

ภาคผนวก ง

ใบรับรองการสอบเทียบเครื่องมือ



THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0517

MTC No. EEL. BP. 14/0767

CALIBRATION CERTIFICATE

Submitted by : Smile Laboratory Co.,Ltd

Address : 563/1, Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok, 10160, Thailand.

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

Instrument Calibrated :

Description : Acoustic Calibrator

Manufacturer : Quest Technologies

Model : QC-20

Serial No. : QF4090085

Ambient Environment

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

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

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

- Standards used :
1. Digital Function Synthesizer NF Electronic DF-193A S/N 122037.
 2. Measuring Amplifier Bruel&Kjaer 2636 S/N 1537484.
 3. Programmable Attenuator Tamagawa TPA-303A S/N OF 2214.
 4. Digital Multimeter Agilent 34401A S/N MY44005560.
 5. Pressure Transmitter Vaisala PTB202AD S/N T0650001.
 6. Audio Analyzer Keithley 2015-P S/N 4106495.
 7. Condenser Microphone Bruel&Kjaer 4180 S/N 2633526.

Calibration Procedure: CP-102-04 based on IEC 60942-2003. The sound pressure level of instrument was measured by standard microphone using an insert voltage technique.

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

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

Date of Receipt : 8 Jul. 2024

Date of Calibration : 12 Jul. 2024

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✓

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

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

FM.BL.MTC.002 Rev.4

Head Office

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Request No. 21-67/0517

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

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

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	93.80	-0.20	± 0.10	± 0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1000.6	0.6	± 1.5	$\pm 1.0\%$

3. Total distortion

Standard Microphone Type	Measured Total distortion (%)	Uncertainty (%)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	2.50	± 0.60	$\pm 3.0\%$

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Date of Calibration : 12 Jul. 2024

2/3

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THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-67/0517

MTC No. EEL. BP. 14/0767

Nominal Output of Unit Under Test = 114 dB re 20µPa at 1000 Hz

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

1. Sound Pressure Level

Standard Microphone Type	Measured Sound Pressure Level (dB)	Deviated value (dB)	Uncertainty (dB)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	113.74	-0.26	± 0.10	±0.40 dB

2. Frequency

Standard Microphone Type	Measured Frequency (Hz)	Deviated value (Hz)	Uncertainty (Hz)	Tolerance limit IEC60942:2003 Class 1
1/2 inch Bruel&Kjaer 4180	1000.6	0.6	± 1.5	±1.0%

3. Total Distortion

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

Note : 1. No adjustment.

2. The calibrator pressure correction was not included.

3. The microphone volume correction was not included.

Calibrated by :



Approved by :



Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 12 Jul. 2024

Date of Issue : 15 Jul. 2024

Ref : 2011267070802505001

End of Certificate

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

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FM.BLMTC.002 Rev.4

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CERTIFICATE OF CALIBRATION

NO. 20231214072

Name of Product:	Sound Level Meter
Model:	ST-11D
Serial Number:	820265
Specification:	Class 1
Conclusion:	Pass
Date of calibration:	2023-12-14
Due Date:	2024-12-13

Calibrated by:



- I. This report certifies that all calibration equipment used in the test is traceable with the internal ISO9001 procedures and meets all specification given in the Manual(s) or respectively surpass then, and applies only to the unit identified above.
- II. This certificate is produced with advanced equipment & procedures which permit comprehensive quality assurance verification of all data supplied herein.
- III. This certificate of calibration shall not be reproduced except in full, without written permission of the Scarlet Tech Co Ltd Taiwan.

1. Preliminary inspection: OK

2. Type & serial No. of Microphone: AWA14425-54838

3. Adjustments to indicated sound levels:

Type of Calibrator B&K 4231 SoundPressure Level 94.0 dB4. Measuring up limit: 140 dBA

5. Frequency weightings (Acoustic signal tests for Z weighting, other electric signal tests.)

Equivalent Free-field Sound Level (reference environment conditions) 93.8 dB

Nominal frequency /Hz	Frequency weighting / dB			Nominal frequency /Hz	Frequency weighting / dB		
	A	C	Z		A	C	Z
10	-71.1	-14.6	0.2	1000	0.0	0.0	-0.1
20	-50.3	-6.1	-0.4	2000	1.2	-0.2	0.0
31.5	-39.6	-3.1	0.1	4000	1.0	-0.8	0.0
63	-26.3	-0.9	-0.1	8000	-1.2	-3.2	0.0
125	-16.2	-0.2	-0.2	12500	-5.8	-7.8	0.1
250	-8.7	0.0	0.0	16000	-11.7	-13.7	0.0
500	-3.2	0.0	0.0	20000	-23.8	-25.8	-0.2

6. Self-generated noise

Microphone replaced by electrical input signal device

7.6 dB(A)	11.0 dB(C)	18.9 dB(Z)
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7. F&S Weighting

Rate of the F weighting decrease (dB/s)	35.2
Rate of the S weighting decrease (dB/s)	4.4
Deviation of F&S	-0.1

8. Level Linearity (A-weighting at frequency 1 kHz)

Reference sound level 90.0 dB

Max error at 10dB steps upper reference sound level 0.1 dB

Max error at 1dB steps within 5dB of the upper limit linear operating range 0.0 dB

Max error at 10dB steps below reference sound level 0.1 dB

Max error at 1dB steps within 5dB upper the lower limit linear operating range 0.1 dB

9. Tone burst response (A Weighting) :

Single Toneburst duration /ms	Toneburst response /dB			
	LAFmax-LA	LASmax-LA	LAE-LA	LAeqT-LA
500	0.0	-4.0	-2.9	-7.0
200	-1.0	-7.4	-6.9	-7.0
2	-18.1	-26.9	-26.9	-7.0
0.25	-27.2	/	-36.0	-7.0

10. Peak C sound level (500Hz) :

Cycle	One cycle	nominal value	Positive half	nominal value	Negative half	nominal value
LCpeak-LC(dB)	3.5	3.5	2.4	2.4	2.3	2.4

11. Overload indication: Pass

12. Statistical analysis function

Sweep signal maximum indicated sound level: 112.8 dB

Sweep amplitude: 40 dB

Scan cycle time: 60 S; Measurement period: 180 S.

Items	Measured value/dB	Theoretical calculated value/dB	Error/dB
L _{Aeq,T}	103.2	103.2	0.0
L ₅	110.8	110.8	0.0
L ₁₀	108.8	108.8	0.0
L ₅₀	92.9	92.8	0.1
L ₉₀	76.9	76.8	0.1
L ₉₅	75.0	74.9	0.1

Uncertainty of measurement results: 0.4 dB (k=2)

Environment conditions:

Air temperature: 20 °C

Relative humidity: 50 %

Static pressure: 101.8 kPa

Reference equipment used in the calibration:

Description:	Model	Serial No.	Expiry Date	Traceable To
Microphone	B&K 4191	2929405	2024-12-15	NML
Multi function sound calibrator	B&K 4226	2288444	2024-10-15	CIGISMEC
Signal generator	DS 360	33873	2024-10-15	CEPREI

Test specifications:

1. All Scarlet's Sound Level Meter has been calibrated in accordance with the requirements as specified in ISO 17025 and the lab calibration procedure SMTP004-CA-152.
2. The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
3. The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responses of the Sound Level Meter.

References:

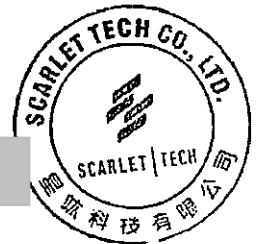
IEC 61672-3 Sound Level Meters Part 3: Periodic tests

CERTIFICATE OF CALIBRATION

NO. 20231214052

Name of Product:	Sound Level Meter
Model:	ST-11D
Serial Number:	820385
Specification:	Class 1
Conclusion:	Pass
Date of calibration:	2023-12-14
Due Date:	2024-12-13

Calibrated by:



- I. This report certifies that all calibration equipment used in the test is traceable with the internal ISO9001 procedures and meets all specification given in the Manual(s) or respectively surpass then, and applies only to the unit identified above.
- II. This certificate is produced with advanced equipment & procedures which permit comprehensive quality assurance verification of all data supplied herein.
- III. This certificate of calibration shall not be reproduced except in full, without written permission of the Scarlet Tech Co Ltd Taiwan.

1. Preliminary inspection: OK

 2. Type & serial No. of Microphone: AWA14425-54573

3. Adjustments to indicated sound levels:

 Type of Calibrator B&K 4231 Sound

 Pressure Level 94.0 dB

 4. Measuring up limit: 140 dBA

5. Frequency weightings (Acoustic signal tests for Z weighting, other electric signal tests.)

 Equivalent Free-field Sound Level (reference environment conditions) 93.8 dB

Nominal frequency /Hz	Frequency weighting / dB			Nominal frequency /Hz	Frequency weighting / dB		
	A	C	Z		A	C	Z
10	-71.1	-14.6	0.2	1000	0.0	0.0	-0.1
20	-50.4	-6.4	-0.4	2000	0.1	0.0	0.0
31.5	-39.4	-2.2	0.1	4000	1.3	-0.1	0.0
63	-26.2	-0.8	-0.1	8000	1.2	-0.8	0.0
125	-16.3	-0.1	-0.2	12500	-5.7	-7.2	0.1
250	-8.5	0.2	0.0	16000	-11.7	-13.4	0.2
500	-3.2	0.1	0.0	20000	-23.9	-25.8	-0.3

6. Self-generated noise

Microphone replaced by electrical input signal device

7.3 dB(A)	11.2 dB(C)	13.3 dB(Z)
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7. F&S Weighting

Rate of the F weighting decrease (dB/s)	35.1
Rate of the S weighting decrease (dB/s)	4.3
Deviation of F&S	-0.1

8. Level Linearity (A-weighting at frequency 1 kHz)

Reference sound level 90.0 dB

Max error at 10dB steps upper reference sound level 0.1 dB

Max error at 1dB steps within 5dB of the upper limit linear operating range 0.0 dB

Max error at 10dB steps below reference sound level 0.1 dB

Max error at 1dB steps within 5dB upper the lower limit linear operating range 0.1 dB

9. Tone burst response (A Weighting) :

Single Toneburst duration /ms	Toneburst response /dB			
	LAFmax-LA	LASmax-LA	LAE-LA	LAeqT-LA
500	0.0	-4.0	-2.9	-7.0
200	-1.0	-7.4	-6.9	-7.0
2	-18.1	-26.9	-26.9	-7.0
0.25	-27.2	/	-36.0	-7.0

10. Peak C sound level (500Hz) :

Cycle	One cycle	nominal value	Positive half	nominal value	Negative half	nominal value
LCpeak-LC(dB)	3.5	3.5	2.4	2.4	2.3	2.4

11. Overload indication: Pass

12. Statistical analysis function

Sweep signal maximum indicated sound level: 112.8 dB

Sweep amplitude: 40 dB

Scan cycle time: 60 S; Measurement period: 180 S.

Items	Measured value/dB	Theoretical calculated value/dB	Error/dB
L _{Aeq,T}	103.2	103.2	0.0
L ₅	110.8	110.8	0.0
L ₁₀	108.8	108.8	0.0
L ₅₀	92.9	92.8	0.1
L ₉₀	76.9	76.8	0.1
L ₉₅	75.0	74.9	0.1

Uncertainty of measurement results: 0.4 dB (k=2)

Environment conditions:

Air temperature: 20 °C

Relative humidity: 50 %

Static pressure: 101.8 kPa

Reference equipment used in the calibration:

Description:	Model	Serial No.	Expiry Date	Traceable To
Microphone	B&K 4191	2929405	2024-12-15	NML
Multi function sound calibrator	B&K 4226	2288444	2024-10-15	CIGISMEC
Signal generator	DS 360	33873	2024-10-15	CEPREI

Test specifications:

1. All Scarlet's Sound level Meter has been calibrated in accordance with the requirements as specified in ISO 17025 and the lab calibration procedure SMTP004-CA-152.
2. The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of $\pm 20\%$.
3. The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responses of the Sound Level Meter.

References:

IEC 61672-3 Sound Level Meters Part 3: Periodic tests

CERTIFICATE OF CALIBRATION

NO. 20240113131

Name of Product:	Sound Level Meter
Model:	ST-11D
Serial Number:	820891
Specification:	Class 1
Conclusion:	Pass
Date of calibration:	2024-01-31
Due Date:	2025-01-29

Calibrated by:



- This report certifies that all calibration equipment used in the test is traceable with the internal ISO9001 procedures and meets all specification given in the Manual(s) or respectively surpass then, and applies only to the unit identified above.
- This certificate is produced with advanced equipment & procedures which permit comprehensive quality assurance verification of all data supplied herein.
- This certificate of calibration shall not be reproduced except in full, without written permission of the Scarlet Tech Co Ltd Taiwan.

1. Preliminary inspection: OK

2. Type & serial No. of Microphone: AWA14425-57258

3. Adjustments to indicated sound levels:

Type of Calibrator B&K 4231 Sound

Pressure Level 94.0 dB

4. Measuring up limit: 140 dBA

5. Frequency weightings (Acoustic signal tests for Z weighting, other electric signal tests.)

Equivalent Free-field Sound Level (reference environment conditions) 93.8 dB

Nominal frequency /Hz	Frequency weighting / dB			Nominal frequency /Hz	Frequency weighting / dB		
	A	C	Z		A	C	Z
10	-71.3	-14.5	-0.3	1000	0.0	0.0	-0.1
20	-50.1	-6.2	-0.1	2000	1.3	-0.1	-0.1
31.5	-39.2	-2.6	-0.1	4000	1.1	-0.9	-0.1
63	-26.1	-0.4	-0.2	8000	-1.0	-3.1	0.0
125	-16.2	-0.1	0.1	12500	-11.5	-13.5	0.1
250	-8.7	0.1	-0.1	16000	-11.5	-13.3	0.1
500	-3.1	0.2	-0.2	20000	-23.9	-25.9	-0.1

6. Self-generated noise

Microphone replaced by electrical input signal device

6.9 dB(A)	8.4 dB(C)	14.8 dB(Z)
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7. F&S Weighting

Rate of the F weighting decrease (dB/s)	35.1
Rate of the S weighting decrease (dB/s)	4.3
Deviation of F&S	-0.1

8. Level Linearity (A-weighting at frequency 1 kHz)

Reference sound level 90.0 dB

Max error at 10dB steps upper reference sound level 0.1 dB

Max error at 1dB steps within 5dB of the upper limit linear operating range 0.0 dB

Max error at 10dB steps below reference sound level 0.1 dB

Max error at 1dB steps within 5dB upper the lower limit linear operating range 0.1 dB

9. Tone burst response (A Weighting) :

Single Toneburst duration /ms	Toneburst response /dB			
	LAFmax-LA	LASmax-LA	LAE-LA	LAeqT-LA
500	0.0	-4.0	-2.9	-7.0
200	-1.0	-7.4	-6.9	-7.0
2	-18.1	-26.9	-26.9	-7.0
0.25	-27.2	/	-36.0	-7.0

10. Peak C sound level (500Hz) :

Cycle	One cycle	nominal value	Positive half	nominal value	Negative half	nominal value
LCpeak-LC(dB)	3.5	3.5	2.4	2.4	2.3	2.4

11. Overload indication: Pass

12. Statistical analysis function

Sweep signal maximum indicated sound level: 112.8 dB

Sweep amplitude: 40 dB

Scan cycle time: 60 S; Measurement period: 180 S.

Items	Measured value/dB	Theoretical calculated value/dB	Error/dB
LAeq,T	103.2	103.2	0.0
L5	110.8	110.8	0.0
L10	108.8	108.8	0.0
L50	92.9	92.8	0.1
L90	76.9	76.8	0.1
L95	75.0	74.9	0.1

Uncertainty of measurement results: 0.4 dB (k=2)

Environment conditions:

Air temperature: 20 °C

Relative humidity: 50 %

Static pressure: 101.8 kPa

Reference equipment used in the calibration:

Description:	Model	Serial No.	Expiry Date	Traceable To
Microphone	B&K 4191	2929405	2024-12-15	NML
Multi function sound calibrator	B&K 4226	2288444	2024-10-15	CIGISMEC
Signal generator	DS 360	33873	2024-10-15	CEPREI

Test specifications:

1. All Scarlet's Sound level Meter has been calibrated in accordance with the requirements as specified in ISO 17025 and the lab calibration procedure SMTP004-CA-152.
2. The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
3. The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responses of the Sound Level Meter.

References:

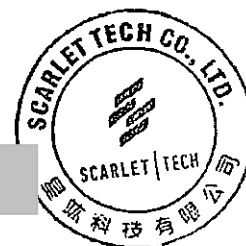
IEC 61672-3 Sound Level Meters Part 3: Periodic tests

CERTIFICATE OF CALIBRATION

NO. 20240113137

Name of Product:	Sound Level Meter
Model:	ST-11D
Serial Number:	820897
Specification:	Class 1
Conclusion:	Pass
Date of calibration:	2024-01-31
Due Date:	2025-01-29

Calibrated by:



- This report certifies that all calibration equipment used in the test is traceable with the internal ISO9001 procedures and meets all specification given in the Manual(s) or respectively surpass then, and applies only to the unit identified above.
- This certificate is produced with advanced equipment & procedures which permit comprehensive quality assurance verification of all data supplied herein.
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1. Preliminary inspection: OK

 2. Type & serial No. of Microphone: AWA14425-59131

3. Adjustments to indicated sound levels:

 Type of Calibrator B&K 4231 Sound

 Pressure Level 94.0 dB

 4. Measuring up limit: 140 dBA

5. Frequency weightings (Acoustic signal tests for Z weighting, other electric signal tests.)

 Equivalent Free-field Sound Level (reference environment conditions) 93.8 dB

Nominal frequency /Hz	Frequency weighting / dB			Nominal frequency /Hz	Frequency weighting / dB		
	A	C	Z		A	C	Z
10	-71.2	-14.1	-0.3	1000	0.0	0.0	-0.1
20	-50.2	-6.2	-0.1	2000	1.3	-0.1	-0.1
31.5	-39.2	-2.3	-0.1	4000	1.2	-0.8	-0.1
63	-26.1	-0.1	-0.1	8000	-1.0	-3.2	0.0
125	-16.2	-0.2	0.1	12500	-11.5	-13.5	0.1
250	-8.6	0.1	-0.1	16000	-11.3	-13.2	0.1
500	-3.1	0.1	-0.1	20000	-23.9	-25.8	-0.1

6. Self-generated noise

Microphone replaced by electrical input signal device

10.3 dB(A)	11.2 dB(C)	16.5 dB(Z)
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7. F&S Weighting

Rate of the F weighting decrease (dB/s)	35.1
Rate of the S weighting decrease (dB/s)	4.4
Deviation of F&S	-0.1

8. Level Linearity (A-weighting at frequency 1 kHz)

Reference sound level 90.0 dB

Max error at 10dB steps upper reference sound level 0.1 dB

Max error at 1dB steps within 5dB of the upper limit linear operating range 0.0 dB

Max error at 10dB steps below reference sound level 0.1 dB

Max error at 1dB steps within 5dB upper the lower limit linear operating range 0.1 dB

9. Tone burst response (A Weighting) :

Single Toneburst duration /ms	Toneburst response /dB			
	LAFmax-LA	LASmax-LA	LAE-LA	LAeqT-LA
500	0.0	-4.0	-2.9	-7.0
200	-1.0	-7.4	-6.9	-7.0
2	-18.1	-26.9	-26.9	-7.0
0.25	-27.2	/	-36.0	-7.0

10. Peak C sound level (500Hz) :

Cycle	One cycle	nominal value	Positive half	nominal value	Negative half	nominal value
LCpeak-LC(dB)	3.5	3.5	2.4	2.4	2.3	2.4

11. Overload indication: Pass

12. Statistical analysis function

Sweep signal maximum indicated sound level: 112.8 dB

Sweep amplitude: 40 dB

Scan cycle time: 60 S; Measurement period: 180 S.

Items	Measured value/dB	Theoretical calculated value/dB	Error/dB
LAeq,T	103.2	103.2	0.0
L5	110.8	110.8	0.0
L10	108.8	108.8	0.0
L50	92.9	92.8	0.1
L90	76.9	76.8	0.1
L95	75.0	74.9	0.1

Uncertainty of measurement results: 0.4 dB (k=2)

Environment conditions:

Air temperature: 20 °C

Relative humidity: 50 %

Static pressure: 101.8 kPa

Reference equipment used in the calibration:

Description:	Model	Serial No.	Expiry Date	Traceable To
Microphone	B&K 4191	2929405	2024-12-15	NML
Multi function sound calibrator	B&K 4226	2288444	2024-10-15	CIGISMEC
Signal generator	DS 360	33873	2024-10-15	CEPREI

Test specifications:

1. All Scarlet's Sound level Meter has been calibrated in accordance with the requirements as specified in ISO17025 and the lab calibration procedure SMTP004-CA-152.
2. The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
3. The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responses of the Sound Level Meter.

References:

IEC 61672-3 Sound Level Meters Part 3: Periodic tests



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TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Site Information

Sampler Location	บริษัท เอเพ็กซ์ ปาร์ค จำกัด	Date	31 October 2024
Project Site	หมู่ที่ 13 บ้านคลองหนึ่ง	Person	Mr. Anupong Kotchasongkham

Calibration Orifice

Transfer Standard Type	Orifice	Q_{std} Slope (m)	2.10372
Calibrator Model	TE-5025A	Q_{std} Intercept (b)	-0.03890
Calibrator Serial Number	3092		

Calibration Information

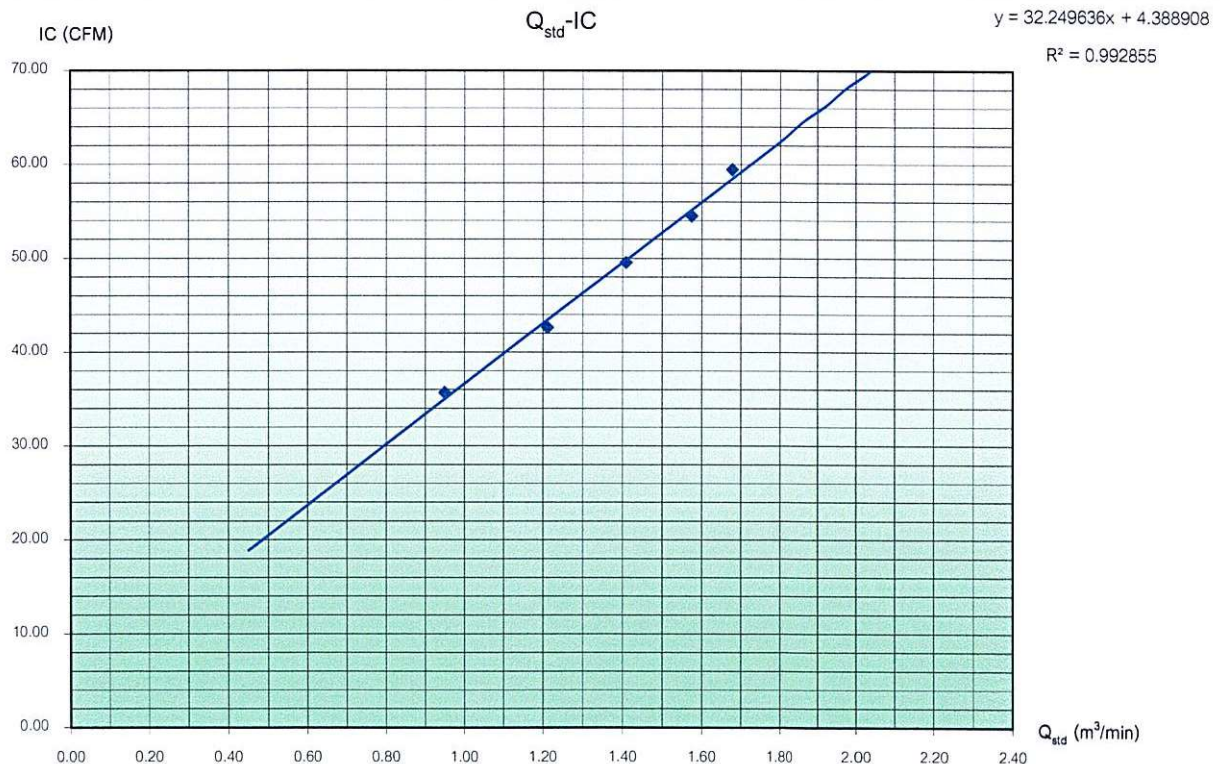
Sampler Number	TSP No.01	Motor Serial Number	1203-415	Recorder Serial Number	653
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Test No.	Pressure Drop Across Orifice (ΔH_2O) (inH ₂ O)			(A)	(X)	(I)	(Y)	Temperature (°K = °C+273)	Barometric Pressure (mmHg)
	Positive	Negative	ΔH_2O	$[\Delta H_2O(P_a/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	Sample Flow Rate Indication (ft ³ /min)	$IC = I[(P_a/P_{std})(T_{std}/T_a)]^{1/2}$ (ft ³ /min)		
1	2.0	1.9	3.90	1.95848	0.94945	36.0	35.70	303.0	760.0
2	3.3	3.1	6.40	2.50886	1.21107	43.0	42.64	303.0	760.0
3	4.4	4.3	8.70	2.92514	1.40895	50.0	49.59	303.0	760.0
4	5.5	5.4	10.90	3.27416	1.57486	55.0	54.54	303.0	760.0
5	6.3	6.1	12.40	3.49219	1.67850	60.0	59.50	303.0	760.0
Average								303.0	760.0

Linear Regression : $y = mX + b$

Slope (m)	32.249636
Intercept (b)	4.388908
R-Square (R^2)	0.992855
Correlation Coefficient (r)	0.996421

Andersen Instruments, Inc.



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TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Site Information

Sampler Location	บริษัท เอเพ็กซ์ ปาร์ค จำกัด	Date	31 October 2024
Project Site	หมู่ที่ 13 บ้านคลองหนึ่ง	Person	Mr. Anupong Kotchasongkham

Calibration Orifice

Transfer Standard Type	Orifice	Q_{std} Slope (m)	2.10372
Calibrator Model	TE-5025A	Q_{std} Intercept (b)	-0.03890
Calibrator Serial Number	3092		

Calibration Information

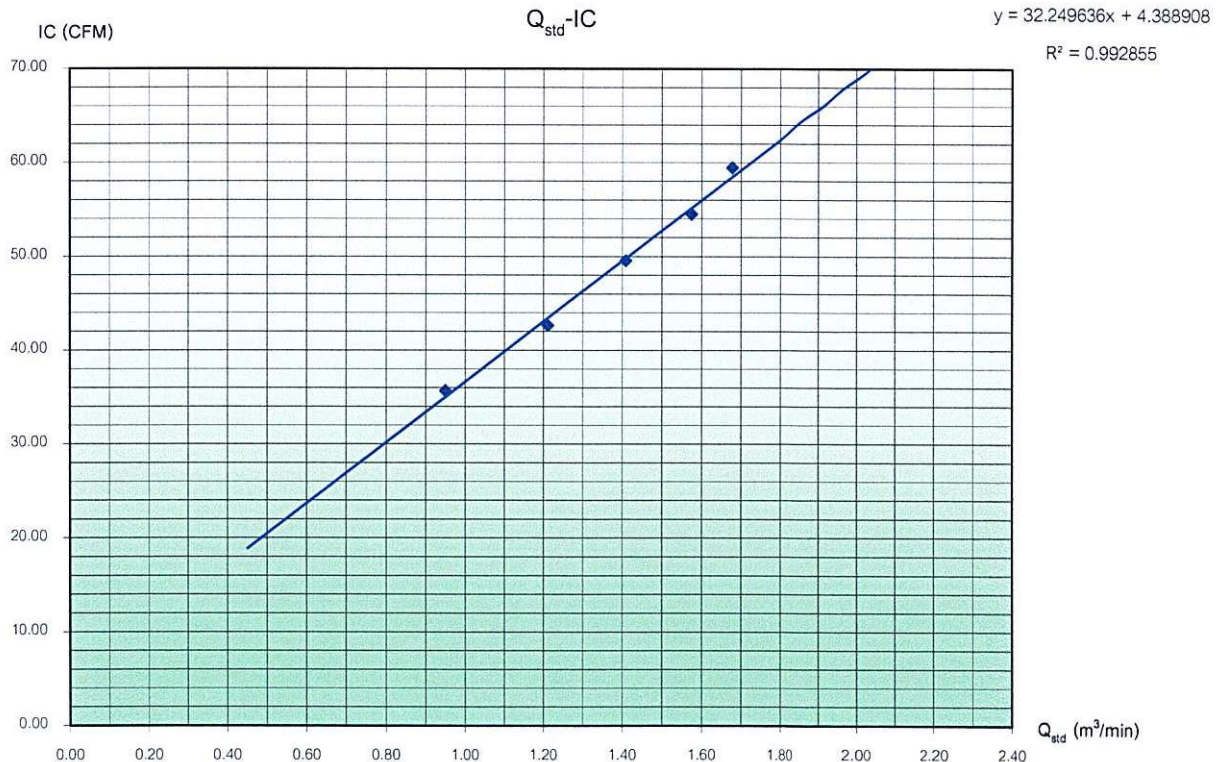
Sampler Number	PM-10 No.01	Motor Serial Number	1203-449	Recorder Serial Number	643
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Test No.	Pressure Drop Across Orifice (ΔH_2O) (inH ₂ O)			(A)	(X)	(I)	(Y)	Temperature (°K = °C+273)	Barometric Pressure (mmHg)
	Positive	Negative	ΔH_2O	$[\Delta H_2O(P_a/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	Sample Flow Rate Indication (ft ³ /min)	$IC = I[(P_a/P_{std})(T_{std}/T_a)]^{1/2}$ (ft ³ /min)		
1	2.0	1.9	3.90	1.95848	0.94945	36.0	35.70	303.0	760.0
2	3.3	3.1	6.40	2.50886	1.21107	43.0	42.64	303.0	760.0
3	4.4	4.3	8.70	2.92514	1.40895	50.0	49.59	303.0	760.0
4	5.5	5.4	10.90	3.27416	1.57486	55.0	54.54	303.0	760.0
5	6.3	6.1	12.40	3.49219	1.67850	60.0	59.50	303.0	760.0
Average								303.0	760.0

Linear Regression : $y = mX + b$

Slope (m)	32.249636
Intercept (b)	4.388908
R-Square (R^2)	0.992855
Correlation Coefficient (r)	0.996421

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TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Site Information

Sampler Location	บริษัท เอเพ็กซ์ ปาร์ค จำกัด	Date	31 October 2024
Project Site	หมู่ที่ 12 บ้านคลองสอง (บ้านแปลงยาวบน)	Person	Mr. Anupong Kotchasongkham

Calibration Orifice

Transfer Standard Type	Orifice	Q_{std} Slope (m)	2.10372
Calibrator Model	TE-5025A	Q_{std} Intercept (b)	-0.03890
Calibrator Serial Number	3092		

Calibration Information

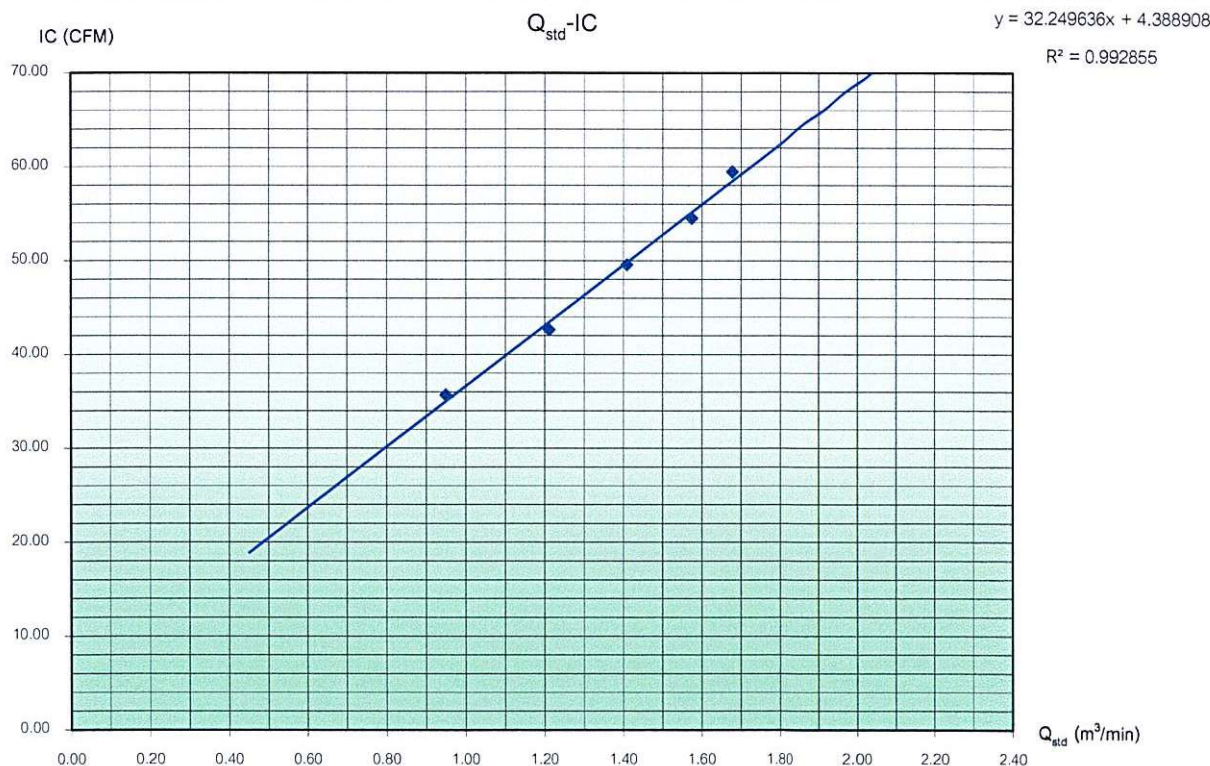
Sampler Number	TSP No.02	Motor Serial Number	1203-416	Recorder Serial Number	654
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Test No.	Pressure Drop Across Orifice (ΔH_2O) (inH ₂ O)			(A)	(X)	(I)	(Y)	Temperature ($^{\circ}K = ^{\circ}C + 273$)	Barometric Pressure (mmHg)
	Positive	Negative	ΔH_2O	$[\Delta H_2O(P_a/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	Sample Flow Rate Indication (ft ³ /min)	$IC = I[(P_a/P_{std})(T_{std}/T_a)]^{1/2}$ (ft ³ /min)		
1	2.0	1.9	3.90	1.95848	0.94945	36.0	35.70	303.0	760.0
2	3.3	3.1	6.40	2.50886	1.21107	43.0	42.64	303.0	760.0
3	4.4	4.3	8.70	2.92514	1.40895	50.0	49.59	303.0	760.0
4	5.5	5.4	10.90	3.27416	1.57486	55.0	54.54	303.0	760.0
5	6.3	6.1	12.40	3.49219	1.67850	60.0	59.50	303.0	760.0
Average								303.0	760.0

Linear Regression : $y = mX + b$

Slope (m)	32.249636
Intercept (b)	4.388908
R-Square (R^2)	0.992855
Correlation Coefficient (r)	0.996421

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TSP HIGH VOLUME AIR SAMPLER CALIBRATION REPORT

Site Information

Sampler Location	บริษัท เอเพ็กซ์ ปาร์ค จำกัด	Date	31 October 2024
Project Site	หมู่ที่ 12 บ้านคลองสอง (บ้านแปลงยาวบน)	Person	Mr. Anupong Kotchasongkham

Calibration Orifice

Transfer Standard Type	Orifice	Q _{std} Slope (m)	2.10372
Calibrator Model	TE-5025A	Q _{std} Intercept (b)	-0.03890
Calibrator Serial Number	3092		

Calibration Information

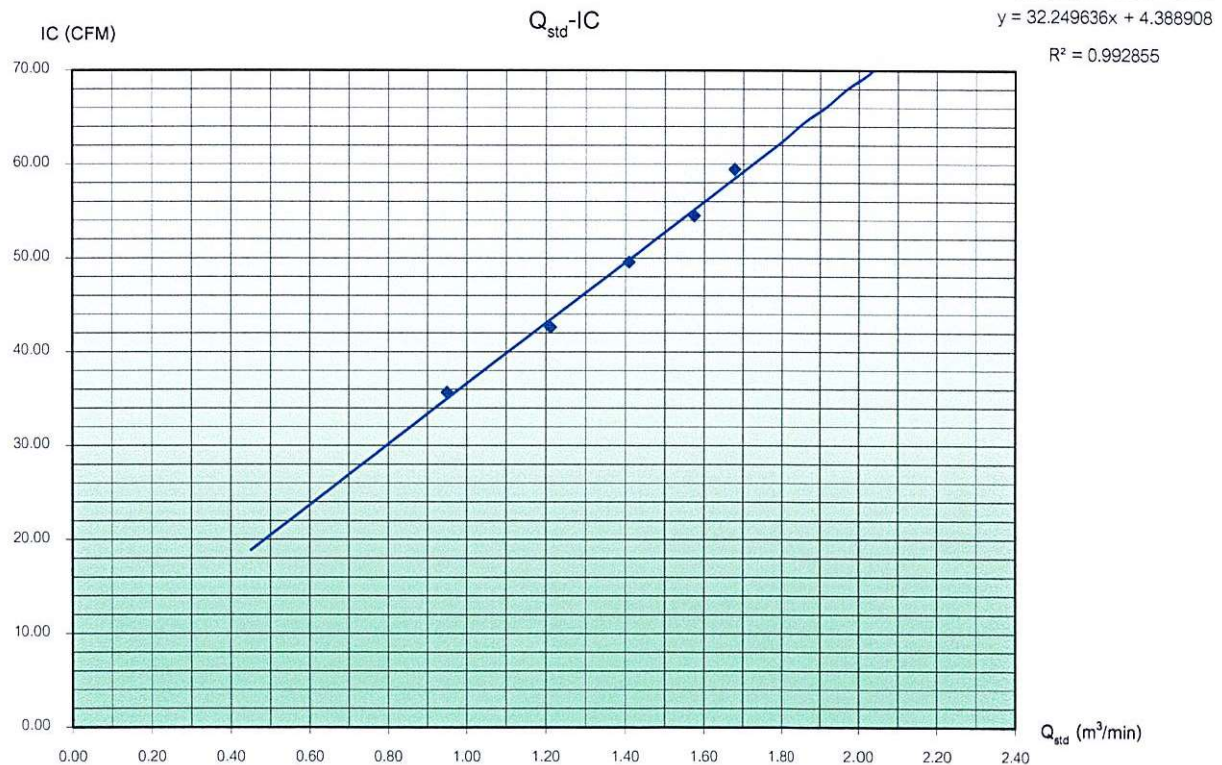
Sampler Number	PM-10 No.02	Motor Serial Number	1203-450	Recorder Serial Number	644
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Test No.	Pressure Drop Across Orifice (ΔH_2O) (inH ₂ O)			(A)	(X)	(I)	(Y)	Temperature (°K = °C+273)	Barometric Pressure (mmHg)
	Positive	Negative	ΔH_2O	$[\Delta H_2O(P_a/P_{std})(T_{std}/T_a)]^{1/2}$	$Q_{std} = (1/m)[(A-b)]$ (m ³ /min)	Sample Flow Rate Indication (ft ³ /min)	$IC = I[(P_a/P_{std})(T_{std}/T_a)]^{1/2}$ (ft ³ /min)		
1	2.0	1.9	3.90	1.95848	0.94945	36.0	35.70	303.0	760.0
2	3.3	3.1	6.40	2.50886	1.21107	43.0	42.64	303.0	760.0
3	4.4	4.3	8.70	2.92514	1.40895	50.0	49.59	303.0	760.0
4	5.5	5.4	10.90	3.27416	1.57486	55.0	54.54	303.0	760.0
5	6.3	6.1	12.40	3.49219	1.67850	60.0	59.50	303.0	760.0
Average								303.0	760.0

Linear Regression : $y = mX + b$

Slope (m)	32.249636
Intercept (b)	4.388908
R-Square (R^2)	0.992855
Correlation Coefficient (r)	0.996421

Andersen Instruments, Inc.



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Saimai, Bangkok 10220, ThailandTel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.comCalibration Cert. # 3884.01
ISO/IEC 17025

Certificate of Calibration

Certificate No. : MT23-6059

Page : 1 of 2

Customer : Smile Laboratory Co.,Ltd.

Address : 563/1 Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok, 10160

Description : Digital Thermometer

Manufacturer : Fluke

Model : 51II

Serial No. : 36650190WS

Identification No. : SML.DT001/61

Calibration Place : Temperature Laboratory

Order No. : 3156/23

Received date : Oct 03, 2023

Calibration date : Oct 06, 2023

Environment Condition :

Temperature : (23+/-3) °C

Humidity : (50+/-15) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure *CP-MT-001* According to comparison with Standard Digital Thermometer with 2 PRT.
The calibration methods based on ITS-90.

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
Standard Digital Thermometer with 2 PRT	1586A/5609/5609	41130006/00543/03713	TE23-0007	Jan 13, 2024

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

Traceability : This measurement are traceable to the International System of Unit (SI), through
National Institute of Metrology Thailand (NIMT)

The reported uncertainty of measurement was based on standard uncertainty multiplied by coverage factor $k = 2$,
providing a level of confidence of not less than 95%



Calibrated by : _____

Issue date : _____

Approved by : _____

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ISO/IEC 17025**Certificate No. : MT23-6059****Page : 2 of 2**

Result : Without Adjustment
Function : Temperature measurement
Sensor Type : Thermocouple type K (wire)
Diameter : - mm
Calibration point : 4, 20, 104, 150, 180 °C

Resolution : 0.1 °C

Immersion depth (mm)	Calibration point (°C)	Standard reading (°C)	UUC* reading (°C)	UUC* correction (°C)	Uncertainty of measurement (+/- °C)
140	4	4.053	4.2	-0.147	0.24
140	20	20.025	20.2	-0.175	0.24
140	104	104.075	103.7	0.375	0.47
140	150	150.061	149.6	0.461	0.47
140	180	180.036	179.6	0.436	0.47
140	4	4.044	4.2	-0.156	0.24

UUC* = Unit under calibration



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Calibration Cert. # 3884.01
ISO/IEC 17025

Certificate of Calibration

Certificate No. : MT23-6082

Page : 1 of 2

Customer : Smile Laboratory Co.,Ltd.

Address : 563/1 Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok, 10160

Description : Digital Thermo & Hygrometer

Manufacturer : Genec

Model : ETTH2000-TH

Serial No. : H2000BC271

Identification No. : SML.TH001/61

Calibration Place : Temperature & Humidity Laboratory

Order No. : 3156/23

Received date : Oct 03, 2023

Calibration date : Oct 06, 2023

Environment Condition :

Temperature : (23+/-3) °C

Humidity : (50+/-15) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure *CP-MT-007* According to comparison with Standard Temperature & Humidity into Environmental Stability Chamber.

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
Standard Digital Hygrometer	One-TH	0x0000158D000E121E	SG-H-00987/65	Nov 10, 2023
Standard Digital Thermometer with Probe	UM RTD	2002Z A21 0181A	MT23-4665	Jul 14, 2024

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

Traceability : This measurement are traceable to the International System of Unit (SI), through National Institute of Metrology Thailand (NIMT)

The reported uncertainty of measurement was based on standard uncertainty multiplied by coverage factor $k = 2$, providing a level of confidence of not less than 95%



Calibrated by : _____

Issue date : _____

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Result : Without adjustment
Function : Temperature measurement
Calibration point : 25 °C
Resolution : 0.1 °C
Standard Humidity reading : 49.91 %RH

Test point (°C)	Standard reading (°C)	UUC* reading (°C)	UUC* correction (°C)	Uncertainty of measurement (+/- °C)
25	25.06	25.6	-0.54	0.36

Result : Without adjustment
Function : Humidity measurement
Calibration point : 50 %RH
Resolution : 1 %RH
Standard Temperature reading : 25.08 °C

Test point (%RH)	Standard reading (%RH)	UUC* reading (%RH)	UUC* correction (%RH)	Uncertainty of measurement (+/- %RH)
50	50.16	47	3.16	2.3

UUC* = Unit under calibration



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Calibration Cert. # 3884.01
ISO/IEC 17025

Certificate of Calibration

Certificate No. : MM23-3120

Page : 1 of 2

Customer : Smile Laboratory Co.,Ltd.

Address : 563/1 Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok, 10160

Description : Standard Weight Set

Manufacturer : N/A

Model : 500 mg-200 g

Serial No. : N/A

Identification No. : STD.W.001-007-55

Calibration Place : Mass & Torque Laboratory

Order No. : 3156/23

Received date : Oct 03, 2023

Calibration date : Oct 05, 2023

Environment Condition :

Temperature : (23+/-3) °C

Humidity : (50+/-15) %RH

Atm. Pressure : (1010+/-10) hPa

Calibration Method : Calibration were conducted using In-house calibration procedure *CP-MM-007* According to comparison with the reference Standard Weight Set and mass comparator.
The calibration methods based on OIML : R111-1 : 2004

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
Standard Weight Set E1	NC-001-0.2K-E1-ASS	0022	NC-527	Oct 17, 2024

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

Traceability : This measurement are traceable to the International System of Unit (SI), through National Institute of Metrology (Thailand)

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor $k = 2$, providing a level of confidence of not less than 95%



Calibrated by : 
Issue date : 

Approved by : 

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Certificate No. : MM23-3120

Page : 2 of 2

Calibration Result : Without Adjustment

Identification No.	Nominal Values		Conventional Mass						Uncertainty	
			Before Adjustment		After Adjustment				of Measurement	
	Weight								(+/-)	
-	500	mg	500	mg	-0.01	mg	-	-	0.012	mg
-	1	g	1	g	0.00	mg	-	-	0.014	mg
-	5	g	5	g	0.01	mg	-	-	0.020	mg
-	10	g	10	g	0.02	mg	-	-	0.025	mg
-	50	g	50	g	-0.01	mg	-	-	0.037	mg
-	100	g	100	g	-0.02	mg	-	-	0.060	mg
-	200	g	200	g	0.02	mg	-	-	0.61	mg



Certificate of Calibration

Certificate No. : MT23-6058

Page : 1 of 2

Customer : Smile Laboratory Co.,Ltd.

Address : 563/1 Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok, 10160

Description : Refrigerator

Manufacturer : Accuplus

Model : SMART i250

Serial No. : 2059-1117-0035

Identification No. : SML.IN002/61

Calibration Place : Laboratory Room

Order No. : 3156/23

Received date : Oct 03, 2023

Calibration date : Oct 03, 2023

Environment Condition :

Temperature : (25+/-10) °C

Humidity : (50+/-30) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure *CP-MT-006* According to comparison with LXI Data Acquisition Switch Unit with sensor. The calibration methods based on Euramet Calibration Guide No.20 - guidelines on the Calibration of Temperature and/or Humidity Controlled Enclosures.

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
LXI Data Acquisition Switch Unit with Sensor	34972A	MY49028922	MT22-6393	Nov 24, 2023

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

Traceability : This measurement are traceable to the International System of Unit (SI), through
National Institute of Metrology Thailand (NIMT)

The reported uncertainty of measurement was based on standard uncertainty multiplied by coverage factor $k = 2$,
providing a level of confidence of not less than 95%



Calibrated by : _____

Issue date : _____

Approved by _____

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Certificate No. : MT23-6058

Page : 2 of 2

Function : Temperature measurement

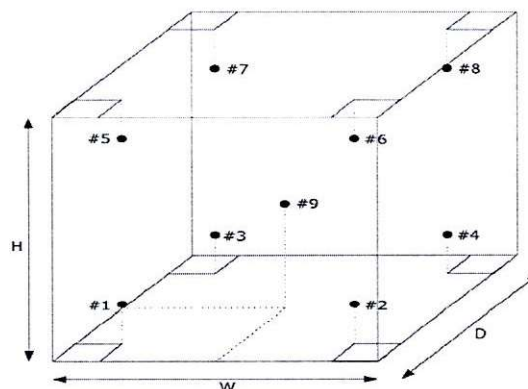
Result : Without adjustment

Calibration point : 4 °C

Resolution : 0.1 °C

Calibration point (°C)	Temperature of UUC* at each position (°C)									Uncertainty of measurement (+/- °C)
	Ch.1	Ch.2	Ch.3	Ch.4	Ch.5	Ch.6	Ch.7	Ch.8	Ch.9	
4	5.321	4.710	4.983	4.837	4.990	4.665	5.131	4.696	4.933	0.31

Setting temperature (°C)	Indicating Temperature (°C)	Measured stability (+/- °C)	Measured uniformity (°C)	Overall variation (°C)
4.0	4.1 to 4.3	0.15	0.53	1.0



Front view

- #1 Lower Left Front
- #2 Lower Right Front
- #3 Lower Left Rear
- #4 Lower Right Rear
- #5 Upper Left Front
- #6 Upper Right Front
- #7 Upper Left Rear
- #8 Upper Right Rear
- #9 Geometric Center

UUC* = Unit under calibration

Uniformity = Maximum and Minimum difference of measured temperature at any probes and the measured temperature at the reference and same time.

Overall Variation = Difference of temperature value between the maximum and minimum any time.

Stability = One half of the maximum difference of measured temperatures at any one probe.



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Calibration Cert. # 3884.01
ISO/IEC 17025

Certificate of Calibration

Certificate No. : MM23-3116

Page : 1 of 3

Customer : Smile Laboratory Co.,Ltd.

Address : 563/1 Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok, 10160

Description : Electronic Balance

Manufacturer : Mettler Toledo

Model : MS205DU

Serial No. : 850938841

Identification No. : SML.AB002/61

Calibration Place : Balance Room

Order No. : 3156/23

Received date : Oct 03, 2023

Calibration date : Oct 03, 2023

Environment Condition :

Temperature : (25+/-10) °C

Humidity : (50+/-30) %RH

Atm. Pressure : (1010+/-10) hPa

Calibration Method : Calibration were conducted using In-house calibration procedure *CP-MM-001*
According to comparison with Standard Weight Set.
The calibration methods based on UKAS - LAB 14 : 2022

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
Standard Weight Set	NC-001-0.2K-E1-ASS	0022	NC-527	Oct 17, 2024

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

Traceability : This measurement are traceable to the International System of Unit (SI), through
National Institute of Metrology (Thailand)

The reported uncertainty of measurement was base on standard uncertainty multiplied by coverage factor $k = 2$,
providing a level of confidence of not less than 95%



Calibrated by : _____
Issue date : _____

Approved by : _____

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Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com

Calibration Cert. # 3884.01
ISO/IEC 17025

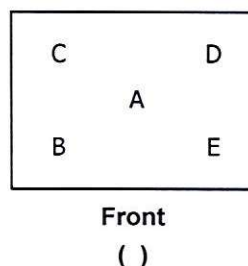
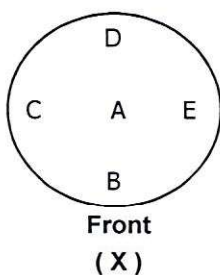
Certificate No. : MM23-3116

Page : 2 of 3

Calibration Result : Without Adjustment
 Function : Repeatability
 Maximum Capacity : 200 g
 Resolution : 0 to 82 g = 0.00001 g
 > 82 g = 0.0001 g

Nominal Weight Value	Instrument Deviation of Reading
(g)	(g)
200	0.0000

Calibration Result : Without Adjustment
 Function : Effect of Off Center Loading



A Mass of 100 Was Placed to various Position on the pan.

The Weight Machine Reading Obtained is Given in The Tabel

Load	Measuring Positions					Maximum Different	
	A	B	C	D	E		
	(g)	(g)	(g)	(g)	(g)		
100	100.0001	100.0001	100.0001	100.0003	100.0001	100.0001	0.0002

Calibration Result : Without Adjustment
 Function : Effect of Tare

Nominal Tare Weight	Standard Weight		UUC* Reading	UUC* Deviation
(g)	(g)		(g)	(g)
100	Tare		0.00000	0.00000
	At 20 %	20	20.00002	-0.00002
	At 40 %	40	40.00006	-0.00006
	At 60 %	60	60.00001	-0.00001
	At 80 %	80	80.00001	-0.00001
	At 100 %	100	100.0002	-0.0002

UUC* = Unit Under Calibration

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Page : 3 of 3

Calibration Result : Without Adjustment

Function : Departure of indication from nominal value

Standard Weight Value (g)	UUC* Reading (g)	UUC* Correction (g)	Uncertainty of Measurement (+/- g)
0.00000	0.00000	0.00000	0.000010
20.00003	20.00002	0.00001	0.000056
40.00008	40.00006	0.00002	0.000084
60.00006	60.00004	0.00002	0.00015
80.00004	80.00001	0.00003	0.00015
100.0000	100.0000	0.0000	0.00016
120.0002	120.0002	0.0000	0.00031
140.0001	140.0001	0.0000	0.00031
160.0002	160.0002	0.0000	0.00031
180.0002	180.0002	0.0000	0.00031
200.0001	200.0001	0.0000	0.00031

UUC* = Unit Under Calibration

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Calibration Cert. # 3884.01
ISO/IEC 17025

Certificate of Calibration

Certificate No. : MC23-2400

Page : 1 of 3

Customer : Smile Laboratory Co., Ltd.

Address : 563/1 Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok, 10160

Description : Spectrophotometer

Manufacturer : Hach

Model : DR 6000

Serial No. : 1735844

Identification No. : SML.UV001/61

Calibration Place : Chemical Laboratory 1

Order No. : 3156/23

Received date : Oct 03, 2023

Calibration date : Oct 05, 2023

Environment Condition :

Temperature : (23+/-3) °C

Humidity : (50+/-15) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure CP-MC-008. According to direct measurement with wavelength standard filter and absorbance standard filter.

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
Neutral Density Filter	RM-1N2N3N	18944	CI-0137-23	Apr 25, 2025
Holmium Filter	RM-HG	19136	CI-0138-23	Apr 24, 2025

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

Traceability : This measurement are traceable to the International System of Unit (SI), through National Institute of Metrology Thailand (NIMT)

The reported uncertainty of measurement was based on standard uncertainty multiplied by coverage factor $k = 2$, providing a level of confidence of not less than 95%



Calibrated by : _____

Issue date : _____

Approved by : _____

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Certificate No. : MC23-2400

Page : 2 of 3

Result : Without adjustment
Function : Photometric accuracy

Wavelength setting (nm)	Standard value (Abs)	UUC* reading (Abs)	UUC* correction (Abs)	Uncertainty of measurement (+/- Abs)
440	0.0000	0.000	0.0000	0.003
	0.5537	0.557	-0.0033	0.003
	0.7450	0.749	-0.0040	0.003
	0.9898	0.990	-0.0002	0.003
465	0.0000	0.000	0.0000	0.003
	0.5142	0.517	-0.0028	0.003
	0.6873	0.691	-0.0037	0.003
	0.9400	0.939	0.0010	0.003
546.1	0.0000	0.000	0.0000	0.003
	0.5104	0.511	-0.0006	0.003
	0.6953	0.697	-0.0017	0.003
	0.9831	0.981	0.0021	0.003
590	0.0000	0.000	0.0000	0.003
	0.5439	0.543	0.0009	0.003
	0.7230	0.724	-0.0010	0.003
	1.0785	1.076	0.0025	0.003
635	0.0000	0.000	0.0000	0.003
	0.5511	0.550	0.0011	0.003
	0.6900	0.691	-0.0010	0.003
	1.0715	1.069	0.0025	0.003

UUC* = Unit under calibration

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Certificate No. : MC23-2400

Page : 3 of 3

Result : Without adjustment
Function : Wavelength accuracy

Spectral Band Width : 2 nm
Scan Speed : -

Standard value (nm)	UUC* reading (nm)	UUC* correction (nm)	Uncertainty of measurement (+/- nm)
288.04	288.0	0.04	0.14
418.34	418.0	0.34	0.14
446.01	446.0	0.01	0.14
536.39	536.0	0.39	0.14
637.84	638.0	-0.16	0.14

UUC* = Unit under calibration



Certificate of Calibration

Certificate No. : MC23-2370

Page : 1 of 2

Customer : Smile Laboratory Co., Ltd.

Address : 563/1 Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok, 10160

Description : pH Meter

Manufacturer : Mettler Toledo

Model : Seven Direct SD20

Serial No. : C238817351

Identification No. : SML.PH001/61

Calibration Place : Laboratory Room

Order No. : 3156/23

Received date : Oct 03, 2023

Calibration date : Oct 03, 2023

Environment Condition :

Temperature : (25+/-10) °C

Humidity : (50+/-30) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure *CP-MC-001* According to direct with Standard Thermometer and Standard Buffer Solution at 25 °C. The calibration methods based on ISO 10523 Water quality - Determination of pH, NIST : 1994.

Calibration were conducted using In-house calibration procedure *CP-MT-001* According to comparison with Standard Digital Thermometer.

The calibration methods based on ITS-90.

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
Digital Thermometer	EFT-4	EFT42020033	MT23-3227	May 01, 2024
Standard Digital Thermometer	UM RTD	2002Z Z38 0073A	MT22-6383	Nov 21, 2023
<u>Instrument</u>	<u>Model</u>	<u>Lot No.</u>	<u>Expired Date.</u>	
Standard Buffer Solution (4 pH)	1040525C	4C22E1	May 28, 2025	
Standard Buffer Solution (7 pH)	1070525C	725C22B1	Feb 28, 2024	
Standard Buffer Solution (10 pH)	1100525C	1125C22B1	Feb 28, 2024	

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

Traceability : This measurement are traceable to the International System of Unit (SI), through
National Institute of Metrology Thailand (NIMT)

The reported uncertainty of measurement was based on standard uncertainty multiplied by coverage factor $k = 2$,
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Calibrated by : _____
Issue date : _____

Approved by : _____

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ISO/IEC 17025

Certificate No. : MC23-2370

Page : 2 of 2

Function : pH measurement (Electrode)

Calibration point : 4, 7, 10 pH

Probe S/N : 2228537

Result : Without adjustment

Resolution : 0.01 pH

Standard Buffer (pH)	UUC* reading (pH)	UUC* correction (pH)	Uncertainty of measurement (+/- pH)
4.01	4.00	0.01	0.017
7.00	6.99	0.01	0.017
9.99	10.00	-0.01	0.017

Function : Temperature measurement

Sensor Type : Thermistor

Diameter : 12 mm

Calibration point : 23, 25, 27 °C

Result : Without adjustment

Resolution : 0.1 °C

Immersion depth (mm)	Calibration point (°C)	Standard reading (°C)	UUC* reading (°C)	UUC* correction (°C)	Uncertainty of measurement (+/- °C)
100	23	23.04	23.3	-0.26	0.20
100	25	25.04	25.2	-0.16	0.20
100	27	27.04	27.1	-0.06	0.20
100	23	23.04	23.3	-0.26	0.20

UUC* = Unit under calibration



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Calibration Cert. # 3884.01
ISO/IEC 17025

Certificate of Calibration

Certificate No. : MT23-6054

Page : 1 of 2

Customer : Smile Laboratory Co.,Ltd.

Address : 563/1 Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok, 10160

Description : Incubator

Manufacturer : Bio Base

Model : BJPX-B7011

Serial No. : 201705233231

Identification No. : SML.IN001/61

Calibration Place : Laboratory Room

Order No. : 3156/23

Received date : Oct 03, 2023

Calibration date : Oct 03, 2023

Environment Condition :

Temperature : (25+/-10) °C

Humidity : (50+/-30) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure *CP-MT-006* According to comparison with LXI Data Acquisition Switch Unit with sensor. The calibration methods based on Euramet Calibration Guide No.20 - guidelines on the Calibration of Temperature and/or Humidity Controlled Enclosures.

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
LXI Data Acquisition Switch Unit with Sensor	34972A	MY49028922	MT22-6393	Nov 24, 2023

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

Traceability : This measurement are traceable to the International System of Unit (SI), through National Institute of Metrology Thailand (NIMT)

The reported uncertainty of measurement was based on standard uncertainty multiplied by coverage factor $k = 2$, providing a level of confidence of not less than 95%



Calibrated by : _____

Issue date : _____

Approved by : _____

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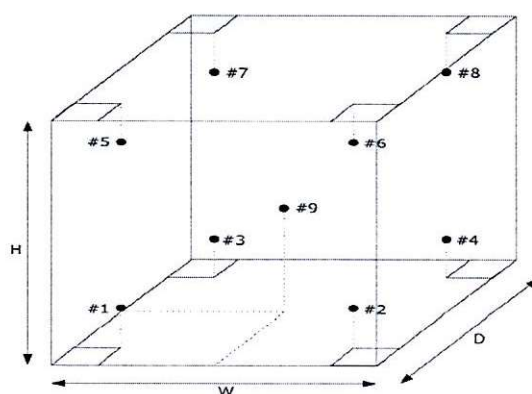
Saimai, Bangkok 10220, Thailand

Tel. (662) 909-8820 (Auto 10 lines) www.imcinstrument.com

Calibration Cert. # 3884.01
ISO/IEC 17025**Certificate No.** : MT23-6054**Page** : 2 of 2**Function** : Temperature measurement**Result** : Without adjustment**Calibration point** : 20 °C**Resolution** : 0.1 °C

Calibration point (°C)	Temperature of UUC* at each position (°C)									Uncertainty of measurement (+/- °C)
	Ch.1	Ch.2	Ch.3	Ch.4	Ch.5	Ch.6	Ch.7	Ch.8	Ch.9	
20	20.110	19.987	20.380	20.217	20.126	20.149	20.103	20.045	20.259	0.31

Setting temperature (°C)	Indicating Temperature (°C)	Measured stability (+/- °C)	Measured uniformity (°C)	Overall variation (°C)
20.0	20.0	0.07	0.32	0.53



- #1 Lower Left Front
- #2 Lower Right Front
- #3 Lower Left Rear
- #4 Lower Right Rear
- #5 Upper Left Front
- #6 Upper Right Front
- #7 Upper Left Rear
- #8 Upper Right Rear
- #9 Geometric Center

Front view**UUC*** = Unit under calibration**Uniformity** = Maximum and Minimum difference of measured temperature at any probes and the measured temperature at the reference and same time.**Overall Variation** = Difference of temperature value between the maximum and minimum any time.**Stability** = One half of the maximum difference of measured temperatures at any one probe.

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ISO/IEC 17025

Certificate of Calibration

Certificate No. : MT23-6057

Page : 1 of 2

Customer : Smile Laboratory Co.,Ltd.

Address : 563/1 Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok, 10160

Description : Hot Air Oven

Manufacturer : Bio Base

Model : BOV-V30F

Serial No. : 175226

Identification No. : SML.OV001/61

Calibration Place : Laboratory Room

Order No. : 3156/23

Received date : Oct 03, 2023

Calibration date : Oct 03, 2023

Environment Condition :

Temperature : (25+/-10) °C

Humidity : (50+/-30) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure *CP-MT-006* According to comparison with LXI Data Acquisition Switch Unit with sensor. The calibration methods based on Euramet Calibration Guide No.20 - guidelines on the Calibration of Temperature and/or Humidity Controlled Enclosures.

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
LXI Data Acquisition Switch Unit with Sensor	34972A	MY49028922	MT22-6393	Nov 24, 2023

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

Traceability : This measurement are traceable to the International System of Unit (SI), through National Institute of Metrology Thailand (NIMT)

The reported uncertainty of measurement was based on standard uncertainty multiplied by coverage factor $k = 2$, providing a level of confidence of not less than 95%



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Page : 2 of 2

Function : Temperature measurement

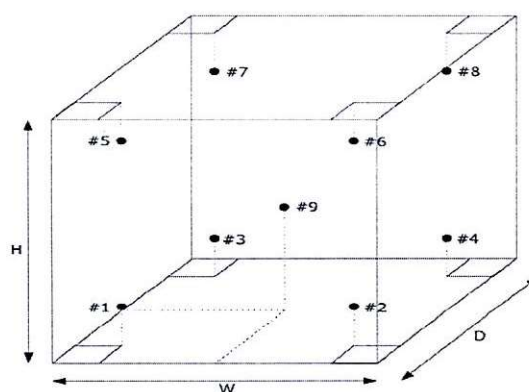
Result : Without adjustment

Calibration point : 104, 150, 180 °C

Resolution : 0.1 °C

Calibration point (°C)	Temperature of UUC* at each position (°C)									Uncertainty of measurement (+/- °C)
	Ch.1	Ch.2	Ch.3	Ch.4	Ch.5	Ch.6	Ch.7	Ch.8	Ch.9	
104	104.459	104.103	104.369	104.477	104.772	104.047	104.293	104.497	104.837	0.44
150	150.112	150.203	150.620	150.164	150.465	150.112	150.498	150.129	150.623	0.44
180	178.765	179.298	179.719	179.639	179.695	179.465	179.079	179.155	179.774	0.58

Setting temperature (°C)	Indicating Temperature (°C)	Measured stability (+/- °C)	Measured uniformity (°C)	Overall variation (°C)
104.0	104.0	0.15	0.95	1.1
150.0	150.1 to 150.2	0.24	0.90	1.2
180.0	180 to 180.2	0.34	1.6	1.9



- #1 Lower Left Front
- #2 Lower Right Front
- #3 Lower Left Rear
- #4 Lower Right Rear
- #5 Upper Left Front
- #6 Upper Right Front
- #7 Upper Left Rear
- #8 Upper Right Rear
- #9 Geometric Center

Front view

UUC* = Unit under calibration

Uniformity = Maximum and Minimum difference of measured temperature at any probes and the measured temperature at the reference and same time.

Overall Variation = Difference of temperature value between the maximum and minimum any time.

Stability = One half of the maximum difference of measured temperatures at any one probe.



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Certificate of Calibration

Certificate No. : ME23-2507

Page : 1 of 2

Customer : Smile Laboratory Co.,Ltd.

Address : 563/1 Thoet Thai Rd., Bangwa, Phasicharoen, Bangkok 10160

Description : Stop Watch

Manufacturer : Seiko

Model : S23601P

Serial No. : A12BI0147

Identification No. : ACF.WA002/59

Calibration Place : Time and Frequency Laboratory

Order No. : 3156/23

Received date : Oct 03, 2023

Calibration date : Oct 05, 2023

Environment Condition :

Temperature : (23 +/- 3) °C

Humidity : (50 +/- 15) %RH

Calibration Method : Calibration were conducted using In-house calibration procedure *CP-ME-001*.
According to comparison with Universal Counter.
The calibration methods based on NIST : SP960-12 : 2009.

Reference Standard Instruments :

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Certificate No.</u>	<u>Due Date</u>
Universal Counter	53131A	3416A06010	E3U230553	Apr 09, 2024

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

Traceability : This measurement are traceable to the International System of Unit (SI), through
National Institute of Metrology Thailand (NIMT)

The reported uncertainty of measurement was based on standard uncertainty multiplied by coverage factor $k = 2$,
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Calibrated by : _____

Issue date : _____

Approved by : _____

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ISO/IEC 17025**Certificate No. : ME23-2507****Page : 2 of 2**

Calibration Result : Without Adjustment
Function : Quartz Crystal Measurement
Frequency Range : 32 kHz

Nominal Value (kHz)	Measurement Value (kHz)	Measurement Error (kHz)	Uncertainty of Measurement (+/- mHz)
32.768	32.7671	-0.0009	0.76

$$\begin{aligned}\text{Timebase in 1 second} &= \frac{\text{Nominal frequency (Hz)}}{\text{Actual frequency (Hz)}} \\ &= 1.0000275 \text{ sec}\end{aligned}$$

The uncertainty of time measurement was ± 0.76 mHz or ± 0.76 ms/s



Avio220 Preventive Maintenance Report

Company Name: Smile Laboratory Co.,Ltd.


Instrument Location: ICP Room,563/1 Thoet Thai Rd.,
Bangwa,Phasicharoen,Bangkok 10160 Thailand.

Instrument Serial No.: M79S2206243

Date: 19-January-2024

ICP-OES/Avio220 Preventive Maintenance (PM)

Company Name:	Smile Laboratory Co.,Ltd.		
Address (Instrument Location):	563/1 Thoet Thai Rd.,Bangwa,Phasicharoen,Bangkok 10160 Thailand.		
Serial Number:	M79S2206243	PM Number:	1 OF 2 W
Customer Name (if applicable):	K. Nantanaphon	Telephone Number:	094-9406014
Service Engineer Name:	Khun Piyawit	Service Order Number:	WO-02685682
Date PM Performed: (DD-MMM-YYYY)	19-Jan-2024	Next PM Due Date: (DD-MMM-YYYY)	19-July-2024
Standard Labor Hours to Complete PM :		4 hours	

Part Number	Release	Publication Date	
TH09370183 Rev.2	B	July 2020	

Scope

The purpose of this PM is to ensure the continued functionality of the PerkinElmer/Avio220 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
Avio220Max	M79S2206243	Syngistix v.5.10

Parts Lists

Parts Included with the PM		
Part Number (if applicable)	Description	Quantity
09995098	Air Filter-Spectrometer	Not Applicable
N077520	Air Filter-RF Generator	Not Applicable
09992731	Axial Window	Not Applicable
B0810377	Radial Window	Not Applicable
N0770438	O-ring kit, injector support adapter	Not Applicable
N0780437	O-ring kit, torch	Not Applicable

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	7-263MFX1	30-Apr-2024
N9300221	Instrument Calibration-4 (N9300221 diluted 100X)	1	59-091CRY1	30-June-2024

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	76psig	76psig
Torch Argon	67psig	67psig
Shear Gas	65psig	65psig
Water	35psig	35psig

- ☒ 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.

Test Spectral Resolution:

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

Parameter	Specification	Test Result	Pass/Fail
As 193.696 - Resolution	≤0.009	0.00852	Passed
Ni 231.604 - Resolution	≤0.011	0.00965	Passed
Ni 341.476 - Resolution	≤0.015	0.01465	Passed
Ba 455.403 - Resolution	≤0.020	0.01745	Passed

Test Precision

- ☒ Test for reproducibility of a set of measurement.

Parameter	Specification	Test Result	Pass/Fail
Zn 213.856	%RSD \leq 1 %	0.59%	Passed
Mg 280.856	%RSD \leq 1 %	0.40%	Passed
Mg 285.207	%RSD \leq 1 %	0.95%	Passed
Ba 455.403	%RSD \leq 1 %	0.09%	Passed

Test MnBEC:

- ☒ 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% HNO_3)" and "IS (N069-1579/10)", record intensities.

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

Element	Mode	Conc.	IB	IS	
Mn 257.610	Radial	1,000 ppb	162,878.7	12,041,240.9	
Mn 257.610	Axial	1,000 ppb	162,302.8	12,032,875.1	
Mn 257.610	IB*Conc.	IS - IB	BEC	Spec	Pass/Fail
Radial	162,878,70	11,878,362.2	13.71	<30 PPB	Passed
Axial	162,302,80	11,870,572.3	13.67	<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

Review

<i>The preventive maintenance checks and if applicable performance tests for ICP-OES/Avio220 have been completed.</i>	
<i>This ICP-OES/Avio220 Passes <input checked="" type="checkbox"/> Fails <input type="checkbox"/> the preventive maintenance.</i>	
Review of Preventive Maintenance:	
Authorized PerkinElmer Representative:	<div></div> <div>Date: 19-Jan-2024 (DD-MMM-YYYY)</div>
Authorized Customer Representative:	<div></div> <div>Date: 19-Jan-2024 (DD-MMM-YYYY)</div>