	Deviated to set point	ΔT_{abs}	Temp. Controller Status ³
Set point	(μ)	Thermometer		±3%	
120 °C	°C	°C	°C	°C	Pass/Fail
Probe	115	117	-2	0.52%	PASS
Filter	116	117	-1	0.26%	PASS

Notes

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

² For valid test results, the maximum difference between test and reference readings should be 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 Heater control acceptance limit Temperature can be maintained at 120 °C ±14 °C, ±57 °F within ±1.5%⁽²⁾ at a flow rate of 20 lpm.

Signature: _____

Date: 09/Feb/24

I certify that the above thermocouple sensors were calibrated in accordance with US EPA Methods 2 and 5, CFR 40 Part 60.

Nozzle Calibration

Nozzle Information

Manufacturer Apex
Type Stainless Steel
Identification _____

Calibration Conditions

Bar. Pressure (mm Hg): 757.4
Ambient Temperature (°C): 25.6
Relative Humidity (%): 65

Calibration Reference

Calibration No.: SA2023001
SITHIPHORN
Work No.: SVO28131
Units: Metric

Reference Equipment

Vernier, 0-250mm 0.01 mm increments model Mitutoyo

Serial No

3038570

Cal No.:

L202310355-0001

Cal. due:

07/Nov/24

Calibration Method

Follow the USEPA Method 5 nozzle size calibration procedure. (ref. 40 CFR PART 60).

Calibration Result

ID No.	Sizes	measured every 60° nozzle			(D ₁ + D ₂ + D ₃) / 3	Different ≤ 0.100 mm.	
	mm.	D ₁	D ₂	D ₃	D _{avg}	i	Judgment
4	3.1	3.01	2.98	3.01	3.000	0.030	PASS
5	3.9	3.89	3.90	3.89	3.893	0.010	PASS
7	5.3	5.38	5.34	5.38	5.367	0.040	PASS
8	6.2	5.95	6.00	5.94	5.963	0.060	PASS
9	7.1	7.18	7.19	7.19	7.187	0.010	PASS
12	9.4	9.35	9.36	9.43	9.380	0.080	PASS
16	12.6	12.35	12.45	12.30	8.217	0.050	PASS

Where :

D₁, D₂, D₃ = Three difference nozzle diameters at 60 degrees to each other,
each measured to the nearest 0.025 mm or 0.001 inch

Δ D = Maximum difference between any two diameters, must be ≤ 0.100 mm or 0.004 inch

$$D_{avg} = (D_1 + D_2 + D_3) / 3$$



Signature _____

Date : 09/Feb/24

Sampling Probe and Pitot validation

Sampling Probe Information

Manufacturer: Apex
Probe Type: SS, 3ft
Probe No.:
Pitot tube Type: S Type 3/8 Inc.
Pitot tube No.: A10664

Calibration Conditions

Bar. Pressure (mm Hg): 757.4
Ambient Temperature (°C): 25.6
Relative Humidity (%): 65
Units: Metric

Calibration Reference

Calibration No.: SA2023001
Work No.: SVO28131

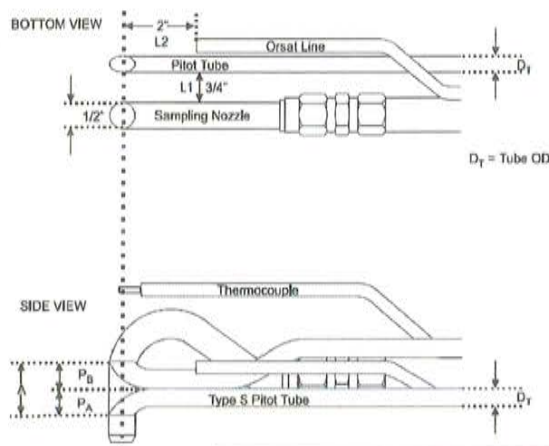
Reference Devices

- Vernier, 0-250mm 0.01 mm increments
Model: Mitutoyo, ID No.: EPD1-VER-57-1-CEN-01

Validation method : Follow the USEPA Method 5 pitot tube (S type) calibration procedure. (ref. 40 CFR PART 60).

Sampling Probe Validation with Tune up

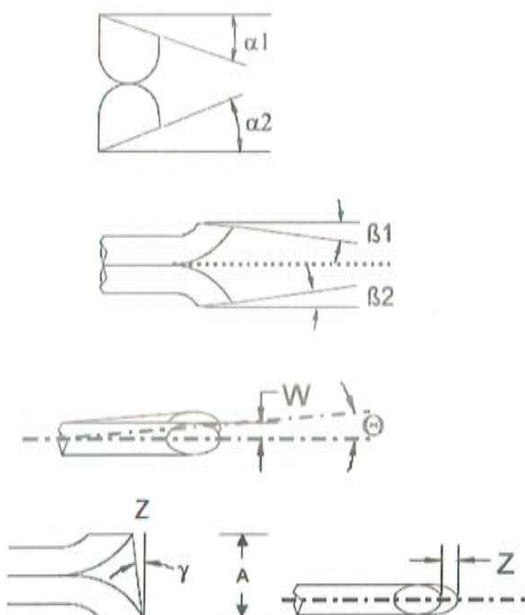
☑ : Measuring and aligning with 1/2" sample nozzle(12.7 mm)



	Measured	Acceptance Standard
$L_1 =$	18.86 mm	(19.05 mm. or 0.75 in.)
$L_2 =$	45.53 mm	(50.8 mm. or 2.0 in.)
$D_T =$	9.55 mm	(9.525 mm., 0.375 in.)
$A =$	21.67 mm	($2.1 D_T \leq A \leq 3D_T$)
$A/2D_T =$	1.135	($1.05 P_A / D_T \leq A \leq 1.5$)

Pitot Tube Validations and Engles measurement Result

☑ : Measure results after maintenance and adjustments.



P_B Size		Acceptance of correctness
$\alpha_1 =$	1.85 °	$\leq 10^\circ$
$\beta_1 =$	0.95 °	$\leq 5^\circ$
P_A Size		
$\alpha_2 =$	1.25 °	$\leq 10^\circ$
$\beta_2 =$	1.10 °	$\leq 5^\circ$

Engles measurement	Calculated Result	Acceptance Criteria
$W =$	0.75 °	0.292 mm
		$W < 0.0794 \text{ mm. (0.03125 in)}$
$Z =$	1.55 °	0.586 mm
		$Z < 3.175 \text{ mm. (0.125 in.)}$

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

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SITHIPORN ASSOCIATES COMPANY LIMITED

Signature: _____

Date: 09/Feb/24

Certificate of Calibration

Certificate No. : 67-200064-2

Page : 1 of 2

Submitted by : M E T Company Limited
36/659 Moo 6, T. Bangrakpattana, A. Bangbuatong, Nonthaburi 11110

Equipment : Electronic Balance
Manufacturer : AND Model : FX-2000i
Serial No. : 15639789 ID No. : MET-EB03/61
Capacity : 2200 g Resolution : 0.01 g

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited
Ambient Temperature : (25.8 to 26.0) °C
Relative Humidity : (60.8 to 61.2) %
Air Pressure : 1012.0 mbar

Date of Received : 22 February 2024

Date of Calibration : 22 February 2024

Date of Issue : 23 February 2024

Calibrated by :

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

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
F181-F1821	67-210021-1	29 Jul 2024	National Institute of Metrology (Thailand), (NIMT)

Approved by :

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 67-200064-2

Page : 2 of 2

Result of Calibration : After Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

Nominal Value (g)	Correction (g)	Uncertainty \pm (g)	Error before Adjustment (g)
200	0.00	0.010	0.00
500	0.00	0.011	0.01
600	0.00	0.011	0.01
700	0.00	0.011	0.02
800	0.00	0.011	0.02
1000	0.00	0.011	0.03
1200	0.00	0.012	0.04
1500	0.00	0.012	0.05
2000	-0.01	0.014	0.08
2200	-0.01	0.023	0.09

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 $k = 2.06$, providing a level of confidence of approximately 95%

Eccentric error

Load test : 500 g

A	B	C	D	E	
0.00	-0.01	-0.02	-0.01	0.00	g



Repeatability

Load test : 2000 g
Stdev. : 0.004 g

- o0o -





Certificate of Calibration

Equipment:	SPECTROPHOTOMETER	Certificate No.:	C06230484
Model:	SP-2100	Issued Date:	16 October 2023
Serial No. (or ID.):	KJOGO5083001 (MET-SP 01/46)	Job No.:	WO-00007312
Manufacturer:	Spectrum	Page:	1 of 2
Condition:	In Condition		

Customer: M E T CO.,LTD.
36/659 Moo 6, Tambol Bangrakpattana,
Amphur Bangbuathong, Nonthaburi 11110 Thailand.

Environment Condition:

Temperature	26.5	°C	±	0.5	°C
Humidity	60.6	%RH	±	1.9	%RH

Calibration Place: M E T CO.,LTD. (Laboratory Room)
36/659 Moo 6, Tambol Bangrakpattana,
Amphur Bangbuathong, Nonthaburi 11110 Thailand.

Calibration By:

Calibration Date: 16 October 2023

The Method used: In house method, CAL-WI-24, base on ASTM E 275-08 and ASTM E 387-04

Traceability: This certificate is traceable to the CRM maintained by National Institute of Standards and Technology (NIST) through Starna Scientific Limited.

The standard for Wavelength Certificate No. 105931 and 105898

The standard for Photometric Certificate No. 105940

Person in charge

Authorized signatory

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

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

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

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด

DKSH Technology Limited

2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260

2533 Sukhumvit Road, Bangchak, Phrakhanong, Bangkok 10260

Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

Calibration Results:
Without Adjustment

Wavelength Accuracy (nm), The spectral bandwidth of Std at 4 nm and UUC at 4 nm

Standard Wavelength	Unit Under Calibration	Correction	Uncertainty
334.22	334	0.22	0.59
418.48	418	0.48	0.59
536.90	536	0.90	0.59
637.94	637	0.94	0.59
748.28	748	0.28	0.59
879.70	879	0.70	0.59

Photometric Accuracy (Absorbance)

Wavelength	Standard absorbance	Unit Under Calibration	Correction	Uncertainty
420 nm	0.0000	0.000	0.0000	0.0045
	0.5890	0.586	0.0030	0.0045
	0.7604	0.755	0.0054	0.0045
	1.0241	1.020	0.0041	0.0045
440 nm	0.0000	0.000	0.0000	0.0045
	0.5782	0.575	0.0032	0.0045
	0.7430	0.738	0.0050	0.0045
	1.0016	0.996	0.0056	0.0045
465 nm	0.0000	0.000	0.0000	0.0045
	0.5283	0.528	0.0003	0.0045
	0.6854	0.681	0.0044	0.0045
	0.9509	0.953	-0.0021	0.0045
546.1 nm	0.0000	0.000	0.0000	0.0045
	0.5457	0.544	0.0017	0.0045
	0.6944	0.689	0.0054	0.0045
	0.9965	0.994	0.0025	0.0045
590 nm	0.0000	0.000	0.0000	0.0045
	0.5837	0.580	0.0037	0.0045
	0.7223	0.717	0.0053	0.0045
	1.0935	1.089	0.0045	0.0045
635 nm	0.0000	0.000	0.0000	0.0045
	0.5675	0.565	0.0025	0.0045
	0.6900	0.685	0.0050	0.0045
	1.0862	1.084	0.0022	0.0045

บริษัท ดีเคเอสเอช เทคโนโลยี จำกัด

DKSH Technology Limited

2533 ถนนสุขุมวิท แขวงบางจาก เขตพระโขนง กรุงเทพมหานคร 10260

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Phone: +66 2639 7000 Email: info.calibration@dksh.com Website: www.dksh.com/scientific-thailand

The End of Certificate

ใบตรวจสอบสภาพเครื่องวัดสิ่งแวดล้อม

เลขที่ใบงาน: WO-00007312

ชนิดเครื่องมือ: SPECTROPHOTOMETER

รุ่น: SP-2100

หมายเลขเครื่อง: KJOGO5083001

ตรวจสอบ (รับ)		รายการตรวจเช็ค	ตรวจสอบ (ส่ง)		หมายเหตุ
16 Oct 2023			16 Oct 2023		
ปกติ	ไม่ปกติ		ปกติ	ไม่ปกติ	
		General			
<input checked="" type="checkbox"/>	<input type="checkbox"/>	1. ความสมบูรณ์เครื่อง	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	2. ความสะอาด (ช่องใส่ตัวอย่าง, ภายใน-นอกเครื่อง)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	3. สวิตช์ ปิด – เปิด เครื่อง (On-Off Swicth)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	4. ปุ่มกด (Keypad)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	5. หน้าจอ (Display, Screen Contrast)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		Spectrophotometer			
<input type="checkbox"/>	<input type="checkbox"/>	6. แรงดันไฟฟ้า (Battery Backup) >= 2.5 VDC	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	7. ตัวหมุนเลือกความยาวคลื่น (Wavelength Control)	<input type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	8. ความยาวคลื่น (Wavelength Check)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	9. แหล่งกำเนิดแสง (UV < 3,000 hour)	<input type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	10. แหล่งกำเนิดแสง (Visible < 5,000 hour)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
<input checked="" type="checkbox"/>	<input type="checkbox"/>	11. ช่องวัดหลายตัวอย่าง (Carousel Module)	<input checked="" type="checkbox"/>	<input type="checkbox"/>	
		pH Meter and Conductivity Meter			
<input type="checkbox"/>	<input type="checkbox"/>	12. อิเล็กโทรด (Electrode and Connection Cable)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	13. ระดับสารละลายใน Electrode (Level KCl)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	14. ฝาปิดกันปลาย Electrode (Dust Protection Hood)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	15. ขาจับอิเล็กโทรด (Stand)	<input type="checkbox"/>	<input type="checkbox"/>	
		Turbidimeter			
<input type="checkbox"/>	<input type="checkbox"/>	16. ค่าความขุ่นที่ต่ำสุด (No Sample)	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	17. ระดับการส่องสว่างของแสง (>= 2.5 ไม่นเกิน 3.0)	<input type="checkbox"/>	<input type="checkbox"/>	
		Automatic titrator			
<input type="checkbox"/>	<input type="checkbox"/>	18. สภาพ Piston Burettes	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	19. Function Rinsing and Dosing	<input type="checkbox"/>	<input type="checkbox"/>	
<input type="checkbox"/>	<input type="checkbox"/>	20. ระบบท่อสายยางและอุปกรณ์ประกอบ	<input type="checkbox"/>	<input type="checkbox"/>	

เพิ่มเติม/ขอแนะนำ :

Service Engineer



บริษัท เอ็ม อี ที จำกัด MET Company Limited

36/659 หมู่ 6 ต.บางรักพัฒนา อ.บางบัวทอง จ. นนทบุรี 11110

36/659 Moo 6 Tambol Bangrakpattana Amphur Bangbuatong Nontaburi 11110

Tel : 0 2920 1458-9 Fax : 0 2920 1460 E-mail : met_jj@yahoo.com

TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	March 31, 2024
โรงเรียนเทศบาลดอนหัวฬ่อ 1				Start Time	9:55 AM
Sampler Number	TSP No.11	Transfer Standard Type	Onifice	Stop Time	10:00 AM
Motor Serial Number	BL-11	Calibrator Model	TE-5025A	Person	
Recorder Serial Number	-	Calibrator Serial Number	1		

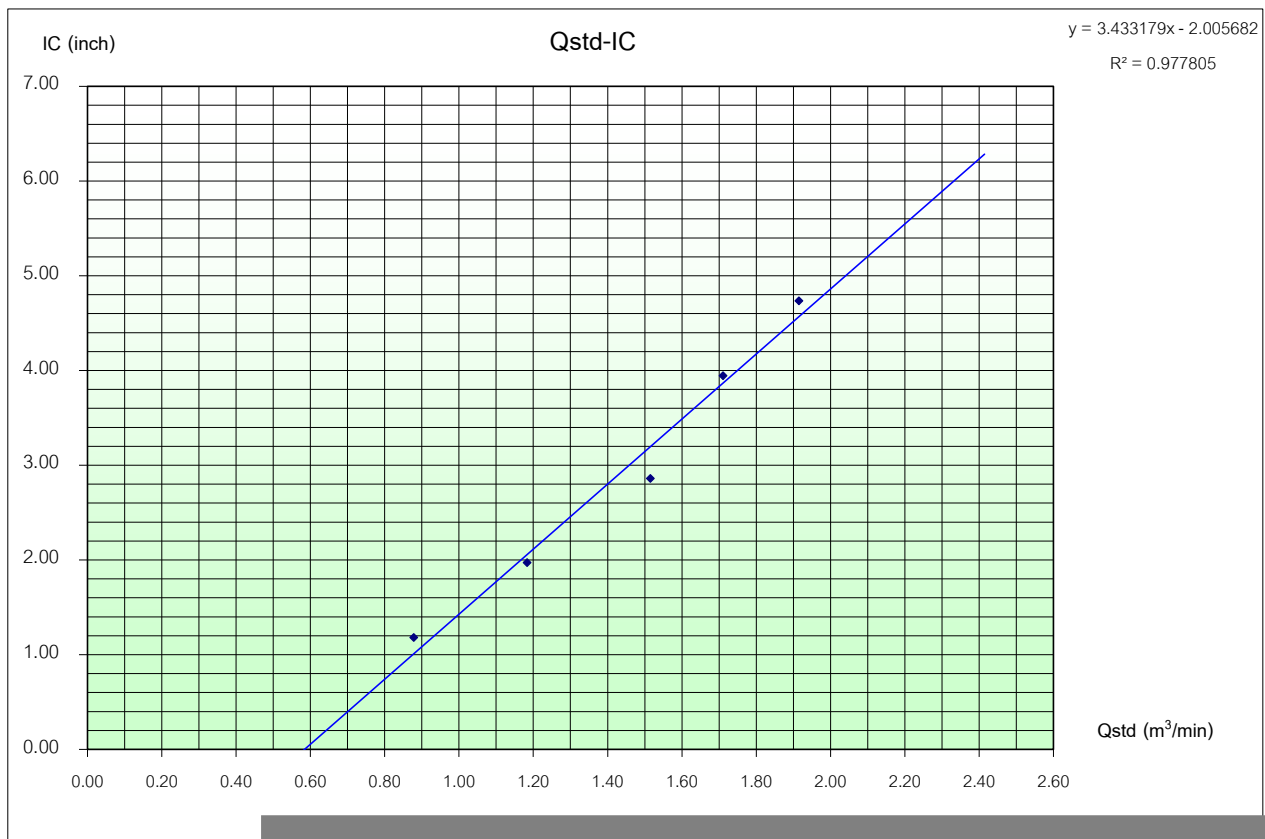
Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric	Start	Stop
	Positive	Negative	ΔH_2O	$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	Sample Flow Rate Indication (inch)	$IC = I[(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	(°K = °C+273)	Pressure (mmHg)	Meter	Meter
5	1.5	1.5	3.0	1.70868	0.87849	1.2	1.18	305.0	757.0		
7	2.7	2.7	5.4	2.29243	1.18357	2.0	1.97	305.0	757.0		
10	4.4	4.4	8.8	2.92645	1.51492	2.9	2.86	305.0	757.0		
13	5.6	5.6	11.2	3.30148	1.71091	4.0	3.95	305.0	757.0		
18	7.0	7.0	14.0	3.69116	1.91457	4.8	4.74	305.0	757.0		

Linear Regression Y ON X : Y= mX + b

1	Slope (m)	1.91345	Linear Equation		Average	305.0	757.0		
2	Intercept (b)	0.02773	Set Point Flow Rate (X) (m ³ /min)	1.133	r ²	0.963579	Pstd(mmHg)	760.0	
3	Correlation Coefficient (r)	0.99995	Final Set Flow Rate = (I)	0	r	0.9816206	T _{NTP}	298.0	
Result							$C = (Pa/P_{std})(T_{std}/T_a)^{0.5}$		0.973192407
									0.986505148

COMMENT

Andersen Instruments, Inc.



Calibrated By

Field Environmental

Division Manager



บริษัท เอ็ม อี ที จำกัด MET Company Limited

36/659 หมู่ 6 ต.บางรักพัฒนา อ.บางบัวทอง จ. นนทบุรี 11110

36/659 Moo 6 Tambol Bangrakpattana Amphur Bangbuatong Nontaburi 11110

Tel : 0 2920 1458-9 Fax : 0 2920 1460 E-mail : met_jj@yahoo.com

PM10 HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Sampler Location				Date	March 31, 2024
โรงเรียนเทศบาลดอนหัวฬ่อ 1				Start Time	2:00 PM
Sampler Number	PM-10 No.6	Transfer Standard Type	Onifice	Stop Time	2:05 PM
Motor Serial Number	HVL-06	Calibrator Model	TE-5025A	Person	
Recorder Serial Number	-	Calibrator Serial Number	1		

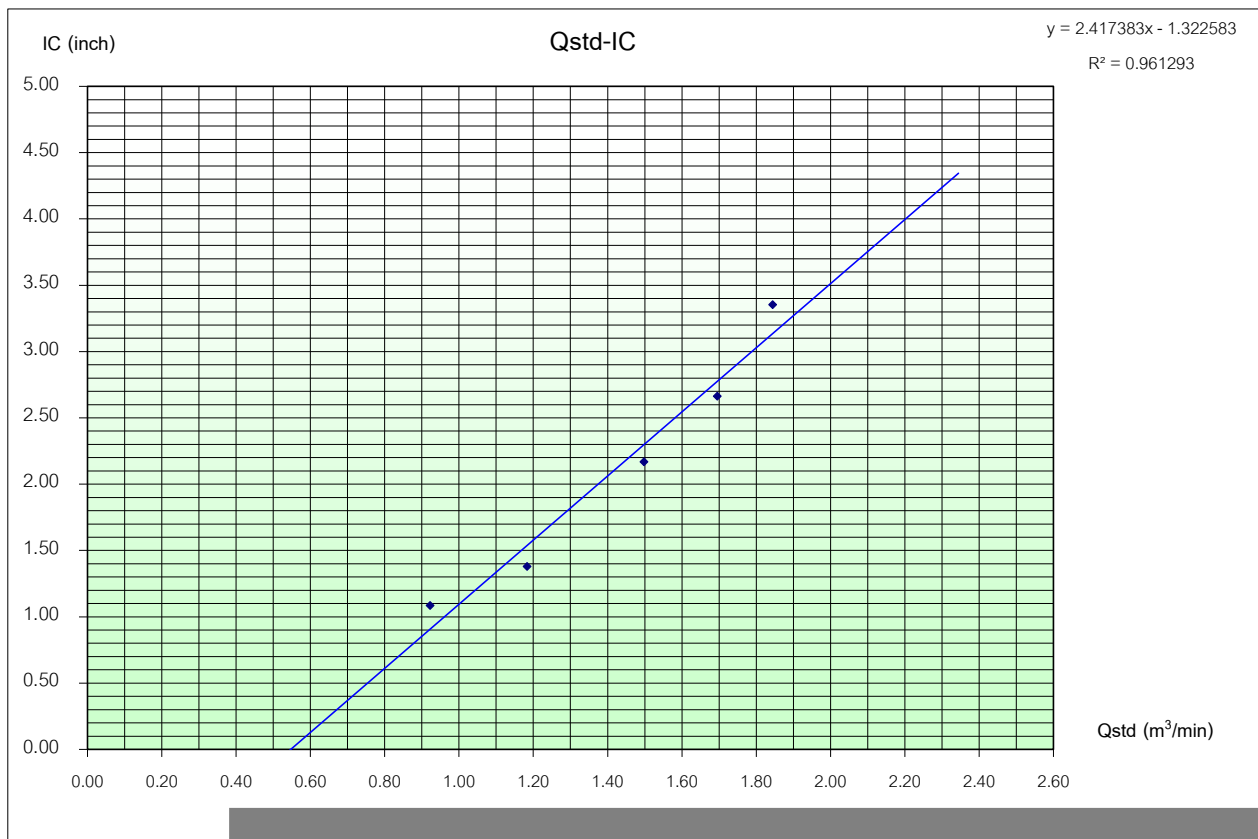
Plate No.	(Delta H)			(A)	(X)	(I)	(Y)	Temperature	Barometric Pressure	Start Meter	Stop Meter
	Positive	Negative	ΔH_2O	$[\Delta H_2O(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	Sample Flow Rate Indication (inch)	$IC = I[(Pa/P_{std})(T_{std}/T_a)]^{1/2}$	(°K = °C+273)	(mmHg)		
5	1.6	1.7	3.3	1.79208	0.92208	1.1	1.09	305.0	757.0		
7	2.7	2.7	5.4	2.29243	1.18357	1.4	1.38	305.0	757.0		
10	4.3	4.3	8.6	2.89300	1.49744	2.2	2.17	305.0	757.0		
13	5.5	5.5	11.0	3.27187	1.69544	2.7	2.66	305.0	757.0		
18	6.5	6.5	13.0	3.55689	1.84440	3.4	3.35	305.0	757.0		

Linear Regression Y ON X : Y= mX + b

1	Slope (m)	1.91345	Linear Equation			r^2	0.997347	Pstd(mmHg)	760.0
2	Intercept (b)	0.02773	Set Point Flow Rate (X) (m ³ /min)	1.133		r	0.99867262	T _{NTP}	298.0
3	Correlation Coefficient (r)	0.99995	Final Set Flow Rate = (I)		0	(Pa/Pstd)*(Tstd/Ta)		0.973192407	
Result						C=(Pa/Pstd)*(Tstd/Ta)^0.5		0.986505148	

COMMENT

Andersen Instruments, Inc.



Calibrate

Field Environmental

Division Manager

Analyzer Performance Test

Calibrated Date: .. March 2024

Instruments Information

Analyzer Type: NO/NO2/NOx Analyzer Model: 42C	Manufacturer Thermo Environmental S/N: 42C-33500-371
--	---

Calibration System

Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API Model 701 S/N: 1924	NO Conc 55.47 PPM SO2 Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

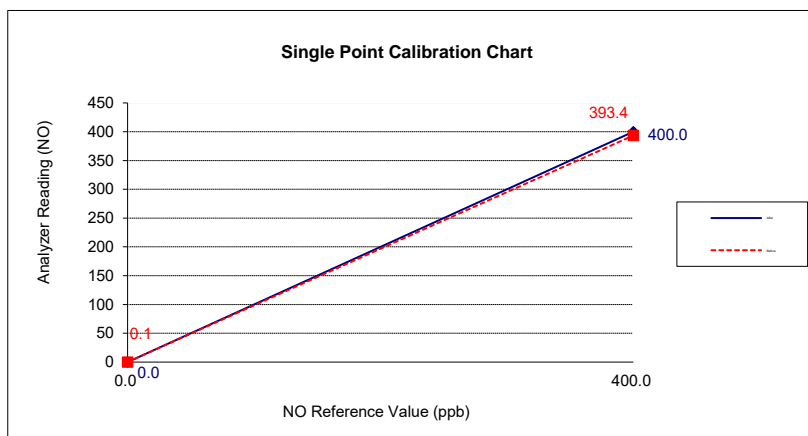
Humidity: 51 %RH

Calibration Check (Before adjust)

GAS	Zero			Span		
	Reading Value (ppb)	Expected Value (ppb)	Drift (ppb)	Reading Value (ppb)	Expected Value (ppb)	Drift%
NO	0.1	0.0	0.1	393.4	400.0	-1.7
NOx	0.1	0.0	0.1	396.7	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	0.0	0.0	0.0	400.0	400.0	0.0
NOx	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By



บริษัท เอ็นไวร์ เซอร์วิส จำกัด

บริษัท เอ็นไวร์ เซอร์วิส จำกัด
ENVIR SERVICE CO., LTD.

42 รามอินทรา 14 แยก 9 แขวงท่าแร้ง เขตบางเขน กรุงเทพฯ 10230 โทรศัพท์ 02-9435814-5 โทรสาร 02-9438201

42 Raminthra 14 yeak 9, Tha Rang, Bangkhen, Bankok 10230 Tel : 02-9435814-5 Fax : 02-9438201

Analyzer Performance Test

Calibrated Date: 31 March 2024

Instruments Information

Analyzer Type: SO2 Analyzer Model: 43C	Manufacturer Thermo Environmental S/N: 43C-33500-719
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Calibration System

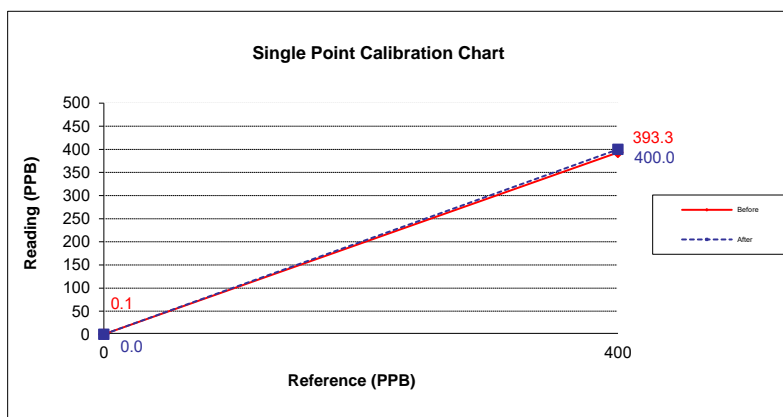
Calibrator Unit	Standard Gas
Dilutor Model Dasibi Model 5008 S/N: 705 ZERO AIR Generator API MODEL 701 S/N: 1924	NO Conc 55.47 PPM SO2 Conc 55.11 PPM CO Conc 4,535 PPM Cylinder number EB0129027 Expire Date: 29 Oct. 2027

Environment: Temperature 25.5 °C

Humidity: 51 %RH

Calibration Report

Status	Zero			Span		
	Reference (PPB)	Reading (PPB)	Drift (PPB)	Reference (PPB)	Reading (PPB)	Drift%
Before	0.0	0.1	0.1	400.0	393.3	-1.7
After	0.0	0.0	0.0	400.0	400.0	0.0



Calibrate By :



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 : 11 March, 2024

Certification No. 112/24

Page : 1 of 2

Object : Weather Station

Manufacturer : Davis Instruments

Type : Weather Monitor III

Serial No. : WC60322A19A

Customer : M E T Company Limited.
36/659 Moo 6 Bangrak Phthana,
Bang Bua Thong, Nonthaburi 11110.

Calibration Condition : Temperature 25.1 °C Barometric Pressure 1012.5 hPa

NATIONAL STANDARD WIND TUNNEL :

: Micromanometer Theodor Friedrichs FC014 Serial No. 9310119

: HOOK GAGE NO 1425 Pitot Tube Theodor Friedrichs Type 0800.0000 serial 9023

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

Mechanical Engineer



THAI METEOROLOGICAL DEPARTMENT

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

The Result of Calibration

Certification No. 112/24

11 March, 2024

Page : 2 of 2

Standard Ultrasonic Anemometer m/sec	HOOK GAGE NO. 1425			TESTED ANEMOMETER	
	Pressure	Vacumm	Velocity	Velocity	Correction
	inches H2O	inches H2O	m/sec	m/sec	m/sec
1.00	-	-	-	0.9	0.10
3.02	-	-	-	2.7	0.32
5.00	-	-	-	4.9	0.10
7.00	-	-	-	6.7	0.30
9.02	-	-	-	9.0	0.02
11.01	-	-	-	10.7	0.31
13.01	-	-	-	13.0	0.01
15.01	-	-	-	14.9	0.11
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	90
180	180
270	270

THAI METEOROLOGICAL DEPT.

Certificate of Calibration

Certificate No. : 66-400619-1

Page : 1 of 2

Submitted by : MET Company Limited

36/659 Moo 6, T. Bangrakpattana, A. Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Refrigerator)

Manufacturer : Sanden Intercool

Model : SRC-680SRTM

Range : N/A °C

Resolution : 1 °C

Serial No. : SRC680201-1107-00165

ID No. : MET-RE 01/54

Environment : On site calibration was carried out at the Laboratory, MET Company Limited

Ambient Temperature : (29.0 to 30.0) °C

Relative Humidity : (55 to 60) %

Line Voltage : (226.5 to 228.2) V

Date of Received : 07 November 2023

Date of Calibration : 07 November 2023

Date of Issue : 11 November 2023

Calibrated by :

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

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

ID No.	Cert. No.	Due Date	Traceability
400046 & 400042	66-400453-1	31 Jan 2024	National Institute of Metrology Thailand (NIMT)

Approved by

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 66-400619-1

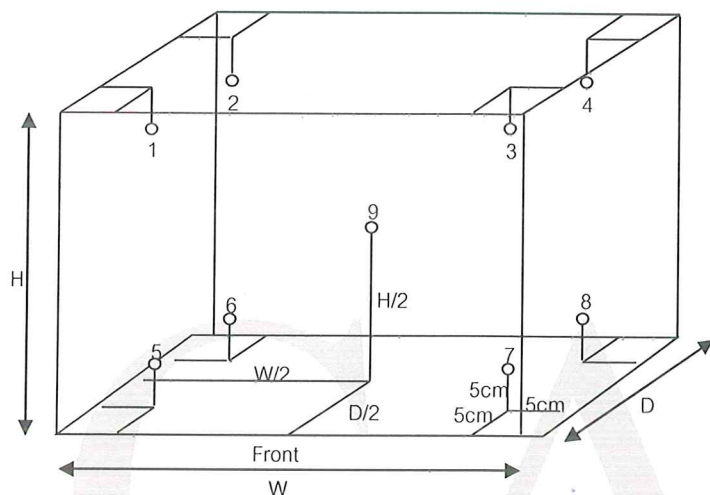
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

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



Inside of Chamber

W = 0.58 m

D = 0.60 m

H = 1.35 m

Capacity = 0.47 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
3	2	2	3.84	3.95	3.07	3.10	3.47	3.74	3.67	3.90	2.93	0.75

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
3	2	2	1.09	0.17	1.31

Remark The uncertainty is not combine uniformity of the air chamber

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

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

- o0o -



Certificate of Calibration

Certificate No. : 66-200271-1

Page : 1 of 2

Submitted by : M E T Company Limited
36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Electronic Balance
Manufacturer : Sartorius Model : BSA224S-CW
Serial No. : 35090472 ID No. : MET-EB 02/60
Capacity : 220 g Resolution : 0.0001 g

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited
Ambient Temperature : (25.0 to 25.6) °C
Relative Humidity : (52.3 to 55.6) %
Air Pressure : 1005.0 mbar

Date of Received : 23 August 2023

Date of Calibration : 23 August 2023

Date of Issue : 25 August 2023

Calibrated by :

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

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

Standard Weights

ID No.	Cert. No.	Due Date	Traceability
E261-E2624	C0222345	10 Nov 2023	National Institute of Metrology (Thailand), (NIMT)

Approved by :

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 66-200271-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Departure of indication from nominal value

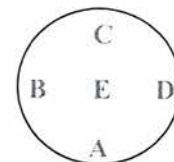
Nominal Value (g)	Correction (g)	Uncertainty \pm (g)
0.05	0.0000	0.00011
0.1	0.0000	0.00011
0.5	0.0001	0.00011
1	0.0000	0.00011
5	0.0000	0.00011
10	0.0001	0.00012
50	0.0001	0.00014
100	0.0001	0.00020
150	0.0001	0.00038
200	0.0000	0.00038

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 multiplied by a coverage factor $k = 2.11$, providing a level of confidence of approximately 95%

Eccentric error Load test : 50 g

A	B	C	D	E	
0.0001	0.0001	0.0001	0.0001	0.0000	g



Repeatability Load test : 200 g

Stdev. : 0.00005 g

- o0o -



Certificate of Calibration

Certificate No. : 66-400618-1

Page : 1 of 2

Submitted by : M E T Company Limited
36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Digital Thermometer with Thermistor Probe
Temperature Indicator
Manufacturer : Hanna Model : HI8424
Range : N/A °C Resolution : 0.1 °C
Serial No. : 06190028101 ID No. : MET-pH09/64
Thermistor Probe
Model : HI7662 Sheath Material : Stainless
Diameter : 3 mm. Length : 115 mm.
Serial No. : 0815071N ID No. : MET-pH09/64

Environment : On site calibration was carried out at the Laboratoty, M E T Company Limited

Ambient Temperature : (24.8 to 25.7) °C

Relative Humidity : (55 to 60) %

Line Voltage : (224.5 to 225.0) VAC

Date of Received : 07 November 2023

Date of Calibration : 07 November 2023

Date of Issue : 11 November 2023

Calibrated by :

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4003 by compared with PRT in the dry-well calibrator at the constant controlled temperature.

The temperature scale used was based on ITS-90

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

1. Platinum Resistance Thermometer (PRT)

ID No.	Cert. No.	Due Date	Traceability
400002	TT-0074-22	20 Jun 2024	National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400033	22E569	22 Feb 2024	National Institute of Metrology Thailand (NIMT)

Approved by

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 66-400618-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

Immersion Depth (mm.)	Standard Reading (° C)	UUC Reading (° C)	Correction (° C)	Uncertainty (± ° C)
115	10.005	10.0	0.0	0.19
115	30.003	30.0	0.0	0.19
115	50.006	50.0	0.0	0.19

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%

- ๐0๐ -



Certificate of Calibration

Certificate No. : 66-400476-1

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Oven)

Manufacturer : Memmert

Model : UM 100

Range : N/A °C

Resolution : 0.1 °C

Serial No. : b197.0985

ID No. : MET-OV01/46

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (31.0 to 32.0) °C

Relative Humidity : (55 to 60) %

Line Voltage : (210.0 to 210.8) V

Date of Received : 23 August 2023

Date of Calibration : 23 August 2023

Date of Issue : 23 August 2023

Calibrated by :

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

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

Standard Digital Thermometer with Thermocouple probe

ID No.	Cert. No.	Due Date	Traceability
400029 & 400032	66-400228-1	25 Oct 2023	National Institute of Metrology Thailand (NIMT)

Approved by

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 66-400476-1

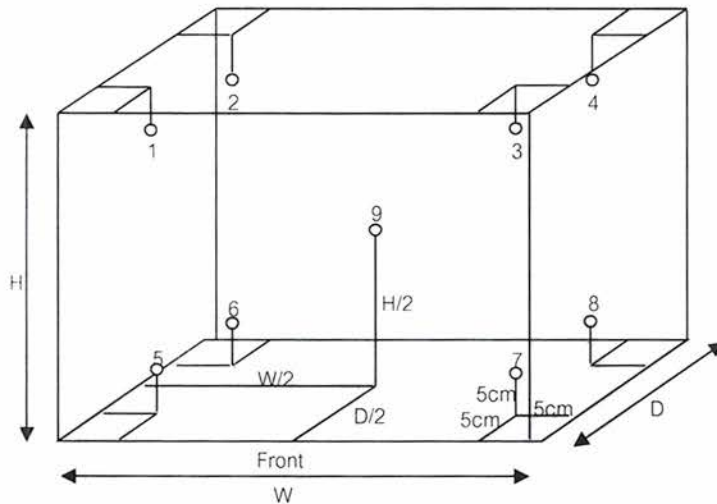
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

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



Inside of Chamber

W = 0.32 m

D = 0.18 m

H = 0.24 m

Capacity = 0.01 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
180.0	180.0	180.0	181.7	180.1	180.5	180.7	181.5	181.7	181.3	181.4	180.1	0.95

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
180.0	180.0	180.0	1.7	0.2	2.0

Remark The uncertainty is not combine uniformity of the air chamber

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

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

- o0o -



Certificate of Calibration

Certificate No. : 66-400476-2

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Oven)

Manufacturer : Binder

Model : ED53

Range : N/A °C

Resolution : 1 °C

Serial No. : 13-07419

ID No. : MET-OV02/57

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (31.0 to 32.0) °C

Relative Humidity : (55 to 60) %

Line Voltage : (210.0 to 210.8) V

Date of Received : 23 August 2023

Date of Calibration : 23 August 2023

Date of Issue : 23 August 2023

Calibrated by :

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

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

Standard Digital Thermometer with Thermocouple probe

ID No.

Cert. No.

Due Date

Traceability

400029 & 400030 66-400227-1

24 Oct 2023

National Institute of Metrology Thailand (NIMT)

Approved by :

Supervisor

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 66-400476-2

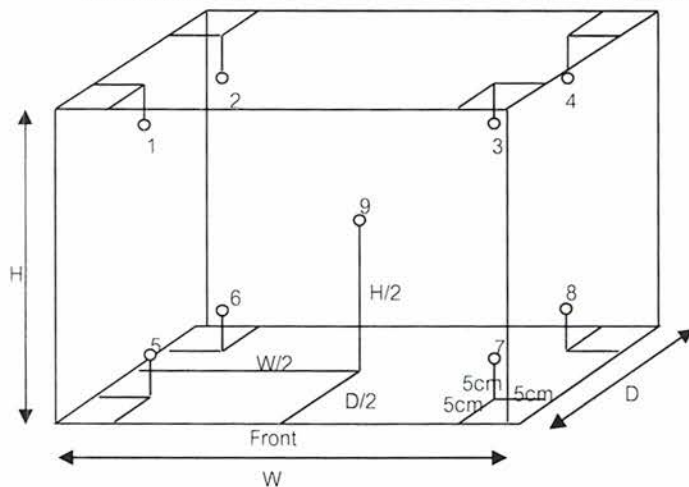
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

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



Inside of Chamber

W = 0.40 m

D = 0.33 m

H = 0.40 m

Capacity = 0.05 m³

Test Point (° C)	Setting Temperature (° C)	Indicating Temperature (° C)	Measured Temperature (° C) @ Sensor No.									Uncertainty (± ° C)
			1	2	3	4	5	6	7	8	9	
104	110	110	105.0	105.0	105.0	104.9	103.9	103.9	104.2	104.2	104.2	0.94
180	184	184	180.1	181.9	180.8	179.7	180.2	180.8	180.7	180.8	180.2	1.2

Test Point (° C)	Setting Temperature (° C)	Indicating Temperature (° C)	Measured Uniformity (° C)	Measured Stability (° C)	Overall Variation (° C)
104	110	110	1.0	0.2	1.3
180	184	184	1.9	0.3	2.7

Remark The uncertainty is not combine uniformity of the air chamber

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

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

- o0o -



Certificate of Calibration

Certificate No. : 66-400691-1

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T.Bangrakpattana, A.Bangbuatong, Nonthaburi 11110

Equipment : Air Chamber (Incubator)

Manufacturer : M-LAB

Model : BIC-140

Range : N/A °C

Resolution : 0.1 °C

Serial No. : 1022

ID No. : MET-BI02/64

Environment : On site calibration was carried out at the Laboratory, M E T Company Limited

Ambient Temperature : (24.0 to 25.0) °C

Relative Humidity : (50.0 to 55) %

Line Voltage : (225.0 to 226.0) V

Date of Received : 19 December 2023

Date of Calibration : 19 December 2023

Date of Issue : 23 December 2023

Calibrated by :

Calibration Method : CAL-M4004, TLAS G-20

The temperature scale used was based on ITS-90

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

ID No.	Cert. No.	Due Date	Traceability
400046 & 400042	66-400453-1	31 Jan 2024	National Institute of Metrology Thailand (NIMT)

Approved by

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

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Certificate of Calibration

Certificate No. : 66-400691-1

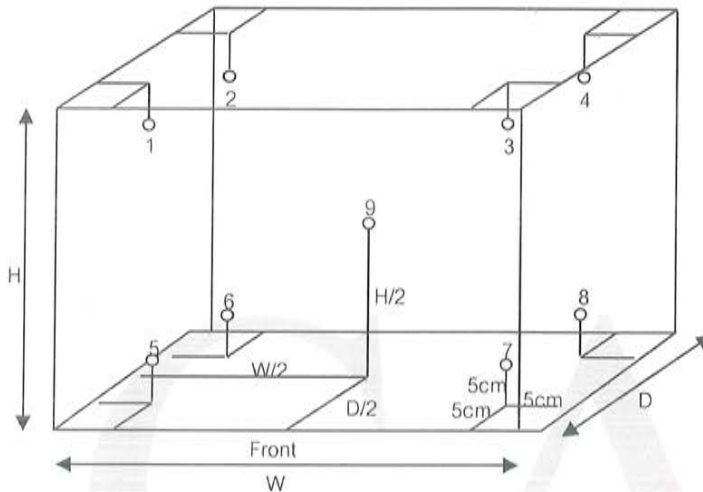
Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement

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



Inside of Chamber

W = 0.37 m

D = 0.33 m

H = 1.14 m

Capacity = 0.14 m³

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Temperature (°C) @ Sensor No.									Uncertainty (± °C)
			1	2	3	4	5	6	7	8	9	
20.0	20.0	20.0	20.12	19.96	20.01	19.96	20.37	20.33	20.07	20.21	20.44	0.32

Test Point (°C)	Setting Temperature (°C)	Indicating Temperature (°C)	Measured Uniformity (°C)	Measured Stability (°C)	Overall Variation (°C)
20.0	20.0	20.0	0.51	0.04	0.53

Remark The uncertainty is not combine uniformity of the air chamber

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

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

- o0o -



Calibration Certificate

Cert. No. : CT-23-10-23746

Page : 1 of 4

Issued date : 18/10/2023

Equipment : COD Reactor , Manufacturer : MLAB , Model : DB1602
S/N = 0169 , Customer ID = -

Client : M E T COMPANY LIMITED.

36/659 M.6 Bang Rak Phatthana, Bang Bua Thong, Nonthaburi 11110

Received Date : 10 October 2023

Ref. Job No. : SO6610-00020

Calibrate by :

Cert. prepare by :

Calibrated Date : 10 October 2023

Approved by :

Calibration Place : Laboratory of Metrology Technical Co.,Ltd.

Environment Condition : Temperature 26.2 ± 0.8 (°c) , Humidity 65.5 ± 7.5 (%RH)

Calibration Method : Measure temperature distribution by 9 channel in flat level. , (MTEC WI No. # WICAL-02-005-R01)

Reference Standard Instrument :

No	Instrument	code	Model	Due date
1	Temperature Datalogger	MTEC-CE-0180	MLAB	10/2023
2	Thermo Hygrometer	MTEC-CE-0181	TP-50	06/2024

Condition of certificate :

(1) This certificate is traceable to International System of units (SI Units). , (2) This certificate was certified only for the instrument we calibrated. , (3) This result of calibration was found accurate as show on date and place of calibration only. , (4) The reported uncertainty of measurement was based on a standard uncertainty multiplied by a coverage factor $k =$ (see result table) , providing a level of confidence of approximately 95%. , (5) This certificate may not be reproduced other than in full, except with the prior written approval of the head of Calibration Division, Metrology Technical Co.,Ltd.

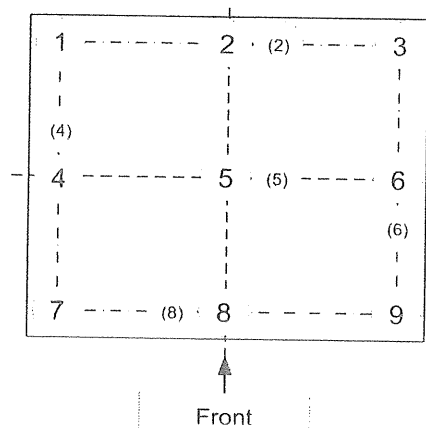
Certificate No. : CT-23-10-23746

Calibration Result :

Page : 2 of 4

Condition of UUC :

- 1) Without Adjustment
- 2) Immersion : 1/2 of the depth of the hole



- (1) The quoted uncertainty include with 'Stability'.
- (2) Stability = One-half of the greatest maximum difference of measured temperatures at any one sensors , for at least half an hour after reaching stesd state.
- (3) Uniformity = The maximum difference of measured temperatures at any sensors and the measured temperature at the reference location which are observed at the same time.
- (4) Overall variation = The difference of the maximum and the minimum measured temperature throughtout observation time.

Pic 1 : Position of each sensor No.

Section 1 : Report of Temperature distribution

Unit : (°c)

Calibration Point	UUC Setting ^(*)	UUC Reading ^(*)	Measured Temperature @ Sensor No.									Uncertainty (±)	k ^(**)
			#1	#2	#3	#4	#5	#6	#7	#8	#9		
150	150	150	150.54	149.65	150.55	150.08	150.75	151.00	149.50	150.35	149.95	0.637	2

(*) = The average of 30 values in each point , (**) = Coverage factor (k) value

Section 2 : Report of Chamber Performance

Unit : (°c)

Calibration Point	UUC Setting	UUC Reading ^(*)	Temperature Uniformity	Temperature Stability (± °c)	Temperature Overall Variation
150	150	150	1.11	0.05	1.61

(*) = The average of 30 values in each point

Approved Signatory :

Certificate No. : CT-23-10-23746

Page : 3 of 4

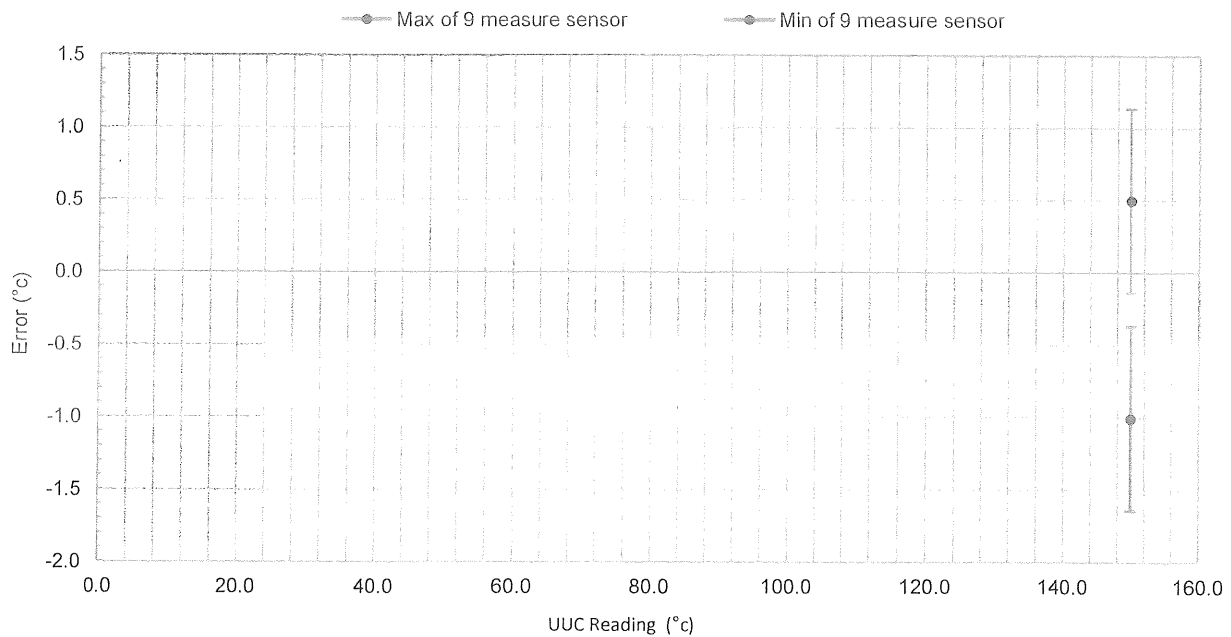
Section 3 : Possible of temperature. Show minimum and maximum of the average values and Include with uncertainty of measurement. The average values is average of each position standard sensor throughout observation time.

Unit : (°c)

Calibration Point	UUC Setting (*)	UUC Reading (*)	Possible of Minimum temperature	Possible of Maximum temperature
150	150	150	148.86	151.64

(*) = The average of 30 values in each point

Section 4 : Trend of accuracy



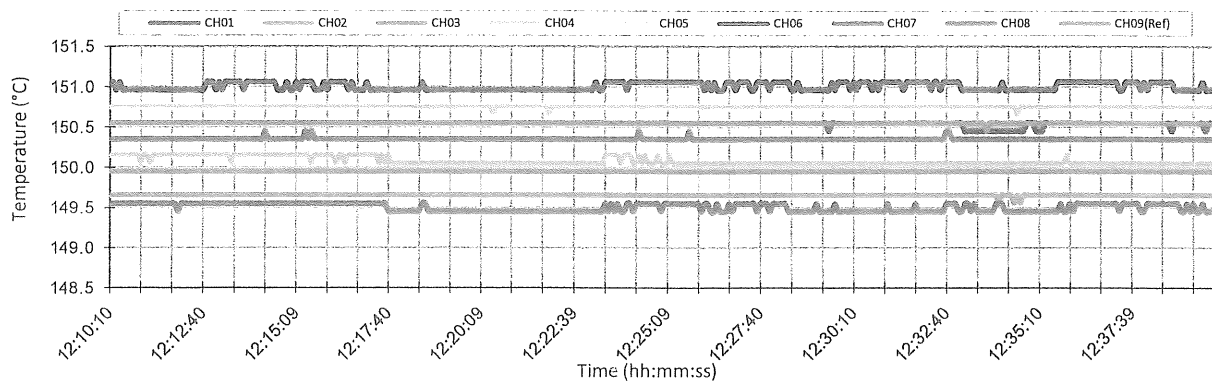
Approved Signatory : ...

Certificate No. : CT-23-10-23746

Page : 4 of 4

Section 5 : Graph report for Temperature distribution , not include uncertainty of measurement

(5.1) Temperature Distribution at UUC Reading 150 °C



Approved Signatory : ..

Packing List

Unit : K-446 Kjeldigester standard



151111112791000281006111

Serial Number 1000281006

Page 1(1)

Item	Pieces	Description		
11059833	1.0000	Packing parts Kjeldigester K-446/K-449 Beipackteile K-446/K-449		✓ OK
037377	5.0000	Sample tubes 300 ml (set of 4) Probengläser 300 ml (Set à 4 Stück)		✓ OK
11059754	1.0000	Rack 20 cpl. Rack 20 kpl.		✓ OK
11058955	1.0000	Aspiration device Kjeldigester K-446/K-449 cpl. Absaugeinheit K-446/K-449		✓ OK
040444	1.0000	Weighing boat 20pcs. Wägeschiffchen 20 Stk.		✓ OK
010020	1.0000	Power cable type USA, 3 pole 120V Anschlusskabel USA W 120V		✓ OK
11058825	1.0000	Fume collection tube with ball joint Dampfsammelrohr mit Kugelschliff		✓ OK
11592548	1.0000	Kjeldahl Practice Guide en Kjeldahl Practice Guide en		✓ OK
11593546	1.0000	Operation Manual K-446/K-449 english Bedienungsanleitung K-446/K-449 englisch		✓ OK
11593635	1.0000	Supplemantary sheet Kjeldigester K-446/K-449 Beiblatt K-446/K-449		✓ OK

Packed by





BUCHI Certificate Final Test Inspection

Unit : BÜCHI Kjeldigester K-446

Serial number 1000281006

Examination Procedure

1. **Visual control of the glass parts and the unit**

✓ OK

- No scratches on the coated surface
- Mounted in accordance to the specific drawing

2. **Security tests**

✓ OK

- High voltage test in accordance with EN 61010-1 (IEC 1010)
- Ground connection test in accordance with EN 61010-1 (IEC 1010)

3. **Functional tests**

Operating panel

✓ OK

- All buttons are working
- Cooling system is working after the instrument has been switched on

Connector plugs

✓ OK

- Scrubber connector is working

Heating element

✓ OK

- Heating-up temperature 420 °C is reached after 40 minutes
- Temperature calibration at 420 °C (3 measuring points)

4. **Completeness of order checked**

✓ OK

BÜCHI Labortechnik AG hereby declares that this unit is in accordance with the specifications



Packing List

Unit : K-415 TripleScrub 230V










151111112781000281005111

Serial Number

1000281005

Page 1(1)

Item	Pieces	Description		
11057332	1.0000	Tray for adsorption storage Ablage für Adsorption		✓ OK
048355	1.0000	Silicone hose D6/9 L=3m Silikonschlauch D6/9 L=3.0m		✓ OK
033701	1.0000	Glass wool 30g Glaswolle 30g		✓ OK
028737	2.0000	Hose clamp Anschlussklemme		✓ OK
11064971	1.0000	Activated Charcoal 2-6mm, 150g Aktivkohle 2-6mm, 150g		✓ OK
010020	1.0000	Power cable type USA, 3 pole 120V Anschlusskabel USA W 120V		✓ OK
11593505	1.0000	Operation Manual K-415 english Bedienungsanleitung K-415 englisch		✓ OK

Packed by





BUCHI Certificate Final Test Inspection

Unit : BÜCHI Scrubber K-415

Serial number 1000281005

Examination Procedure

1. **Visual control of the glass parts and the unit**

✓ OK

- No scratches or splinters on the glass parts
- Mounted in accordance to the specific drawing

2. **Security tests**

✓ OK

- High voltage test in accordance with EN 61010-1 (IEC 1010)
- Ground connection test in accordance with EN 61010-1 (IEC 1010)

3. **Functional tests**

Vacuum test

✓ OK

- Bypass valve open: Pressure is 0 - 65 mbar below the atmospheric pressure
- Bypass valve closed: Pressure is 400 mbar (+/- 10 %) below the atmospheric pressure

4. **Completeness of order checked**

✓ OK

BÜCHI Labortechnik AG hereby declares that this unit is in accordance with the specifications



Packing List

Unit : K-360 Plastik Basic









151111113001000281014111

Serial Number

1000281014

Page 1(1)

Item	Pieces	Description		
043410	3.0000	Canister 10L thin-walled Kanister 10L dünnwandig		✓ OK
043603	1.0000	Packing parts K-360 Beipackteile K-360		✓ OK
047871	1.0000	Suppl. sheet distillation unit Beiblatt Distillation Unit		✓ OK
010020	1.0000	Power cable type USA, 3 pole 120V Anschlusskabel USA W 120V		✓ OK
11592548	1.0000	Kjeldahl Practice Guide en Kjeldahl Practice Guide en		✓ OK
093176	1.0000	Operation Manual K-360 english Bedienungsanleitung K-360 englisch		✓ OK

Packed by





BUCHI Certificate Final Test Inspection

Unit : BÜCHI BÜCHI Kjelflex K-360

Serial number 1000281014

Examination Procedure

1. **Visual control of the glass parts and the unit**

✓ OK

- No scratches on the coated surface or splinters on the glass parts
- Mounted in accordance to the specific drawing

2. **Security tests**

✓ OK

- High voltage test in accordance with EN 61010-1:2002 (IEC 61010-1, VDE 0411)
- Ground connection test in accordance with EN 61010-1:2002 (IEC 61010-1, VDE 0411)
- Safety door sensor checked

3. **Functional tests**

✓ OK

Electronics

- Electronic modul is tested with the checking device PG157
- Connector plugs are working

Operating panel

✓ OK

- Display is working
- All buttons of the keypad are working

Pump testing

✓ OK

- All pumps are working
- All pumps (exception: water pump of the steam generator) are precalibrated

Valve testing

✓ OK

- All valves are working

Steam generator testing

✓ OK

- The steam generator is filled with water
- The steam generator valve is working
- The amount of distillate corresponds to specifications

Further testing

✓ OK

- Beeper is working

4. **Unit configuration and completeness of order checked**

✓ OK

BÜCHI Labortechnik AG hereby declares that this unit is in accordance with the specifications



Optima8000 Preventive Maintenance Report

Company Name: MET Company Limited.

Instrument Location: 36 659 Soi Mu Ban Monwadi Park 6,
Bang Rak Phatthana, Bang Bua Thong District, Nonthaburi 11110

Instrument Serial No.: 078S1407053C

Date: 20-Dec-2023

ICP-OES/Optima8000 Preventive Maintenance (PM)

Company Name:	MET Company Limited.		
Address (Instrument Location):	Bang Rak Phatthana, Bang Bua Thong District, Nonthaburi 11110		
Serial Number:	078S1407053C	PM Number:	1 of 2
Customer Name (if applicable):		Telephone Number:	065 850 0726
Service Engineer Name:		Service Order Number:	WO-02461909
Date PM Performed: (DD-MMM-YYYY)	20-Dec-2023	Next PM Due Date: (DD-MMM-YYYY)	20-Jun-2024
Standard Labor Hours to Complete PM :		4 hours	

Part Number	Release	Publication Date	
09370140 Rev.5	A	January 2018	

Scope

The purpose of this PM is to ensure the continued functionality of the PerkinElmer/Optima8000 by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The customer should save their method before the PM begins.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files. The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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Component List

Component / Specific Model	Serial #	Configuration Notes
Optima8000	078S1407053C	Winlab V 5.5.0.0714
S10 Autosampler		

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
09995098	Air Filter-Spectrometer	1
N077520	Air Filter-RF Generator	1
09992731	Axial Window	1
B0810377	Radial Window	1
N0770438	O-ring kit, injector support adapter	1
N0780437	O-ring kit, torch	1

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date: (MM/YY)
N0691579	Multi-Element Standard (N069-1579 diluted 10X)	1	59-091CRY1	06/24
N9300221	Instrument Calibration-4 (N9300221 diluted 100X)	1	8-038MFX1	06/24

Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

1. General:

- ✓ Ask customer about unit's performance since last visit.
- ✓ Check incoming AC line voltage under load for proper levels and grounding.
- ✓ Is the instrument operational?

2. Mechanical:

- ✓ Inspect and clean all fans and filters.
- ✓ Inspect and replace torch components and necessary.

Torch Components Replaced: ☐ Yes ☒ No

If yes, list components replaced:

- ✓ Inspect all tubing for signs of cracking or leaking and replace as necessary.

Tubing Replaced: ☒ Yes ☐ No

If yes, list tubing replaced:

- ✓ Inspect the peristaltic pump for proper operation.
- ✓ Check and adjust if necessary, the external nitrogen, argon shear gas and water supply pressures.
- ✓ Check and adjust if necessary, the internal nitrogen, main argon, torch argon and shear gas pressures

Regulator	Measured Pressure	Set Pressure
Nitrogen	N/A	NA (calibrated in Factory)
Main Argon	76	76psig
Torch Argon	67	67psig
Shear Gas	65	65psig
Water	35	35psi

- ✓ Check the shear gas nozzle for blockages and proper, uniform flow.
- ✓ Inspect nitrogen Hi/Low purge and shear gas solenoids for proper function.
- ✓ Inspect the function of all spectrometer motors. Drive the motors from the Spectrometer DCM. Check all motors, couplings, set screws, gears or drive assembly located on the spectrometer (prism/grating wavelength drives, slits, shutter, DV mirror, X/Y mirror) if problems are found.
- ✓ Perform preventative maintenance on the chiller as required. Make the customer aware of the importance of maintaining the chiller fluid level and filter replacement.
- ✓ Drain air compressor surge tank.
- ✓ Clean exterior of instrument.

3. Electrical:

- ☒ Visually inspect all PC boards for cleanliness and signs of corrosion.
 - ☒ Check all RF generator and spectrometer power supply voltages.
 - ☒ Run instrument diagnostic checks from the appropriate Device Control Module.

RF Generator:

- ☒ Check the RF generator status screens.
- ☒ Check the function of all interlocks.

Spectrometer:

- ☒ Check the spectrometer status screens.
- ☒ Check for proper function of all motors from the Motor Control window.

4. Optical:

- ☒ Check the neon lamp for proper operation.
- ☒ Ensure that neon initialization passes at power up.
- ☒ Ensure that there is a single, well defined peak of sufficient intensity (approximately 15,000 to 60,000 cts.) for the 703.241nm neon line viewed in the DCM Collect Spectra window. Re-generate the neon correction table if problems are encountered. If problems are still exhibited after the table is re-generated, replace the neon lamp assembly.

Neon Lamp Replaced: ☐Yes ☒No

- ☒ Perform the Initialize Optics routine from the Spectrometer Control window.
- ☒ Insure that the routine passes with no error codes. If it fails, run a manual prism scan from the spectrometer DCM.
- ☒ Insure the Dark Current measurement (Detector Calibration) passes at initialization.
- ☒ Check the shutter home sensor position.
- ☒ Check prism/electronics temperature sensor readback values from the DCM. It is normal for these readings to be shown in red. A typical prism temperature is approximately 29.5 degree C. A typical electronics temperature is approximately 35 degree C.
- ☒ Check the detector temperature from the DCM for -7.0 to -8.5 degree C. If outside of this range the detector cooling fan may not be operational. Further inspection may be necessary.
- ☒ Inspect for proper function of the transfer optics. 1) shutter 2) DV mirror 3) X/Y mirror.
- ☒ Clean or replace the axial and radial view windows as necessary.

Axial Window Replaced: ☒Yes ☐No
Radial Window Replaced: ☒Yes ☐No

5. Post PM Performance Tests:

- ☒ Perform View Align.

5.1 Spectral Resolution:

- ☒ Measure the spectrometers ability to separate two adjacent wavelengths.

Parameter	Specification	Test Result	Pass/Fail
As 193.696 - Resolution	≤0.009	0.00686	Passed
Ni 231.604 - Resolution	≤0.011	0.00880	Passed
Ni 341.476 - Resolution	≤0.015	0.01205	Passed
Ba 455.403 - Resolution	≤0.020	0.01530	Passed

5.2 Precision:

- ☒ Test for reproducibility of a set of measurement.

Parameter	Specification	Test Result	Pass/Fail
Zn 213.856	%RSD \leq 1 %	0.85	Passed
Mg 280.856	%RSD \leq 1 %	0.47	Passed
Mg 285.207	%RSD \leq 1 %	0.96	Passed
Ba 455.403	%RSD \leq 1 %	0.84	Passed

5.3 Mn BEC:

- ☒ Run Axial and Radial BEC according to the A&T spec, or the commissioning test procedure.

Mn Background Equivalent Concentration:

Method "MnBEC" For Samples "IB (2%HNO3)" and "IS (N069-1579/10)", record intensities.

Calculated BEC: $BEC = (IB * Conc\ of\ Std) / (IS - IB)$. Where Conc of Std = 1,000 PPB

Element	Mode	Conc.	IB	IS	
Mn 257.610	Radial	1,000 ppb	9061.7	4200541.8	
Mn 257.610	Axial	1,000 ppb	17982.3	777080.7	
Mn 257.610	IB*Conc.	IS - IB	BEC	Spec	Pass/Fail
Radial	9061700	4182559.5	11.80	<30 PPB	Passed
Axial	17982300	768019	4.30	<30 PPB	Passed

6. Review:

- ☒ Review with the customer PM work performed.
- ☒ Discuss recommended customer supplied materials to have on hand.
- ☒ Attach PM sticker.

Additional Comments

Additional Comments Regarding the PM

This image shows a completely blank white rectangular area enclosed within a thin black frame. There are no markings, text, or illustrations present on the page.

Review

The preventive maintenance checks and if applicable performance tests for ICP-OES/Optima8000 have been completed.

This ICP-OES/Optima8000 Passes ☒ Fails ☐ the preventive maintenance.

Review of Preventive Maintenance:

Authorized PerkinElmer Representative:

Date:

20-Dec-2023

(DD-MMM-YYYY)

Authorized Customer Representative:

Date:

20-Dec-2023

(DD-MMM-YYYY)

Certificate of Calibration

Certificate No. : 66-400632-1

Page : 1 of 2

Submitted by : M E T Company Limited

36/659 Moo 6, T. Bangrakpattana, A. Bangbuatong, Nonthaburi 11110

Equipment : Digital Thermometer with Thermocouple probe Type K
Temperature Indicator

Manufacturer : Digicon

Model : DP-77

Range : N/A

Resolution : 0.1 °C

Serial No. : I.531214

ID No. : MET-TC15/64

Environment : Ambient Temperature : (23 ± 2) °C
Relative Humidity : (50 ± 15) %
Line Voltage : (220 ± 22) VAC

Date of Received : 07 November 2023

Date of Calibration : 11 November 2023

Date of Issue : 11 November 2023

Calibrated by :

Calibration Method : This instrument was calibrated by In-house method comparison technique CAL-M4003 by compared with PRT in the liquid bath at the constant controlled temperature.

The temperature scale used was based on ITS-90

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

1. Platinum Resistance Thermometer (PRT)

ID No.	Cert. No.	Due Date	Traceability
400016	TT-0053-23	15 May 2025	National Institute of Metrology Thailand (NIMT)

2. Standard Digital Thermometer

ID No.	Cert. No.	Due Date	Traceability
400003	23E1866	01 Jun 2025	National Institute of Metrology Thailand (NIMT)
400004	23E1866	01 Jun 2025	National Institute of Metrology Thailand (NIMT)

Approved by

Laboratory Manager

The Uncertainties are for a confidence probability of approximately 95%

This certificate may not be reproduced other than in full except with the prior written approval of the Calibratech Co.,Ltd.



Certificate of Calibration

Certificate No. : 66-400632-1

Page : 2 of 2

Result of Calibration : Without Adjustment

UUC Condition As-Received : Good

Function : Temperature measurement Type K

Sheath Material : Teflon ID No. : MET-TC20/65

Diameter : 1.5 mm. Length : 1000 mm.

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
130	180.0019	179.8	0.2	0.65

Sheath Material : Teflon ID No. : MET-TC26/65

Diameter : 1.5 mm. Length : 1000 mm.

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
130	180.0008	178.8	1.2	0.65

Sheath Material : Teflon ID No. : MET-TC27/65

Diameter : 1.5 mm. Length : 1000 mm.

Immersion Depth (mm.)	Standard Reading (°C)	UUC Reading (°C)	Correction (°C)	Uncertainty (± °C)
130	180.0029	179.8	0.2	0.65

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%

- 000 -



PinAAcle 900T Preventive Maintenance Report

Company Name: SPS Consulting Service Co., Ltd.

Instrument Location: 7 Soi Phaholyothin 24, Phaholyothin Rd.


Jompol, Chatuchak, Bangkok, 10900

Instrument Serial No.: PTCS14111103

Date: 29-Jun-2023

PinAAcle 900T Preventive Maintenance (PM)

Company Name:	SPS Consulting Service Co., Ltd.		
Address (Instrument Location):	7 Soi Phaholyothin 24, Phaholyothin Rd. Jompol, Bangkok, 10900		
Serial Number:	PTCS14111103	PM Number:	2/2
Customer Name (if applicable):		Telephone Number:	083-926-9252
Customer Support Engineer Name:		Service Order Number:	WO-02419478
Date PM Performed: (DD-MMM-YYYY)	29-Jun-2023	Next PM Due Date: (DD-MMM-YYYY)	29-Dec-2023
Standard Labor Hours to Complete PM :		5 hours	

Part Number	Release	Publication Date	
09370143 Rev.9	A	January 2018	

Scope

The purpose of this PM is to ensure the continued functionality of the PinAAcle 900T by inspecting and replacing any worn or damaged parts. This service should only be performed by a trained representative of PerkinElmer.

The customer should save their method before the PM begins.

General Instructions:

The customer must provide the engineer operational data to demonstrate recent instrument performance prior to starting the PM. Always check with the customer before making any changes that may affect the customer's analysis or calibration, including a current back-up of system software and/or data files. The completed document should be signed by an authorized PerkinElmer and customer representative and left with the customer. Update the PM sticker and instrument logbook as required.

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Component List

Component / Specific Model	Serial #	Configuration Notes
AS900	AS91S14B1002	Winlab32

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
B0501696	Fan Filters	N/A
B3002013	THGA Contact Cylinders	N/A
B3141064	Glycerol for THGA Cooling	N/A
N3160156	O-Ring Kits for Sampling Introduction (Stainless Steels Nebulizer)	N/A
N3160157	O-Ring Kits for Sampling Introduction (Plastic Nebulizer)	N/A
N9301714	Replacement Acetylene Filter Cartridge	N/A
TH001022	Replacement Air Filter Cartridge	N/A

Additional Reagents and Standards Required for PM				
Part Number (if applicable)	Description	Quality	Batch/Lot #	Expired Date (MM/YY)
N9300183	1000 mg/L Copper Standard	AR	26-87CUY1	30-Jan-2024
N9300244	GFAAS Mixed Standard	AR	56-21CRY1	30-Jun-2023

Additional Reagents and Standards Required for PM (Customer Support Solution)				
Part Number (if applicable)	Description	Quantity	Batch/Lot #	Expiration Date (MM/YY)
N/A	DI Water	250 ml.	AR	AR
N/A	0.5% HNO ₃	250 ml.	AR	AR

Additional Tools Required for PM			
Part Number (if applicable)	Description	Quantity	Serial #
N1013000	0.2A Neutral density filter	1	MG0-252
N1013002	1.0A Neutral density filter	1	MG2-358
B3100652 Or N9307029	Electronic Flow Meter	1	NA
B0505495	Test Jig	1	NA
03030997	System 2 EDL Driver	1	03030997
N3050605	As System 2 EDL	1	16148
N3050121	Cu Lumina HCL	1	092216-010130
N3050109	Ba Lumina HCL	1	102416-040160
N3050139	K Lumina HCL	1	110716-010060
N3050152	Ni Lumina HCL	1	100516-030190
N3050119	Cr Lumina HCL	1	091911-020150

Procedure Checklist

Use (✓) to check off those steps in the checklist that have been completed.

1. General:

- ✓ Review the instrument performance with the customer and document any recent problems.
- ✓ Inspect the customer log book and make any appropriate PM entries.
- ✓ Perform general inspection of system for cleanliness.

2. PC Instrument Software:

- ✓ Instrument Software user files/databases archived, packed, and/or deleted as needed.

3. Mechanical:

- ✓ Inspect and clean all fans and filters. Replace filters if necessary
- ✓ Inspect all gas and water lines for leaks and/or wear. Replace if needed. Thoroughly inspect all quick connects. Replace the Y connector, P/N 09921079, if needed.
- ✓ Clean exterior of the instrument.

3.1 Flame Technique

- ✓ Inspect the burner head, burner chamber, and nebulizer. Clean if needed as stated in the Hardware Guide.
- ✓ Check burner head dimensions with the feeler gauge as stated in the Hardware Guide in the Maintenance chapter section on cleaning the burner head and checking sloth width. Replace if out of specification
- ✓ Check the condition of the end cap, burner head, and nebulizer O-rings. Replace if necessary.
- ✓ Check the drain system for signs of wear. Replace worn or damaged parts.
- ✓ Visually check for proper flame conditions when igniting the Air-C₂H₂ and N₂O-C₂H₂ flames (if applicable).

3.2 THGA Technique

- ✓ Inspect the pole pieces and clean where the pole pieces contact the furnace. Replace the pole piece p-rings as needed, P/N's B0501018 & B0501250. Grease the O-rings as needed with Apiezon L grease, P/N 09905148
- ✓ Inspect the four insulation pads on the front contact housing of the THGA in furnace. If the pads are missing replace the THGA furnace or replace the insulator pads on the furnace.
- ✓ Inspect the graphite tube and clean the contact cylinders. Replace if necessary.
- ✓ Check internal and external gas flows with the Electronic Gas Flow Meter and the Gas Flow Test Probe as described in the Service Manual. Correct if necessary.
- ✓ Check furnace open/close function.
- ✓ Verify the operation of the GFTV Camera for proper operation and viewing alignment in the furnace camera Tube View window. Align if needed.
- ✓ Check the operation of the Halogen Light ASSY for the GFTV Camera. Replace if needed.
- ✓ Check the water level/quality in the recirculation (if applicable). Add distilled water if necessary.
- ✓ Check the cooling system fluid flow rate with the FCS In-Line Flow Meter for proper levels if needed. Refer to SDB# COSY008.STN

- ✓ Perform Cooling System maintenance if needed per SDB# COSY005.STN.
- ✓ Check auto sampler operation.
- ✓ Perform an auto sampler check valve test as described in the Service Manual.
- ✓ Lubricate the spindles of the auto sampler pumps and all moving parts of the tray mechanics as described in the Service Manual.
- ✓ Inspect the auto sampler sampling capillary as described in the Service Manual. Replace if necessary.

4. Electrical:

- ✓ Inspect PC boards. Clean if necessary.
- ✓ Carefully check all internal and external cable connections.
- ✓ Check instrument firmware revisions upgrade to current levels (if necessary)
- ✓ Run Diagnostics Test within the Advanced function of the Spectrometer page. Check the results in the service log folder in the Spectrometer BM Log Viewer.

5. Optics:

- ✓ Inspect and clean the sample compartment windows, if needed.
- ✓ Inspect and clean the furnace windows, if needed.
- ✓ Inspect and clean the GFTV camera lens, if needed.
- ✓ Inspect optics. Clean or replace if necessary,

6. Gasses:

- ✓ Verify that the Gasses supplied to the instrument are within the pressure and purity specifications found in the PinAAcle 900 Series Pre-installation Checklist SDB.
- ✓ Verify that the air filter element is dry. Replace if necessary.

7. Flame Interlock Check:

Description: Check to ensure that all safety interlocks are closed.

Parameter	Specification	Test Results	Pass/Fail
Flame Sensor	Air/C ₂ H ₂ Flame correctly shuts down	Active	Passed
Drain Sensor	Air/C ₂ H ₂ Flame correctly shuts down	Active	Passed
Nebulizer Sensor	Air/C ₂ H ₂ Flame correctly shuts down	Active	Passed
C ₂ H ₂ Pressure Sensor	Air/C ₂ H ₂ Flame correctly shuts down	Active	Passed
Air Pressure Sensor	Air/C ₂ H ₂ Flame correctly shuts down	Active	Passed
Burner Head Sensor	Choosing Nitrous Oxide as the oxidant should trigger an interlock shuts down	Active	Passed

8. After PM Performance tests [Flame]:

8.1 Detector Linearity with Barium

Description: Ensures that the detector is linear in the Visible Range.

Parameter	Specification	Certificate Value at 553.6 nm (Abs.)	Test Results	Pass/Fail
1.0 A ND Filter	± 5% from Cert.	0.9798	0.9877	Passed
0.2 A ND Filter	± 5% from Cert.	0.2042	0.1985	Passed

8.2 Baseline Noise at 1.0 Absorbance with Barium

Description: Ensures that a high absorbance will not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0016	Passed

8.3 AA Baseline Noise with Copper

Description: Check baseline noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.001	0.0001	Passed

8.4 D₂ Background Compensation with Copper

Description: Verifies the instruments ability to compensate for Background absorption.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.010	0.0044	Passed

8.5 AA-BG Baseline Noise with Copper

Description: Ensures that background correction does not produce excessive noise.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0001	Passed

8.6 AA-BG Baseline Noise with Arsenic

Description: Ensures that background correction does not produce excessive noise at a low wavelength.

Parameter	Specification	Results	Pass/Fail
Standard Deviation	≤ 0.005	0.0013	Passed

8.7 Flame Sensitivity

Description: Instrument Sensitivity checked against Copper standard.

Standard Copper Sensitivity	Specification	Results (Abs.)	Pass/Fail
5 mg/L Sensitivity SS Neb (if applicable)	> 0.250 Abs.	NA	Not Applicable
2 mg/L Sensitivity HS Neb (if applicable)	> 0.250 Abs.	0.3421	Passed

9. After PM Performance tests [THGA]:

9.1 Furnace Gas Flows

Description: Ensures the flow rates are within specification.

Parameter	Specification	Test Results	Pass/Fail
Internal Flow Rate	250 mL/min \pm 25 mL/min	255	Passed
External Flow Rate	100 mL/min \pm 10 mL/min	105	Passed

9.2 Chromium Baseline Noise

Description: Signal to noise check.

Parameter	Specification	Results	Pass/Fail
Baseline Noise	≤ 0.005 Abs.	0.0005	Passed
Standard Deviation	≤ 0.005	0.0004	Passed

9.3 Chromium Characteristic Mass and Precision

Description: Calculate the characteristic mass using the characteristic mass tool and precision from the integrated absorbance values.

Parameter	Specification	Results	Pass/Fail
Cr m_0 Results	≤ 7.0 pg/0.0044 A-s	5.8	Passed
Precision	≤ 2.0 %	1.18	Passed

9.4 Copper Characteristic Mass and Zeeman Ratio

Description: Calculate the characteristic mass using the characteristic mass tool and check the Zeeman Ratio.

Parameter	Specification	Results	Pass/Fail
Cu m ₀ Result	≤ 16.5 pg/0.0044 A-s	13.6	Passed
Zeeman Ratio	0.52 ± 0.04	0.52	Passed

10. Review:

- ☒ Review with the customer PM work performed.
- ☒ Review with the customer routine maintenance procedures.
- ☒ Discuss recommended customer supplied materials to have on hand.
- ☒ Attach PM sticker.

Additional Comments

Additional Comments Regarding the PM	
Zeeman Ratio	$= \frac{\text{Atomic Signal (Peak area)}}{\text{Atomic Signal (Peak area)} + \text{Background Signal (Peak area)}}$ $= \frac{0.1614}{0.1614 + 0.1448}$ $= 0.52$

Review

<i>The preventive maintenance checks and if applicable performance tests for PinAAcle 900T have been completed.</i>	
<i>This PinAAcle 900T Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.</i>	
Review of Preventive Maintenance:	
Authorized PerkinElmer Representative:	<div style="background-color: #808080; width: 150px; height: 60px; margin: 0 auto;"></div> <div style="text-align: right; padding-right: 10px;"> Date: 06-Jun-2023 <small>(DD-MMM-YYYY)</small> </div>
Authorized Customer Representative:	<div style="background-color: #808080; width: 150px; height: 60px; margin: 0 auto;"></div> <div style="text-align: right; padding-right: 10px;"> Date: 06-Jun-2023 <small>(DD-MMM-YYYY)</small> </div>



National Institute of Metrology (Thailand)

Certificate of Calibration



Certificate No. : AA-2022-23
Issued by : Acoustics Laboratory
Acoustics and Vibration Group

Page 1 of 5 pages

MEASUREMENT ITEM : Sound Calibrator
MANUFACTURER : RION
MODEL/TYPE : NC-75
SERIAL NUMBER : 34480442
CUSTOMER : MET Co., Ltd.
36/659 Moo 6, T. Bangrakphatthana,
A. Bangbuathong, Nonthaburi 11110
MEASUREMENT DATE : 25 August 2023

The reported measurement result relates only to the measurand and applies only at the time of measurement.

*The calibration results only marked with an asterisk * in this certificate are not included in the scope of accreditation.*

The reported uncertainty is based on a standard uncertainty multiplied by a coverage factor $k=2$, providing a level of confidence of approximately 95%. This calibration certificate may not be reproduced other than in full except with the permission of the Director of National Institute of Metrology (Thailand).

Reference
AUVCI32-01/23

Date
25 August 2023

Authorized Signatory

Person in charge

This certificate is consistent with the capabilities that are included in Appendix C of the MRA drawn up by the CIPM. Under the MRA, all participating institutes recognize the validity of each other's calibration and measurement certificates for the quantities, ranges and measurement uncertainties specified in Appendix C (for details see <http://www.bipm.org>).

National Institute of Metrology (Thailand)

Ministry of Higher Education, Science, Research and Innovation

3/4-5 Moo 3, Klong 5, Klong Luang, Pathumthani 12120, Thailand. Tel: (66) 2577 5100, Fax: (66) 2577 3659

75/7 Rama VI Road, Rachathewi, Bangkok 10400, Thailand. Tel: (66) 2354 3700, Fax: (66) 2354 3692



UNCERTAINTY OF MEASUREMENT

The stated uncertainty is the expanded uncertainty obtained by multiplying the standard uncertainty by the coverage factor $k=2$. It has been determined in accordance with EA publication EA-4/02 M:2013 "Evaluation of the Uncertainty of Measurement in Calibration" and JCGM 100:2008 "Evaluation of measurement data --Guide to the Expression of Uncertainty in Measurement (GUM 1995 with minor corrections)". The value of the measured lies within the assigned range of value with a probability of 95 %.

Parameter	Uncertainty at SPL94 dB	Maximum-permitted uncertainty of measurement for a coverage probability of 95%	Unit
1.Sound Pressure level	0.08	0.15	dB
2. Frequency	0.1	0.2	%
3. THD+N	0.1	0.5	%

TRACEABILITY

This certificate provides traceability of measurement to recognized national standards, and to the realization of the International System of Units (SI).



ENVIRONMENTAL CONDITIONS

Ambient condition in the laboratory are as follows :

Temperature	:	(23.0 ± 1.0)	°C
Pressure	:	(101.325 ± 1.500)	kPa
Relative Humidity	:	(50.0 ± 15.0)	%

Reference Condition : 101.325 kPa , 23.0 °C and 50.0 %RH.

Calibration Condition

Preconditionings : 16 hours at ambient conditions.

Measurement Conditions : The average values during measurement are
 (100.343 ± 0.036) kPa, (22.0 ± 0.3) °C and (53.0 ± 2.0) %RH

MEASUREMENT METHOD

The sound pressure level, frequency and total distortion of the sound calibrator was measured using the reference microphone. The insert voltage technique was employed and the measurement procedure was based on IEC 60942: 2017.

Reference Microphone

4180 serial no.1395446

TABULATION OF RESULTS

The following tables give the calibration results and associated measurement uncertainties at 95% of confidence level. The calibration results of sound pressure level which quoted in dB with reference to 20 μ Pa are corrected to the values under the reference environmental conditions.

The calibration results exclude the calibrator pressure correction but include the microphone volume correction, which was obtained from the manufacturer instruction manual of the sound calibrator, at the level of 0 dB.



MEASUREMENT RESULTS

1. Sound pressure level

Specified sound pressure level (dB)	Measured value (dB)	Deviated value ^[1] (dB)	Acceptance Limit ^[2] (dB)
Microphone 4180 Serial No.1395446			
94	94.15	0.15	± 0.25

Note ^[1] : The deviated value is the absolute value of the difference between the measured value and the corresponding specified sound pressure level.

Note ^[2] : The acceptance limit is obtained from IEC 60942: 2017.

2. Frequency*

Specified Frequency (Hz)	Measured value (Hz)	Deviated value ^[3] (%)	Acceptance Limit ^[4] (%)
At the sound pressure level of 94 dB			
1000	1000.0	0.0	± 0.7

Note ^[3] : The deviated value is the absolute value of the difference in percent between the measured value and the corresponding specified frequency.

Note ^[4] : The acceptance limit is obtained from IEC 60942: 2017.



3. Total distortion + Noise*

Microphone 4180 Serial No.1395446

Measured value ^[5] (%)	Maximum total distortion + Noise ^[6] (%)
At the sound pressure level of 94 dB	
0.2	2.5

Note ^[5] : The measured value is the total distortion, measured over the frequency range from 20 Hz to 20 kHz.

Note ^[6] : The maximum total distortion + noise is obtained from IEC 60942: 2017.

End of Certificate of Calibration

NIMT



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24010224-1

Page : 1 of 3

Customer : MET CO.,LTD.

36/659 Moo. 6 Tambol Bangragpattana, Amphur Bangbuatong,
Nonthaburi 11110

Equipment Name : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial Number : 76238

ID. Number : N/A

Environmental Conditions

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

Received Date : 15 Jan 2024

Relative Humidity : $50\text{ } \% \pm 15\text{ } \%$

Calibration Date : 17 Jan 2024

Location of Calibration : In-Lab

Recommend Due Date : 17 Jan 2025

Calibration Procedure : SP-CPE-04-01

Date of Issue : 18 Jan 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 :



Calibration Officer

Approved by :



Authorized Signatory



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24010224-1

Page : 2 of 3

Reference Standards

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

Traceability

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



ID LINE : IEC17025



Result of Calibration

Certificate Number : SPR24010224-1

Page : 3 of 3

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

- End of Certificate -



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24010224-3

Page : 1 of 3

Customer : MET CO.,LTD.

36/659 Moo. 6 Tambol Bangragpattana, Amphur Bangbuatong,
Nonthaburi 11110

Equipment Name : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial Number : 76239

ID. Number : N/A

Environmental Conditions

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

Received Date : 15 Jan 2024

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

Calibration Date : 17 Jan 2024

Location of Calibration : In-Lab

Recommend Due Date : 17 Jan 2025

Calibration Procedure : SP-CPE-04-01

Date of Issue : 18 Jan 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 :



Approved by



Authorized Signatory



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24010224-3

Page : 2 of 3

Reference Standards

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

Traceability

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



ID LINE : IEC17025



Result of Calibration

Certificate Number : SPR24010224-3

Page : 3 of 3

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

- End of Certificate -



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24010224-2

Page : 1 of 3

Customer : MET CO.,LTD.

36/659 Moo. 6 Tambol Bangragpattana, Amphur Bangbuatong,
Nonthaburi 11110

Equipment Name : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial Number : 79210

ID. Number : N/A

Environmental Conditions

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

Received Date : 15 Jan 2024

Relative Humidity : $50\text{ } \% \pm 15\text{ } \%$

Calibration Date : 17 Jan 2024

Location of Calibration : In-Lab

Recommend Due Date : 17 Jan 2025

Calibration Procedure : SP-CPE-04-01

Date of Issue : 18 Jan 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



Approved by :



Authorized Signatory



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24010224-2

Page : 2 of 3

Reference Standards

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

Traceability

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



ID LINE : IEC17025



Result of Calibration

Certificate Number : SPR24010224-2

Page : 3 of 3

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	113.9	113.9	-0.1	-0.1	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	113.8	113.8	-0.2	-0.2	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	113.8	113.8	-0.2	-0.2	0.15

Note :

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

Measurement Uncertainty

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

- End of Certificate -



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24010224-4

Page : 1 of 3

Customer : MET CO.,LTD.

36/659 Moo. 6 Tambol Bangragpattana, Amphur Bangbuatong,
Nonthaburi 11110

Equipment Name : Sound Level Meter

Manufacturer : Rion

Model : NL-21

Serial Number : 00722042

ID. Number : SLM-46

Environmental Conditions

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

Received Date : 15 Jan 2024

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

Calibration Date : 17 Jan 2024

Location of Calibration : In-Lab

Recommend Due Date : 17 Jan 2025

Calibration Procedure : SP-CPE-04-01

Date of Issue : 18 Jan 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 :



Approved by



Authorized Signatory



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24010224-4

Page : 2 of 3

Reference Standards

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

Traceability

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



ID LINE : IEC17025



Result of Calibration

Certificate Number : SPR24010224-4

Page : 3 of 3

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	113.9	113.9	-0.1	-0.1	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	113.9	113.9	-0.1	-0.1	0.15

Select F

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	113.9	113.9	-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 $k = 2.00$, providing a level of confidence approximately 95%.

- End of Certificate -



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24010224-5

Page : 1 of 3

Customer : MET CO.,LTD.

36/659 Moo. 6 Tambol Bangragpattana, Amphur Bangbuatong,
Nonthaburi 11110

Equipment Name : Sound Level Meter

Manufacturer : Rion

Model : NL-21

Serial Number : 00722043

ID. Number : SLM-45

Environmental Conditions

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

Received Date : 15 Jan 2024

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

Calibration Date : 17 Jan 2024

Location of Calibration : In-Lab

Recommend Due Date : 17 Jan 2025

Calibration Procedure : SP-CPE-04-01

Date of Issue : 18 Jan 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 :



Approved by :



Authorized Signatory



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24010224-5

Page : 2 of 3

Reference Standards

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

Traceability

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



ID LINE : IEC17025



Result of Calibration

Certificate Number : SPR24010224-5

Page : 3 of 3

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	113.9	113.9	-0.1	-0.1	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	113.9	113.9	-0.1	-0.1	0.15

Select F

Unit : dB

Standard Setting	UUC Reading		Error		Uncertainty (±)
	Fast	Slow	Fast	Slow	
94	94.0	94.0	0.0	0.0	0.15
114	113.9	113.9	-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 $k = 2.00$, providing a level of confidence approximately 95%.

- End of Certificate -



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24010268-1

Page : 1 of 3

Customer : MET CO.,LTD.

36/659 Moo. 6 Tambol Bangragpattana, Amphur Bangbuatong,
Nonthaburi 11110

Equipment Name : Noise Dose Meter

Manufacturer : Tenmars

Model : ST-130

Serial Number : 170400104

ID. Number : ND-10

Environmental Conditions

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

Received Date : 18 Jan 2024

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

Calibration Date : 22 Jan 2024

Location of Calibration : In-Lab

Recommend Due Date : 22 Jan 2025

Calibration Procedure : SP-CPE-04-01

Date of Issue : 23 Jan 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.

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Calibrated by :



Approved by :



Authorized Signatory



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24010268-1

Page : 2 of 3

Reference Standards

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

Traceability

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



ID LINE : IEC17025



Result of Calibration

Certificate No. : SPR24010268-1

Page : 3 of 3

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	113.8	113.8	-0.2	-0.2	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	113.8	113.8	-0.2	-0.2	0.15

Note :

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

Measurement Uncertainty

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

- End of Certificate -



ID LINE : IEC17025



Certificate of Calibration

Certificate Number : SPR24010268-2

Page : 1 of 3

Customer : MET CO.,LTD.

36/659 Moo. 6 Tambol Bangragpattana, Amphur Bangbuatong,
Nonthaburi 11110

Equipment Name : Noise Dose Meter

Manufacturer : Tenmars

Model : ST-130

Serial Number : 200300135

ID. Number : ND-13

Environmental Conditions

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

Received Date : 18 Jan 2024

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

Calibration Date : 22 Jan 2024

Location of Calibration : In-Lab

Recommend Due Date : 22 Jan 2025

Calibration Procedure : SP-CPE-04-01

Date of Issue : 23 Jan 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 :



Approved by :



Authorized Signatory



ID LINE : IEC17025



Calibration Report

Certificate Number : SPR24010268-2

Page : 2 of 3

Reference Standards

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

Traceability

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

TISTR - Thailand Institute of Scientific and Technological Research



ID LINE : IEC17025



Result of Calibration

Certificate No. : SPR24010268-2

Page : 3 of 3

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	113.9	113.9	-0.1	-0.1	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	113.9	113.9	-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 $k = 2.00$, providing a level of confidence approximately 95%.

- End of Certificate -