

ภาคผนวกที่ 4

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สรุปเอกสารสอบเทียบอุปกรณ์เครื่องมือ

เอกสารการสอบเทียบเครื่องมือตรวจวัดระดับเสียงในบรรยากาศ

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0074

MTC No. EEL. BP. 17/1165

## CALIBRATION CERTIFICATE

**Submitted by** : C.E.M. TECHNOLOGY (THAILAND) CO., LTD.

**Address** : 31/8 Moo 13, Raikhing, Samphran, Nakhornpathom 73210.

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

**Instrument Calibrated :**

Description : Sound Level Meter

Manufacturer : ACO

Model : 6236

Serial No. : 222128 (NS-03-013)

Microphone : Type 7052NR No.84161

Preamplifier : -

**Ambient Environment**

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

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

Ambient Pressure :  $(101.325 \pm 1.5) \text{ kPa}$

**Standards used :**

1. Band Pass Filter Stanford Research Systems SR 650 S/N 28712.
2. Condenser Microphone Brüel&Kjær 4180 S/N 2633526.
3. Decade Attenuator Ando AL-205 S/N 00464602.
4. Function/Arbitrary Waveform Generator Agilent 33220A S/N MY44042668.
5. Digital Function Synthesizer NF Electronic Instruments DF-193A S/N 122037.
6. Digital Multimeter Fluke 8520A S/N 4985007.
7. Pistonphone Rion NC-72 S/N 00402446.
8. Measuring Amplifier Brüel&Kjær 2636 S/N 1537484.

**Date of Receipt** : 2 Nov. 2022

**Date of Calibration** : 3 Nov. 2022

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9. Power Amplifier Brüel&Kjær 2706 S/N 1517650.
10. Speaker Tannoy Limited, Great Britain British Patent No. 215300.
11. Digital Multimeter Agilent 34401A S/N MY44005560.
12. Programmable Attenuator Tamagawa TPA-303A S/N 2212.

**Calibration Procedure :**

This instrument was calibrated by using calibration procedures no CP-102-02 and CP-102-03, which were based on IEC 61672-3 Electroacoustics - Sound Level Meters - Part 3 : Periodic tests (2013). These calibration procedures were related to the electrical and acoustic signal tests. The electrical signal test was carried out with the direct measurement method. The acoustic signal test was performed in an anechoic room with the comparison measurement method.

This instrument has been calibrated against standards maintained at the 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.

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%.

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1. Absolute Sensitivity

Reference Acoustic Signal (dB)	Measured value (dB)		Deviation value (dB)	Acceptance limit Class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	Before adjust	After adjust				
113.97	113.3	114.0	0.0	1.0	0.30	N/A

**Note:** The external calibration adjustment was firstly performed. The internal calibration adjustment was then completed at the display of 114.2 dB.

2. Self-generated noise

2.1 Normal test

Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
20.6	0.10	N/A

2.2 The microphone of the sound level meter was replaced by electrical signal input device

Frequency Weighting	Measured value (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
A-Weight	16.9	0.10	N/A
C-Weight	21.7	0.10	N/A
Flat	26.0	0.10	N/A

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3. Acoustical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
125	0.0	0.0	0.1	1.5	0.45	0.6
1 000	-0.4	-0.4	-0.5	1.0	0.45	0.6
8 000	-4.3	-4.4	-4.1	5.0	0.45	0.7

4. Electrical signal test of frequency weightings

Frequency (Hz)	Deviation from frequency response (dB)			Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
	A-weight	C-weight	Flat			
63	-0.4	0.0	0.0	2.0	0.20	0.6
125	-0.4	0.1	0.0	1.5	0.20	0.6
250	-0.3	0.1	0.1	1.5	0.20	0.6
500	-0.2	-0.1	-0.1	1.5	0.20	0.6
1 000	0.0	-0.1	-0.1	1.0	0.20	0.6
2 000	0.0	0.0	0.0	2.0	0.20	0.6
4 000	-0.2	-0.2	0.0	3.0	0.20	0.6
8 000	-0.2	-0.5	0.0	5.0	0.20	0.7

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5. Long-term stability

Time	Measured Value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted
	(dB)	(dB)	class 2		uncertainty of measurement
			(±dB)	(±dB)	(±dB)
Begin	94.0	0.0	0.3	0.10	0.1
End	94.0				

6. Frequency and time weightings at 1 kHz

6.1 Frequency weightings at 1 kHz

Frequency	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted
Weighting	(dB)	(dB)	class 2		uncertainty of measurement
			(±dB)	(±dB)	(±dB)
A-weight	94.0	0.0	0.2	0.20	0.2
C-weight	94.0	0.0	0.2	0.20	0.2
Flat	94.0	0.0	0.2	0.20	0.2

6.2 Time weightings at 1 kHz

Frequency	Measured value	Deviated value	Acceptance limit	Uncertainty	Maximum-permitted
Weighting	(dB)	(dB)	class 2		uncertainty of measurement
			(±dB)	(±dB)	(±dB)
Fast	94.0	0.0	0.1	0.20	0.2
Slow	94.0	0.0	0.1	0.20	0.2
Leq	94.0	0.0	0.1	0.20	0.2

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7. Level linearity on the reference level range

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
122	122.1	0.1	1.1	0.30	0.3
121	121.1	0.1	1.1	0.30	0.3
120	120.1	0.1	1.1	0.30	0.3
119	119.1	0.1	1.1	0.30	0.3
114	114.0	0.0	1.1	0.30	0.3
109	109.0	0.0	1.1	0.30	0.3
104	104.0	0.0	1.1	0.30	0.3
99	99.0	0.0	1.1	0.30	0.3
94	94.0	0.0	1.1	0.30	0.3
89	88.9	-0.1	1.1	0.30	0.3
84	84.0	0.0	1.1	0.30	0.3
79	79.1	0.1	1.1	0.30	0.3
74	74.3	0.3	1.1	0.30	0.3
69	68.9	-0.1	1.1	0.30	0.3
64	63.8	-0.2	1.1	0.30	0.3
59	58.8	-0.2	1.1	0.30	0.3
54	53.8	-0.2	1.1	0.30	0.3
49	48.8	-0.2	1.1	0.30	0.3

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7. Level linearity on the reference level range (cont.)

Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (+dB)	Uncertainty (+dB)	Maximum-permitted uncertainty of measurement (+dB)
44	43.9	-0.1	1.1	0.30	0.3
39	38.8	-0.2	1.1	0.30	0.3
34	34.1	0.1	1.1	0.30	0.3
33	33.2	0.2	1.1	0.30	0.3
32	32.2	0.2	1.1	0.30	0.3
31	31.3	0.3	1.1	0.30	0.3
30	30.4	0.4	1.1	0.30	0.3

8. Level linearity including the level range control

At reference sound level on the reference level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (+dB)	Uncertainty (+dB)	Maximum-permitted uncertainty of measurement (+dB)
40-130	94.0	94.0	0.0	1.1	0.30	0.3
30-120	94.0	94.0	0.0	1.1	0.30	0.3
20-110	94.0	94.0	0.0	1.1	0.30	0.3
20-100	94.0	93.9	-0.1	1.1	0.30	0.3

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**8. Level linearity including the level range control**

At reference level at 5 dB greater than the under-range on a level range

Range	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
40-130	45.0	45.0	0.0	1.1	0.30	0.3
30-120	35.0	35.0	0.0	1.1	0.30	0.3
20-110	25.0	25.6	0.6	1.1	0.30	0.3
20-100	25.0	25.6	0.6	1.1	0.30	0.3
20-90	25.0	25.5	0.5	1.1	0.30	0.3
20-80	25.0	25.7	0.7	1.1	0.30	0.3

**9. Tone burst response**

Time Weighting	Toneburst Duration, Tb (ms)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Fast	200	116.0	0.0	±1.0	0.20	0.3
	2	98.9	-0.1	+1.0; -2.5	0.20	0.3
	0.25	89.9	-0.1	+1.5; -5.0	0.20	0.3
Slow	200	109.5	-0.1	±1.0	0.20	0.3
	2	89.9	-0.1	+1.0; -5.0	0.20	0.3
SEL	200	109.9	-0.1	±1.0	0.20	0.3
	2	90.0	0.0	+1.0; -2.5	0.20	0.3
	0.25	80.9	-0.1	+1.5; -5.0	0.20	0.3

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10. Peak C sound level

Number of cycles in test signal	Anticipated value (dB)	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Complete cycle	125.4	125.7	0.3	3.0	0.20	0.35
Positive half cycle	124.4	124.2	-0.2	2.0	0.20	0.35
Negative half cycle	124.4	124.2	-0.2	2.0	0.20	0.35

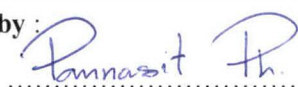
11. Overload indication

Measured value (dB)		Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Positive one-half cycle	Negative one-half cycle				
130.0	130.0	0.0	1.5	0.20	0.25

12. High-level stability

Time	Measured value (dB)	Deviated value (dB)	Acceptance limit class 2 (±dB)	Uncertainty (±dB)	Maximum-permitted uncertainty of measurement (±dB)
Begin	129.0	0.0	0.3	0.10	0.1
End	129.0				

Calibrated by :



(Mr. Pannasit Phasingsri)

Approved by :



(Mr. Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 3 Nov. 2022

Date of Issue : 3 Nov. 2022

Ref : 2011265110204749001

End of Certificate

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## CERTIFICATE OF CALIBRATION

Certificate No. : 66S0205-3

Job No. : 66S0205

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Customer : C.E.M Technology (Thailand) Co.,Ltd.

Address : 31/9 Moo 13, Raikhing, Samphran,  
Nakhornpathom 73210

Location : Laboratory

Equipment : Sound Level Meter

Ambient temperature : ( 20 ± 2 ) °C

Manufacturer : ACO

Relative humidity : ( 50 ± 15 ) %

Model : 6236

Atmospheric pressure : -

Serial No. : 222186

Date of received : 03-Feb-2023

Identity No. : NS-03-016

Date of calibration : 07-Feb-2023

Range : See to Data

Date of issued : 09-Feb-2023

Calibration Method : This instrument was calibrated by comparison measurement with sound level calibrator, according to in house calibration method.

### Reference Standard Instruments :

Equipment	Model	Serial No.	Certification No.	Due Date
Sound Level Calibrator	8930B	2000210	EEL.BP.31/0664	15-Jun-2023

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

- National Institute of Metrology Thailand, (NIMT).

Calibrated By : Mr. Boonyarit Auejirakarn

Approved By :

[ ] Ms. Bhacharin Phanangkaew (MD)

Reviewed By : [ ] Mr. Sompong Srisert

[ ] Mr. Boonyarit Auejirakarn

[x] Ms. Natthaparakarn Thammaphan



Result of Calibration : Without Adjustment

Function : Sound Level Measurement

Calibration Range : @ 1 kHz

Resolution : 0.1 dB / 1 dB

Response	Standard Setting ( dB )	UUC Reading ( dB )	Error Value ( dB )	Uncertainty ( +/-dB )
A	94	94.3	0.3	0.20
	104	104.2	0.2	0.20
	114	114.1	0.1	0.20
B	94	94.4	0.4	0.20
	104	104.2	0.2	0.20
	114	113.9	-0.1	0.20
Z	94	94.4	0.4	0.20
	104	104.1	0.1	0.20
	114	113.9	-0.1	0.20

*UUC\* = Unit Under Calibration*

- The End -

## CERTIFICATE OF CALIBRATION

Certificate No. : 66S0205-4

Job No. : 66S0205

Page : 1 of 2

Customer : C.E.M Technology (Thailand) Co.,Ltd.

Address : 31/9 Moo 13, Raikhing, Samphran,  
Nakhornpathom 73210

Location : Laboratory

Equipment : Sound Level Meter

Ambient temperature : ( 20 ± 2 ) °C

Manufacturer : ACO

Relative humidity : ( 50 ± 15 ) %

Model : 6236

Atmospheric pressure : -

Serial No. : 222187

Date of received : 03-Feb-2023

Identity No. : NS-03-017

Date of calibration : 07-Feb-2023

Range : See to Data

Date of issued : 09-Feb-2023

**Calibration Method :** This instrument was calibrated by comparison measurement with sound level calibrator, according to in house calibration method.

### Reference Standard Instruments :

Equipment	Model	Serial No.	Certification No.	Due Date
Sound Level Calibrator	8930B	2000210	EEL.BP.31/0664	15-Jun-2023

**Traceability :** This certification is traceable to the International System of Unit maintained at : -  
- National Institute of Metrology Thailand, (NIMT).

Calibrated By : Mr. Boonyarit Auejirakarn

Approved By :

[ ] Ms. Bhacharin Phanangkaew (MD)

Reviewed By : [ ] Mr. Sompong Srisert

[ ] Mr. Boonyarit Auejirakarn

[ ] Ms. Natthaparakarn Thammaphan

Result of Calibration : Without Adjustment

Function : Sound Level Measurement

Calibration Range : @ 1 kHz

Resolution : 0.1 dB / 1 dB

Response	Standard Setting ( dB )	UUC Reading ( dB )	Error Value ( dB )	Uncertainty ( +/-dB )
A	94	94.2	0.2	0.20
	104	104.0	0.0	0.20
	114	113.9	-0.1	0.20
B	94	94.2	0.2	0.20
	104	104.1	0.1	0.20
	114	113.8	-0.2	0.20
Z	94	94.2	0.2	0.20
	104	104.1	0.1	0.20
	114	113.8	-0.2	0.20

*UUC\* = Unit Under Calibration*

- The End -



## CERTIFICATE OF CALIBRATION

Certificate No. : 66S0420-22

Job No. : 66S0420

Page : 1 of 2

Customer : C.E.M Technology (Thailand) Co.,Ltd.

Address : 31/8 Moo 13, Raikhing, Samphran,  
Nakhornpathom 73210

Location : Laboratory

Equipment : Sound Level Meter

Ambient temperature : ( 20 ± 2 ) °C

Manufacturer : ACO

Relative humidity : ( 50 ± 15 ) %

Model : 6236

Atmospheric pressure : -

Serial No. : 222188

Date of received : 30-Mar-2023

Identity No. : NS-03-018

Date of calibration : 03-Apr-2023

Range : See to Data

Date of issued : 05-Apr-2023

Calibration Method : This instrument was calibrated by comparison measurement with sound level calibrator, according to in house calibration method.

### Reference Standard Instruments :

Equipment	Model	Serial No.	Certification No.	Due Date
Sound Level Calibrator	8930B	2000210	EEL.BP.31/0664	15-Jun-2023

Traceability : This certification is traceable to the International System of Unit maintained at : -  
- National Institute of Metrology Thailand, (NIMT).

Calibrated By : Mr. Boonyarit Auejirakarn

Approved By :

Reviewed By : [ ] Mr. Sompong Srisert

[ ] Ms. Bhacharin Phanangkaew (MD)

[ ] Ms. Natthaparakarn Thammaphan

[ ] Mr. Boonyarit Auejirakarn



Result of Calibration : Without Adjustment

Function : Sound Level Measurement

Calibration Range : @ 1 kHz

Resolution : 0.1 dB / 1 dB

Response	Standard Setting ( dB )	UUC Reading ( dB )	Error Value ( dB )	Uncertainty ( +/-dB )
A	94	94.0	0.0	0.20
	104	104.0	0.0	0.20
	114	113.9	-0.1	0.20
B	94	94.0	0.0	0.20
	104	103.9	-0.1	0.20
	114	113.8	-0.2	0.20
Z	94	94.0	0.0	0.20
	104	103.9	-0.1	0.20
	114	113.9	-0.1	0.20

*UUC\* = Unit Under Calibration*

- The End -

**CERTIFICATE OF CALIBRATION**

Certificate No. : 66S0420-24

Job No. : 66S0420

Page : 1 of 2

Customer : C.E.M Technology (Thailand) Co.,Ltd.

Address : 31/8 Moo 13, Raikhing, Samphran,  
Nakhornpathom 73210

Location : Laboratory

Equipment : Sound Level Meter

Ambient temperature : ( 20 ± 2 ) °C

Manufacturer : ACO

Relative humidity : ( 50 ± 15 ) %

Model : 6236

Atmospheric pressure : -

Serial No. : 222193

Date of received : 30-Mar-2023

Identity No. : NS-03-023

Date of calibration : 03-Apr-2023

Range : See to Data

Date of issued : 05-Apr-2023

**Calibration Method** : This instrument was calibrated by comparison measurement with sound level calibrator, according to in house calibration method.

**Reference Standard Instruments :**

Equipment	Model	Serial No.	Certification No.	Due Date
Sound Level Calibrator	8930B	2000210	EEL.BP.31/0664	15-Jun-2023

**Traceability** : This certification is traceable to the International System of Unit maintained at : -  
- National Institute of Metrology Thailand, (NIMT).

Calibrated By : Mr. Boonyarit Auejirakarn

Approved By : 

[ ] Ms. Bhacharin Phanangkaew (MD)

Reviewed By : [ ] Mr. Sompong Srisert

[ ] Mr. Boonyarit Auejirakarn

[x] Ms. Natthaparakarn Thammaphan

Result of Calibration : Without Adjustment

Function : Sound Level Measurement

Calibration Range : @ 1 kHz

Resolution : 0.1 dB / 1 dB

Response	Standard Setting ( dB )	UUC Reading ( dB )	Error Value ( dB )	Uncertainty ( +/-dB )
A	94	93.8	-0.2	0.20
	104	103.8	-0.2	0.20
	114	113.8	-0.2	0.20
B	94	93.8	-0.2	0.20
	104	103.8	-0.2	0.20
	114	113.8	-0.2	0.20
Z	94	93.8	-0.2	0.20
	104	103.8	-0.2	0.20
	114	113.8	-0.2	0.20

*UUC\* = Unit Under Calibration*

- The End -



# G.Ruamkit Panich Co.,Ltd.


219/44 Moo 12 Petchkasem Rd., Omnoi, Krathumban Samutsakorn 74130

CERTIFICATE No : GR 17 E 30062

PAGE : 1 OF 2

## Certificate of Calibration

**EQUIPMENT** : SOUND LEVEL METER  
**MANUFACTURER** : ACO  
**MODEL** : TYPE 6226  
**SERIAL No.** : 060209  
**ID No.** : CEM-SI-01  
  
**SUBMITTED BY** : C.E.M TECHNOLOGY (THAILAND) CO.,LTD.  
219/43 MOO 12, PETCHKASEM RD., OMNOI,  
KRATHUMBAN SAMUTSAKORN 74130

**CALIBRATED BY** :   
**CALIBRATION DATE** : 9-May-23

**APPROVED BY** :   
DHUDIT P.

**ISSUED DATE** : 9-May-23

# G.Ruamkit Panich Co.,Ltd.

219/44 Moo 12 Petchkasem Rd., Omnoi,Krathumban Samutsakorn 74130

CERTIFICATE No : GR 17 E 30062

PAGE : 2 OF 2

## Calibration Report

EQUIPMENT : SOUND LEVEL METER  
MANUFACTURER : ACO  
MODEL : TYPE 6226 SERIAL NUMBER : 060209  
ID No. : CEM-SI-01  
RECEIVED DATE : 4-May-23 CALIBRATION DATE : 9-May-23  
AMBIENT TEMPERATURE : 22 °C ± 3°C RELATIVE HUMIDITY : 50%RH ± 20%RH

### CONDITION OF THIS RESULTS OF CALIBRATION

- THIS INSTRUMENT WAS CALIBRATED ACCORDING TO IEC 61672-2:2003-04 AGAINST MULTIFUNCTION SOUND CALIBRATOR.  
THIS INSTRUMENT WAS PERFORMED SELF-CALIBRATION BY CALIBRATOR FROM CUSTOMER AT 114 Hz BEFORE CALIBRATION.
- REFERENCE STANDARD INSTRUMENTS :-

INSTRUMENT	MODEL	SERIAL No.	CERTIFICATTE No.	DUE DATE
1) MULTIFUNCTION SOUND CALIBRATOR.	1986	01827	EEL.BP.55/0974	12-Jan-24

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

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

- THIS CERTIFICATE IS TRACEABLE TO :-

- NATIONAL INSTITUTE OF METROLOGY (THAILAND) THROUGH THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR).

### RESULT OF CALIBRATION : WITHOUT ADJUSTMENT

#### 1. A-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
125.00	-16.10	-15.80	-0.30	0.50
250.00	-8.60	-8.10	-0.50	0.50
500.00	-3.20	-3.0	-0.20	0.50
1000.00	0.00	0.00	0.0	0.50
2000.00	1.20	0.90	0.3	0.50

#### 2. C-WEIGHTING ACOUSTIC FREQUENCY RESPONSE

FREQUENCY (Hz)	STANDARD EXPECTED READING (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
125.00	-0.20	0.1	-0.3	0.50
250.00	0.00	0.5	-0.5	0.50
500.00	0.00	0.3	-0.3	0.50
1000.00	0.00	0.0	0.0	0.50
2000.00	-0.20	-0.4	0.2	0.50

#### 3. SOUND LEVEL LINEARITY TEST AT 1000 Hz

STANDARD APPLIED (dB)	UUC READING (dB)	CORRECTION (dB)	UNCERTAINTY OF MEASUREMENT (±dB)
74	74.0	0.0	0.50
84	84.0	0.0	0.50
94	94.0	0.0	0.50
104	104.1	-0.1	0.50
114	114.2	-0.2	0.50

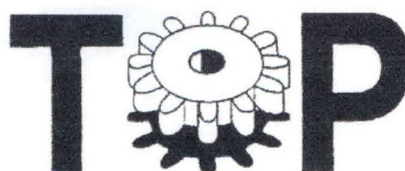
UUC\* : UNIT UNDER CALIBRATION

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

END OF CALIBRATION REPORT

เอกสารการสอบเทียบเครื่องมือตรวจวัดคุณภาพอากาศในบรรยากาศ





Trade & Engineering  
**TSP High Volume Sampler**  
**TE-5000 TSP Sampler Verification**

**Site Information**

<b>Location:</b> -	<b>Site ID:</b> -	<b>Date:</b> 9 Jan 23
<b>Sampler:</b> TE-5000 TSP	<b>Serial No:</b> 3268	<b>Tech:</b> Tong.P

**Site Conditions**

<b>Barometric Pressure (in Hg):</b> 27.60	<b>Corrected Pressure (mm Hg):</b> 701.0
<b>Temperature (deg F):</b> 76.0	<b>Temperature (deg K):</b> 297.6
<b>Average Press. (in Hg):</b> 27.00	<b>Corrected Average (mm Hg):</b> 685.8
<b>Average Temp (Deg F):</b> 75.2	<b>Average Temp: (Deg K):</b> 297.2

**Calibration Orifice**

<b>Make:</b> Tisch	<b>Qstd Slope:</b> 1.58304
<b>Model:</b> TE-5028A	<b>Qstd Intercept:</b> -0.01520
<b>Serial#:</b> 1179	<b>Calibration Due Date</b> 12 December 2023

**Calibration Information**

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	Linear Regression
1	7.30	1.650	62.7	60.26	<b>Slope:</b> 35.0463
2	5.50	1.433	56.0	53.82	<b>Intercept:</b> 2.9864
3	4.10	1.239	48.8	46.90	<b>Corr. Coeff:</b> 0.9975
4	3.60	1.162	45.6	43.83	
5	3.00	1.061	41.1	39.50	
					<b># of Observations:</b> 5

**Calculations**

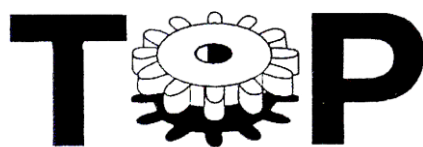
$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta)) - b]$   
 $IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$

Qstd = standard flow rate  
IC = corrected chart response  
I = actual chart response  
m = calibrator Qstd slope  
b = calibrator Qstd intercept  
Ta = actual temperature during calibration (deg K)  
Pa = actual pressure during calibration (mm Hg)  
Tstd = 298 deg K  
Pstd = 760 mm Hg  
For subsequent calculation of sampler flow:  
 $1/m((I)[\text{Sqrt}(298/Tav)(Pav/760)] - b)$

m = sampler slope  
b = sampler intercept  
I = chart response  
Tav = daily average temperature  
Pav = daily average pressure

<b>nter Average I (chart):</b>	49.0
<b>Average Flow Calculation m3/min</b>	1.244829703
<b>Average Flow Calculation in cfm</b>	43.95585051
<b>Sample Time (Hrs):</b>	24.0
<b>Total flow in 24 hours m3/min</b>	1792.554772
<b>Total flow in 24 hours cfm</b>	63296.42474

**NOTE: Ensure calibration orifice has been certified within 12 months of use**



Trade & Engineering

**TSP High Volume Sampler  
TE-5000 TSP Sampler Verification  
Site Information**

<b>Location:</b> -	<b>Site ID:</b> -	<b>Date:</b> 16 Oct 23
<b>Sampler:</b> TE-5000 TSP	<b>Serial No:</b> 3269	<b>Tech:</b> Tong.P

**Site Conditions**

<b>Barometric Pressure (in Hg):</b> 27.80	<b>Corrected Pressure (mm Hg):</b> 706.1
<b>Temperature (deg F):</b> 76.1	<b>Temperature (deg K):</b> 297.7
<b>Average Press. (in Hg):</b> 27.30	<b>Corrected Average (mm Hg):</b> 693.4
<b>Average Temp (Deg F):</b> 75.0	<b>Average Temp: (Deg K):</b> 297.0

**Calibration Orifice**

<b>Make:</b> Tisch	<b>Qstd Slope:</b> 1.58304
<b>Model:</b> TE-5028A	<b>Qstd Intercept:</b> -0.01520
<b>Serial#:</b> 1179	<b>Calibration Due Date</b> 12 December 2023

**Calibration Information**

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	Linear Regression
1	7.50	1.678	59.7	57.58	<b>Slope:</b> 35.4041
2	6.30	1.539	55.4	53.43	<b>Intercept:</b> -2.1709
3	5.20	1.399	47.9	46.20	<b>Corr. Coeff:</b> 0.9834
4	4.50	1.302	43.7	42.15	
5	3.10	1.112	40.1	38.68	
					<b># of Observations:</b> 5

**Calculations**

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$
$$IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$$

Qstd = standard flow rate

IC = corrected chart response

I = actual chart response

m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m((I)[\text{Sqrt}(298/Tav)(Pav/760)]-b)$$

m = sampler slope

b = sampler intercept

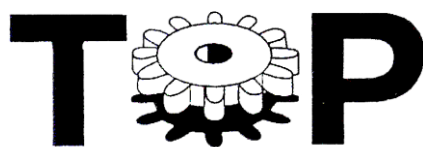
I = chart response

Tav = daily average temperature

Pav = daily average pressure

<b>Enter Average I (chart):</b>	49.4
<b>Average Flow Calculation m3/min</b>	1.395189676
<b>Average Flow Calculation in cfm</b>	49.26517152
<b>Sample Time (Hrs):</b>	24.0
<b>Total flow in 24 hours m3/min</b>	2009.073133
<b>Total flow in 24 hours cfm</b>	70941.84699

**NOTE: Ensure calibration orifice has been certified within 12 months of use**



Trade & Engineering

**TSP High Volume Sampler  
TE-5000 TSP Sampler Verification  
Site Information**

<b>Location:</b> -	<b>Site ID:</b> -	<b>Date:</b> 13 Oct 23
<b>Sampler:</b> TE-5000 TSP	<b>Serial No:</b> 3278	<b>Tech:</b> Tong.P

**Site Conditions**

<b>Barometric Pressure (in Hg):</b> 28.00	<b>Corrected Pressure (mm Hg):</b> 711.2
<b>Temperature (deg F):</b> 75.8	<b>Temperature (deg K):</b> 297.5
<b>Average Press. (in Hg):</b> 26.00	<b>Corrected Average (mm Hg):</b> 660.4
<b>Average Temp (Deg F):</b> 76.3	<b>Average Temp: (Deg K):</b> 297.8

**Calibration Orifice**

<b>Make:</b> Tisch	<b>Qstd Slope:</b> 1.58304
<b>Model:</b> TE-5028A	<b>Qstd Intercept:</b> -0.01520
<b>Serial#:</b> 1179	<b>Calibration Due Date</b> 12 December 2023

**Calibration Information**

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	Linear Regression
1	7.00	1.628	60.5	58.58	<b>Slope:</b> 48.3100
2	6.20	1.532	56.4	54.61	<b>Intercept:</b> -20.5901
3	5.70	1.470	50.7	49.09	<b>Corr. Coeff:</b> 0.9844
4	4.80	1.350	44.3	42.89	
5	3.80	1.202	40.1	38.82	
					<b># of Observations:</b> 5

**Calculations**

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$
$$IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$$

Qstd = standard flow rate

IC = corrected chart response

I = actual chart response

m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m((I)[\text{Sqrt}(298/Tav)(Pav/760)]-b)$$

m = sampler slope

b = sampler intercept

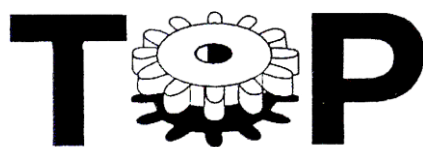
I = chart response

Tav = daily average temperature

Pav = daily average pressure

<b>Enter Average I (chart):</b>	50.4
<b>Average Flow Calculation m3/min</b>	1.399099132
<b>Average Flow Calculation in cfm</b>	49.40321728
<b>Sample Time (Hrs):</b>	24.0
<b>Total flow in 24 hours m3/min</b>	2014.70275
<b>Total flow in 24 hours cfm</b>	71140.63288

**NOTE: Ensure calibration orifice has been certified within 12 months of use**



Trade & Engineering

**TSP High Volume Sampler  
TE-5000 TSP Sampler Verification  
Site Information**

<b>Location:</b> -	<b>Site ID:</b> -	<b>Date:</b> 18 Oct 23
<b>Sampler:</b> TE-5000 TSP	<b>Serial No:</b> 3280	<b>Tech:</b> Tong.P

**Site Conditions**

<b>Barometric Pressure (in Hg):</b> 28.40	<b>Corrected Pressure (mm Hg):</b> 721.4
<b>Temperature (deg F):</b> 77.0	<b>Temperature (deg K):</b> 298.2
<b>Average Press. (in Hg):</b> 26.50	<b>Corrected Average (mm Hg):</b> 673.1
<b>Average Temp (Deg F):</b> 75.8	<b>Average Temp: (Deg K):</b> 297.5

**Calibration Orifice**

<b>Make:</b> Tisch	<b>Qstd Slope:</b> 1.58304
<b>Model:</b> TE-5028A	<b>Qstd Intercept:</b> -0.01520
<b>Serial#:</b> 1179	<b>Calibration Due Date</b> 12 December 2023

**Calibration Information**

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	Linear Regression
1	7.50	1.695	60.9	59.32	<b>Slope:</b> 39.2312
2	6.00	1.517	56.0	54.54	<b>Intercept:</b> -5.8658
3	4.80	1.358	50.7	49.38	<b>Corr. Coeff:</b> 0.9824
4	4.30	1.285	45.8	44.61	
5	3.60	1.177	39.7	38.67	
					<b># of Observations:</b> 5

**Calculations**

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$
$$IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$$

Qstd = standard flow rate

IC = corrected chart response

I = actual chart response

m = calibrator Qstd slope

b = calibrator Qstd intercept

Ta = actual temperature during calibration (deg K)

Pa = actual pressure during calibration (mm Hg)

Tstd = 298 deg K

Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m((I)[\text{Sqrt}(298/Tav)(Pav/760)]-b)$$

m = sampler slope

b = sampler intercept

I = chart response

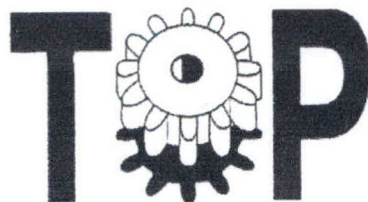
Tav = daily average temperature

Pav = daily average pressure

<b>Enter Average I (chart):</b>	50.6
<b>Average Flow Calculation m3/min</b>	1.364865144
<b>Average Flow Calculation in cfm</b>	48.19439004
<b>Sample Time (Hrs):</b>	24.0
<b>Total flow in 24 hours m3/min</b>	1965.405807
<b>Total flow in 24 hours cfm</b>	69399.92166

**NOTE: Ensure calibration orifice has been certified within 12 months of use**





Trade & Engineering

## PM10 High Volume Sampler Verification

### Site Information

Location: -

Site ID: -

Date: 10 January 2023

Sampler: TE-6070 PM10

Serial No: 1239

Tech: Tong P.

### Site Conditions

Barometric Pressure (in Hg): 27.00

Temperature (deg F): 75.6

Average Press. (in Hg): 26.50

Average Temp. (deg F): 75.2

Corrected Pressure (mm Hg): 685.8

Temperature (deg K): 297.2

Corrected Average (mm Hg): 673.1

Average Temp. (deg K): 297.0

### Calibration Orifice

Make: Tisch Environmental, Inc.

Model: TE-5028A

Serial#: 1179

Qstd Slope: 1.58304

Qstd Intercept: -0.01520

Calibration Due Date: 12 Dec 23

### Calibration Data

Plate or Test #	In H2O	Qa (m3/min)	I (chart)	IC (corrected)	Linear Regression
1	8.60	1.229	59.7	39.30	Slope 33.1155
2	6.80	1.094	54.7	36.01	Intercept -0.8080
3	5.60	0.994	49.7	32.72	Corr. Coeff 0.9947
4	4.80	0.921	44.6	29.36	SFR 1.110
5	3.60	0.799	38.5	25.35	SSP 54.60

# of Observations: 5

### Calculations

$$Qa = 1/m(\text{Sqrt}((H2O)(Ta/Pa))-b)$$

$$IC = I(\text{Sqrt}(Ta/Pa))$$

Qa = actual flow rate

IC = corrected chart response

m = calibrator slope

b = calibrator intercept

Ta = actual temperature (deg K)

Pa = actual pressure (mm Hg)

For subsequent calculation

of sampler flow:

$$SFR = 1.13(Ps/Pa)(Ta/Ts)$$

$$SSP = (m*SFR+b)(\text{Sqrt}(Pa/Ta))$$

SFR = sampler set point flow rate

SSP = sampler chart set point

m = sampler slope

b = sampler intercept

Ta = actual temperature (deg K)

Pa = actual pressure (mm Hg)

Ts = Average temperature (deg K)

Ps = Average pressure (mm Hg)

m = sampler slope

b = sampler intercept

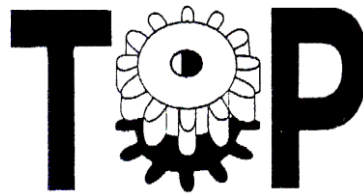
I = chart response

Tav = daily average temperature

Pav = daily average pressure

**NOTE: Ensure calibration orifice has been certified within 12 months of use**

Average I(chart):	50.1
Average Flow over Sample (m3/min)	1.029348739
Enter Total Time (Hrs):	24.0
Total flow over sample (m3/min)	1482.262184
Total flow over sample (CFM)	52338.6777



Trade & Engineering

## PM10 High Volume Sampler Verification

### Site Information

Location: - Site ID: - Date: 2 October 2023  
Sampler: TE-6070 PM10 Serial No: 3115 Tech: Tong P.

### Site Conditions

Barometric Pressure (in Hg): 26.60 Corrected Pressure (mm Hg): 675.6  
Temperature (deg F): 75.3 Temperature (deg K): 297.1  
Average Press. (in Hg): 26.65 Corrected Average (mm Hg): 676.9  
Average Temp. (deg F): 76.5 Average Temp. (deg K): 297.7

### Calibration Orifice

Make: Tisch Environmental, Inc. Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date: 12 Dec 23

### Calibration Data

Plate or Test #	In H2O	Qa (m3/min)	I (chart)	IC (corrected)	Linear Regression
1	9.80	1.321	60.5	40.12	Slope 33.7625
2	7.35	1.145	55.7	36.93	Intercept -3.3283
3	6.60	1.086	50.8	33.68	Corr. Coeff 0.9758
4	5.35	0.978	45.5	30.17	SFR 1.130
5	4.60	0.908	39.3	26.06	SSP 52.50

# of Observations: 5

### Calculations

$Qa = 1/m(\text{Sqrt}((H2O)(Ta/Pa))-b)$   
 $IC = I(\text{Sqrt}(Ta/Pa))$

Qa = actual flow rate  
IC = corrected chart response  
m = calibrator slope  
b = calibrator intercept  
Ta = actual temperature (deg K)  
Pa = actual pressure (mm Hg)  
For subsequent calculation  
of sampler flow:

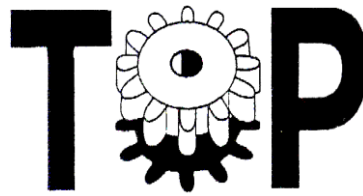
$SFR = 1.13(Ps/Pa)(Ta/Ts)$   
 $SSP = (m*SFR+b)(\text{Sqrt}(Pa/Ta))$   
SFR = sampler set point flow rate  
SSP = sampler chart set point  
m = sampler slope  
b = sampler intercept  
Ta = actual temperature (deg K)  
Pa = actual pressure (mm Hg)  
Ts = Average temperature (deg K)  
Ps = Average pressure (mm Hg)

m = sampler slope  
b = sampler intercept  
I = chart response  
Tav = daily average temperature  
Pav = daily average pressure

**NOTE: Ensure calibration orifice has been certified within 12 months of use.**

Average I(chart): 50.4  
Average Flow over Sample (m3/min)  
1.088579793  
Enter Total Time (Hrs): 24.0  
Total flow over sample (m3/min)  
1567.554902  
Total flow over sample (CFM)  
55350.36359





Trade & Engineering

## PM10 High Volume Sampler Verification

### Site Information

Location: - Site ID: - Date: 2 October 2023  
Sampler: TE-6070 PM10 Serial No: 3183 Tech: Tong P.

### Site Conditions

Barometric Pressure (in Hg): 27.02 Corrected Pressure (mm Hg): 686.3  
Temperature (deg F): 75.3 Temperature (deg K): 297.1  
Average Press. (in Hg): 26.70 Corrected Average (mm Hg): 678.2  
Average Temp. (deg F): 76.1 Average Temp. (deg K): 297.5

### Calibration Orifice

Make: Tisch Environmental, Inc. Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date: 12 Dec 23

### Calibration Data

Plate or Test #	In H2O	Qa (m3/min)	I (chart)	IC (corrected)	Linear Regression
1	9.45	1.287	60.5	39.80	Slope 36.1461
2	7.75	1.167	55.3	36.38	Intercept -6.1754
3	6.50	1.069	50.7	33.36	Corr. Coeff 0.9935
4	5.75	1.006	45.3	29.80	SFR 1.115
5	4.60	0.901	39.6	26.05	SSP 51.87

# of Observations: 5

### Calculations

$Qa = 1/m(\text{Sqrt}((H2O)(Ta/Pa))-b)$   
 $IC = I(\text{Sqrt}(Ta/Pa))$

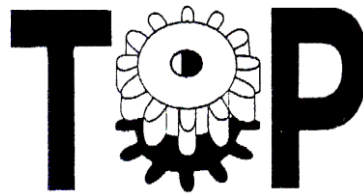
Qa = actual flow rate  
IC = corrected chart response  
m = calibrator slope  
b = calibrator intercept  
Ta = actual temperature (deg K)  
Pa = actual pressure (mm Hg)  
For subsequent calculation  
of sampler flow:

$SFR = 1.13(Ps/Pa)(Ta/Ts)$   
 $SSP = (m*SFR+b)(\text{Sqrt}(Pa/Ta))$   
SFR = sampler set point flow rate  
SSP = sampler chart set point  
m = sampler slope  
b = sampler intercept  
Ta = actual temperature (deg K)  
Pa = actual pressure (mm Hg)  
Ts = Average temperature (deg K)  
Ps = Average pressure (mm Hg)

m = sampler slope  
b = sampler intercept  
I = chart response  
Tav = daily average temperature  
Pav = daily average pressure

**NOTE: Ensure calibration orifice has been certified within 12 months of use.**

Average I(chart): 50.3  
Average Flow over Sample (m3/min)  
1.092521097  
Enter Total Time (Hrs): 24.0  
Total flow over sample (m3/min)  
1573.23038  
Total flow over sample (CFM)  
55550.76473



Trade & Engineering

## PM10 High Volume Sampler Verification

### Site Information

Location: - Site ID: - Date: 2 October 2023  
Sampler: TE-6070 PM10 Serial No: 3211 Tech: Tong P.

### Site Conditions

Barometric Pressure (in Hg): 27.10 Corrected Pressure (mm Hg): 688.3  
Temperature (deg F): 75.3 Temperature (deg K): 297.0  
Average Press. (in Hg): 26.55 Corrected Average (mm Hg): 674.4  
Average Temp. (deg F): 76.2 Average Temp. (deg K): 297.6

### Calibration Orifice

Make: Tisch Environmental, Inc. Qstd Slope: 1.58304  
Model: TE-5028A Qstd Intercept: -0.01520  
Serial#: 1179 Calibration Due Date: 12 Dec 23

### Calibration Data

Plate or Test #	In H2O	Qa (m3/min)	I (chart)	IC (corrected)	Linear Regression
1	9.60	1.295	60.7	39.87	Slope 34.8028
2	7.50	1.146	55.5	36.46	Intercept -4.2838
3	6.45	1.063	50.8	33.37	Corr. Coeff 0.9827
4	5.35	0.969	45.9	30.15	SFR 1.105
5	4.60	0.900	39.2	25.75	SSP 52.02

# of Observations: 5

### Calculations

$Qa = 1/m(\text{Sqrt}((H2O)(Ta/Pa))-b)$   
 $IC = I(\text{Sqrt}(Ta/Pa))$

Qa = actual flow rate  
IC = corrected chart response  
m = calibrator slope  
b = calibrator intercept  
Ta = actual temperature (deg K)  
Pa = actual pressure (mm Hg)  
For subsequent calculation  
of sampler flow:

$SFR = 1.13(Ps/Pa)(Ta/Ts)$   
 $SSP = (m*SFR+b)(\text{Sqrt}(Pa/Ta))$   
SFR = sampler set point flow rate  
SSP = sampler chart set point  
m = sampler slope  
b = sampler intercept  
Ta = actual temperature (deg K)  
Pa = actual pressure (mm Hg)  
Ts = Average temperature (deg K)  
Ps = Average pressure (mm Hg)

m = sampler slope  
b = sampler intercept  
I = chart response  
Tav = daily average temperature  
Pav = daily average pressure

**NOTE: Ensure calibration orifice has been certified within 12 months of use.**

Average I(chart): 50.4  
Average Flow over Sample (m3/min)  
1.085070646  
Enter Total Time (Hrs): 24.0  
Total flow over sample (m3/min)  
1562.501731  
Total flow over sample (CFM)  
55171.9361

## Certificate of Calibration

Calibrated Date : 2-Sep-23

Certificate No. : 0223-002

Page : 1/1

### Instruments

Instruments : PM2.5-PM10 Air Sampler

Manufacturer : Thermo Scientific

Model : 2000-D

Serial No. : 200DA200310704

### Environmental

Temperature : 24.7 °C

Humidity : 52.8 %RH

### Calibration System

Instruments : Drycal

Manufacturer : Bios

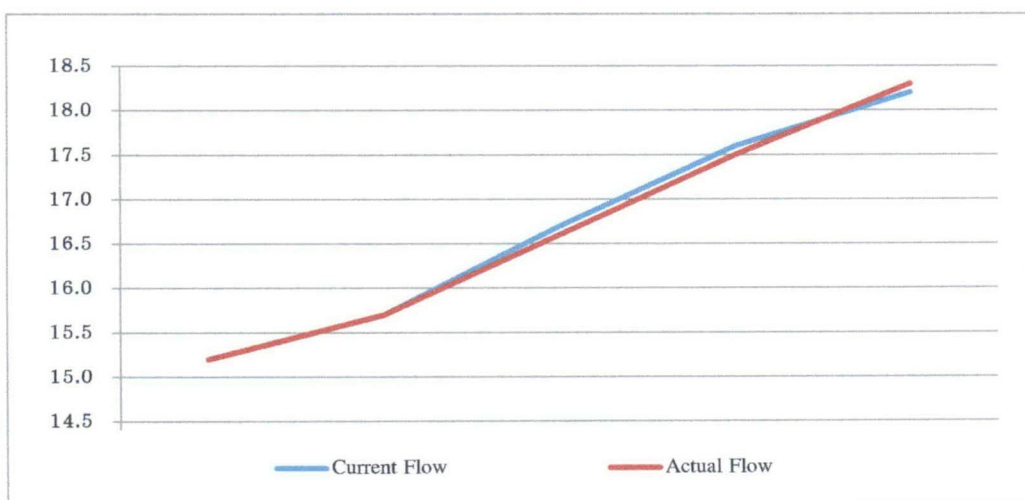
Model : DCL-H

Serial No. : 102591


Calibration due date : 24-Oct-23

### Flow Tetsing

Filter	Set Flow Instrument (L/min)	Current Flow Instrument reading (L/min)	Actual Flow Reference Standard (L/min)
47 mm.	16.7	16.7	16.6
	17.5	17.6	17.5
	15.8	15.7	15.7
	18.3	18.2	18.3
	15.0	15.2	15.2



Calibrated by :

  
 (Mr. Tong Piima)

## Certificate of Calibration

Calibrated Date : 1-Apr-23

Certificate No. : 0423-002

Page : 1/1

### Instruments

Instruments : PM2.5-PM10 Air Sampler

Manufacturer : Thermo Scientific

Model : 2000-H

Serial No. : 200FA201309703

### Environmental

Temperature : 25.2 °C

Humidity : 52.3 %RH

### Calibration System

Instruments : Drycal

Manufacturer : Bios

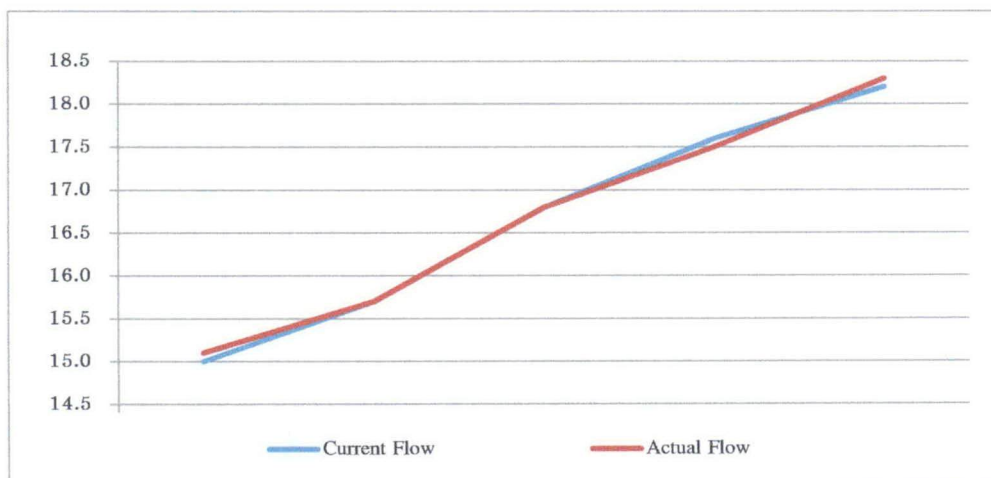
Model : DCL-H

Serial No. : 102591

Calibration due date : 24-Oct-23

### Flow Tetsing

Filter	Set Flow Instrument (L/min)	Current Flow Instrument reading (L/min)	Actual Flow Reference Standard (L/min)
47 mm.	16.7	16.8	16.8
	17.5	17.6	17.5
	15.8	15.7	15.7
	18.3	18.2	18.3
	15.0	15.0	15.1



Calibrated by :

  
 (Mr. Tong Piima)

## Certificate of Calibration

Calibrated Date : 5-Sep-23

Certificate No. : 0923-004

Page : 1/1

### Instruments

Instruments : PM2.5-PM10 Air Sampler

Manufacturer : TEOM Control Unit (RP)

Model : 1400a

Serial No. : 140AB254490412

### Environmental

Temperature : 23.8 °C

Humidity : 42.5 %RH

### Calibration System

Instruments : Drycal

Manufacturer : Bios

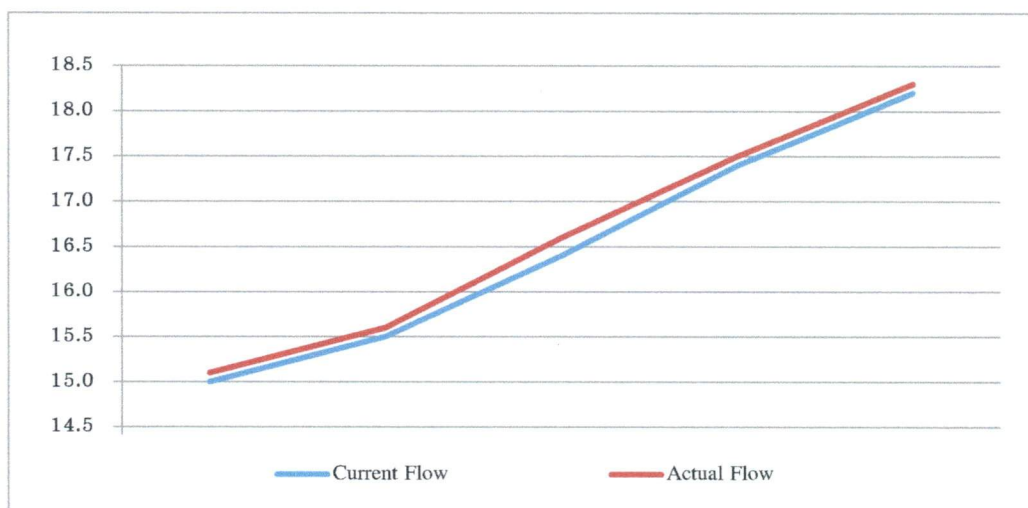
Model : DCL-H

Serial No. : 102591

Calibration due date : 20-Oct-22

### Flow Tetsing

Filter	Set Flow Instrument (L/min)	Current Flow Instrument reading (L/min)	Actual Flow Reference Standard (L/min)
47 mm.	16.5	16.4	16.6
	17.3	17.4	17.5
	15.6	15.5	15.6
	18.0	18.2	18.3
	15.1	15.0	15.1



Calibrated by :

  
 (Mr. Tong Piima)



## Certificate of Analyzer Performance Testing

Calibrated Date : 30-Jan-23

Certificate No. : 0123-002

Page : 1/1

### Analyzer Instruments

Analyzer Type : THC Analyzer

Manufacturer : Baseline

Model : Series 8800

Serial No. : 584

### Environmental

Temperature : 24.5 °C

Humidity : 56.3 %RH

### Calibration System

#### Calibrator Units

Gas Calibration : Thermo Environmental

Zero Air Generator : API

Model : 146C

Model : 701

Serial No. : 514811458

Serial No. : 179

### Standard Gas

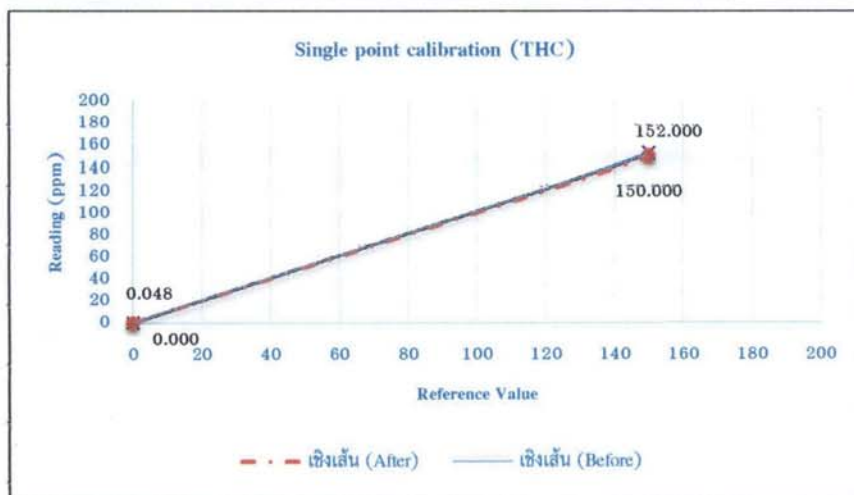
Propane Conc. : 150 ppm

Cylinder No. : 21W281046

Expire Date : 26-Sep-25

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
Before						
THC	0.048	0.000	0.048	152	150	1.333
After						
THC	0.000	0.000	0.000	150	150	0.000



Calibrated by :

  
(Mr. Tong Piima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 1-Apr-23

Certificate No. : 0423-001

Page : 1/1

### Analyzer Instruments

Analyzer Type : CO Analyzer

Manufacturer : Thermo Environmental

Model : 48C

Serial No. : 401304261

### Environmental

Temperature : 25.2 °C

Humidity : 52.3 %RH

### Calibration System

#### Calibrator Units

Gas Calibration : Thermo Environmental

Zero Air Generator : API

Model : 146C

Model : 701

Serial No. : 514811458

Serial No. : 179

### Standard Gas

NO Conc. : 2 ppm

Cylinder No. : CC750227

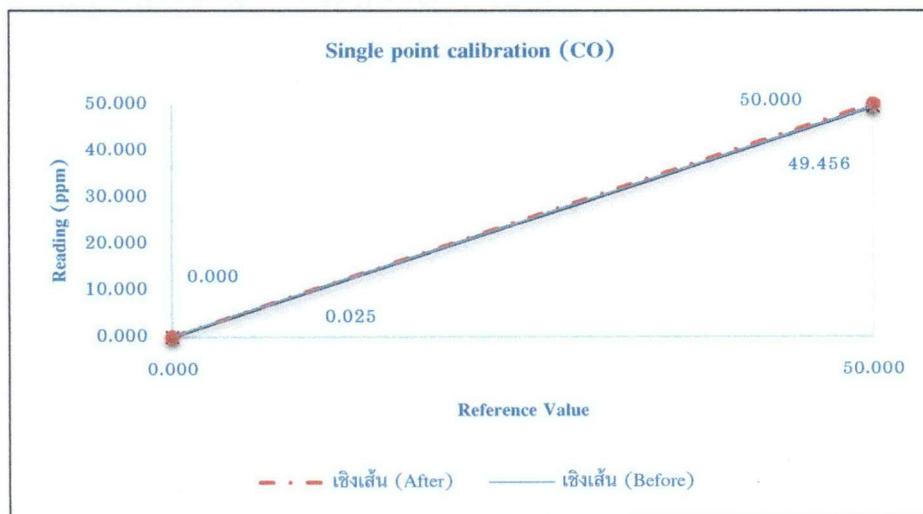
SO<sub>2</sub> Conc. : 2 ppm

Expire Date : 21-Nov-23

CO Conc. : 50 ppm

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
Before						
CO	0.025	0.000	0.03	49.456	50.000	-1.09
After						
CO	0.000	0.000	0.00	50.000	50.000	0.00



Calibrated by :

  
 (Mr. Tong Piima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 26-Aug-23

Certificate No. : 0823-005

Page : 1/1

### Analyzer Instruments

Analyzer Type : CO Analyzer

Manufacturer : Thermo Environmental

Model : 48C

Serial No. : 508011069

### Environmental

Temperature : 25.5 °C

Humidity : 53.7 %RH

### Calibration System

#### Calibrator Units

Gas Calibration : Thermo Environmental

Zero Air Generator : API

Model : 146C

Model : 701

Serial No. : 514811458

Serial No. : 179

### Standard Gas

NO Conc. : 2 ppm

Cylinder No. : CC750227

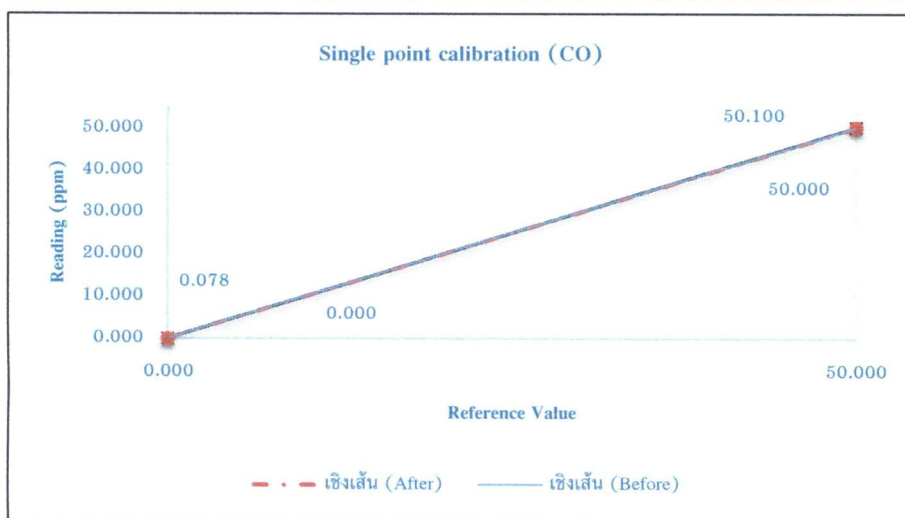
SO2 Conc. : 2 ppm

Expire Date : 21-Nov-23


CO Conc. : 50 ppm

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
Before						
CO	0.078	0.000	0.08	50.1	50.000	0.20
After						
CO	0.000	0.000	0.00	50.0	50.000	0.00



Calibrated by :

  
 (Mr. Tong Piima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 26-Aug-23

Certificate No. : 0823-001

Page : 1/1

### Analyzer Instruments

Analyzer Type : NO/NO/NO<sub>x</sub> Analyzer

Manufacturer : Thermo Environmental

Model : 42C

Serial No. : 66193-351

### Environmental

Temperature : 25.3 °C

Humidity : 40.2 %RH

### Calibration System

#### Calibrator Units

Gas Calibration : Thermo Environmental

Zero Air Generator : API

Model : 146C

Model : 701

Serial No. : 514811458

Serial No. : 179

### Standard Gas

NO Conc. : 2 ppm

Cylinder No. : CC750227

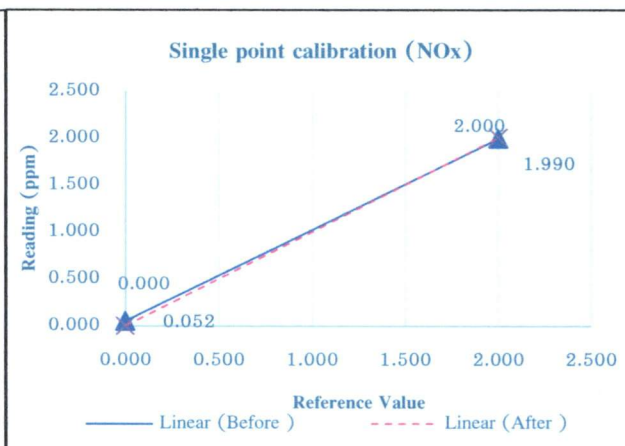
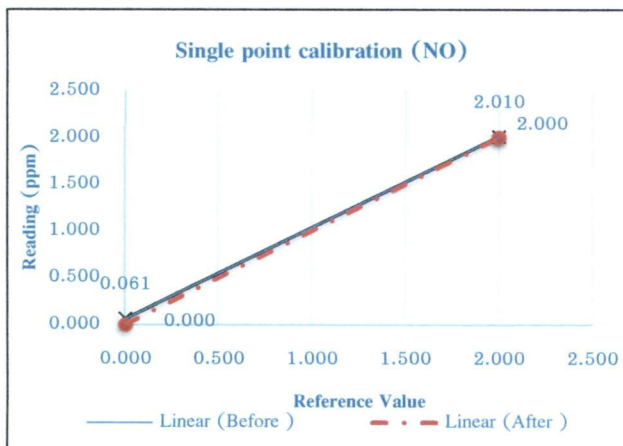
SO<sub>2</sub> : 2 ppm

Expire Date : 21-Nov-23


CO Conc. : 50 ppm

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
Before						
NO	0.061	0.000	0.06	2.01	2.00	0.50
NO <sub>x</sub>	0.052	0.000	0.05	1.99	2.00	-0.50
After						
NO	0.000	0.000	0.00	2.00	2.00	0.00
NO <sub>x</sub>	0.000	0.000	0.00	2.00	2.00	0.00



Calibrated by :

  
(Mr. Tong Piima)



## Certificate of Analyzer Performance Testing

Calibrated Date : 11-Mar-23

Certificate No. : 0323-003

Page : 1/1

### Analyzer Instruments

Analyzer Type : NO/NO<sub>x</sub> Analyzer  
Model : 42C

Manufacturer : Thermo Environmental  
Serial No. : 58926-320

### Environmental

Temperature : 24.3 °C  
Humidity : 51.4 %RH

### Calibration System

#### Calibrator Units

Gas Calibration : Thermo Environmental  
Model : 146C  
Serial No. : 514811458

Zero Air Generator : API  
Model : 701  
Serial No. : 179

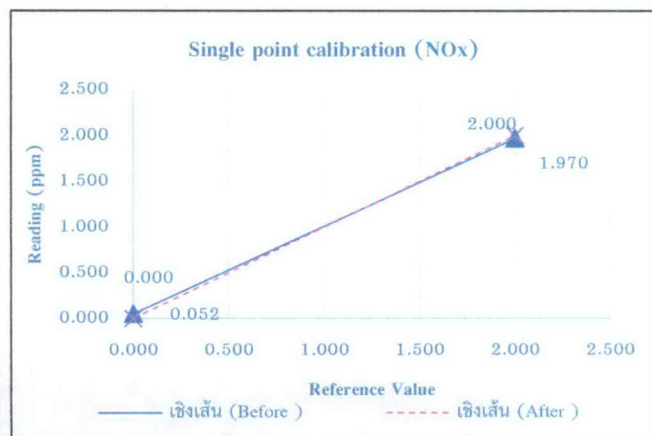
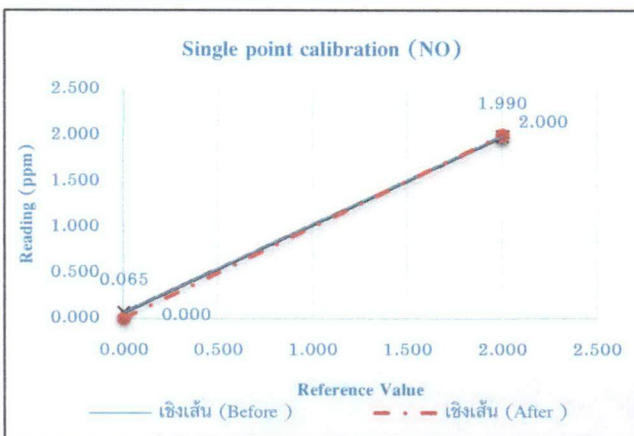
### Standard Gas

NO Conc. : 2 ppm  
SO<sub>2</sub> : 2 ppm  
CO Conc. : 50 ppm

Cylinder No. : CC750227  
Expire Date : 21-Nov-23

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
Before						
NO	0.065	0.000	0.07	1.99	2.00	-0.50
NO <sub>x</sub>	0.052	0.000	0.05	1.97	2.00	-1.50
After						
NO	0.000	0.000	0.00	2.00	2.00	0.00
NO <sub>x</sub>	0.000	0.000	0.00	2.00	2.00	0.00



Calibrated by :

*Tong Piima*  
(Mr. Tong Piima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 5-Aug-23

Certificate No. : 0823-001

Page : 1/1

### Analyzer Instruments

Analyzer Type : SO2 Analyzer

Manufacturer : Thermo Environmental

Model : 43C

Serial No. : 43C-62201-334

### Environmental

Temperature : 25.0 °C

Humidity : 51.9 %RH

### Calibration System

#### Calibrator Units

Gas Calibration : Thermo Environmental

Zero Air Generator : API

Model : 146C

Model : 701

Serial No. : 514811458

Serial No. : 179

### Standard Gas

NO Conc. : 2 ppm

Cylinder No. : CC750227

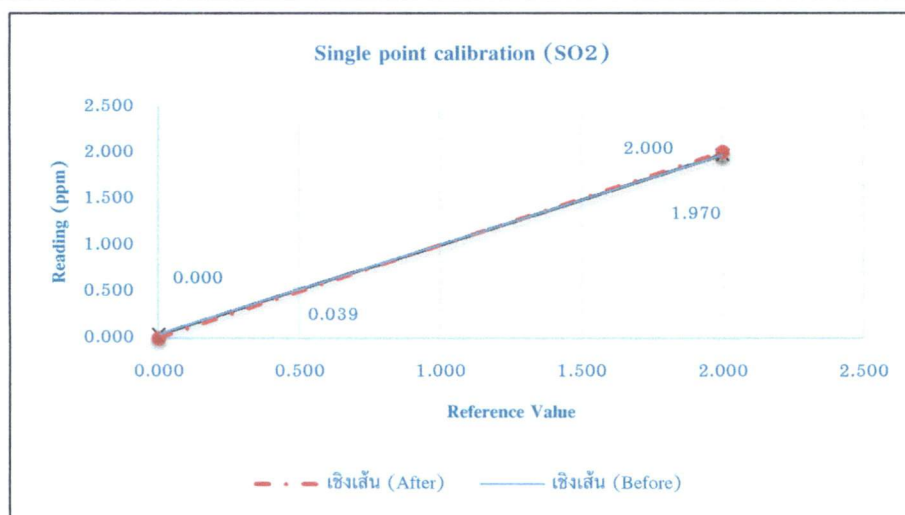
SO2 Conc. : 2 ppm

Expire Date : 21-Nov-23


CO Conc. : 50 ppm

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
Before						
SO2	0.039	0.000	0.04	1.97	2.000	-1.50
After						
SO2	0.000	0.000	0.00	2.00	2.000	0.00



Calibrated by :

  
 (Mr. Tong Piima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 26-Aug-23

Certificate No. : 0823-003

Page : 1/1

### Analyzer Instruments

Analyzer Type : SO2 Analyzer

Manufacturer : Thermo Environmental

Model : 43C

Serial No. : 43C-70852-367

### Environmental

Temperature : 24.9 °C

Humidity : 46.9 %RH

### Calibration System

#### Calibrator Units

Gas Calibration : Thermo Environmental

Zero Air Generator : API

Model : 146C

Model : 701

Serial No. : 514811458

Serial No. : 179

### Standard Gas

NO Conc. : 2 ppm

Cylinder No. : CC750227

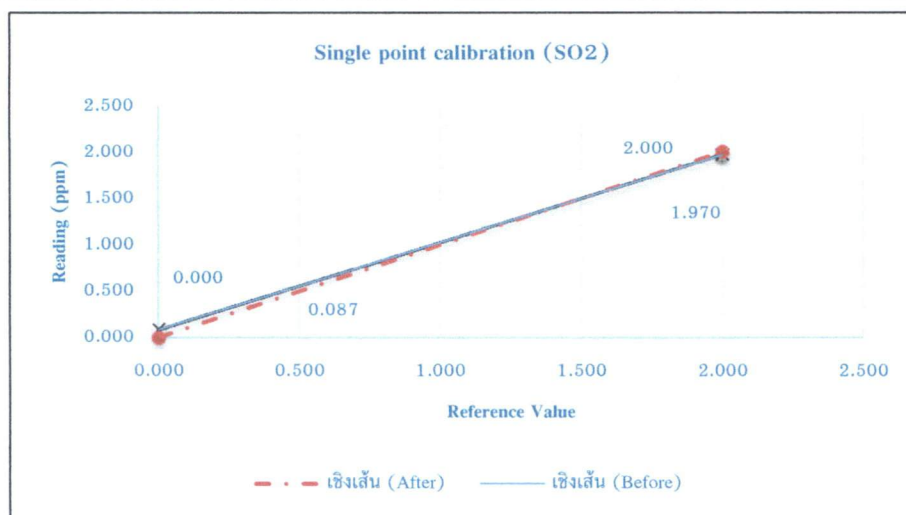
SO2 Conc. : 2 ppm

Expire Date : 21-Nov-23


CO Conc. : 50 ppm

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
Before						
SO2	0.087	0.000	0.09	1.97	2.000	-1.50
After						
SO2	0.000	0.000	0.00	2.00	2.000	0.00



Calibrated by :

  
 (Mr. Tong Piima)

## Certificate of Analyzer Performance Testing

Calibrated Date : 1-Apr-23

Certificate No. : 0423-003

Page : 1/1

### Analyzer Instruments

Analyzer Type : SO2 Analyzer

Manufacturer : Thermo Environmental

Model : 43C

Serial No. : 69858-364

### Environmental

Temperature : 25.2 °C

Humidity : 52.3 %RH

### Calibration System

#### Calibrator Units

Gas Calibration : Thermo Environmental

Zero Air Generator : API

Model : 146C

Model : 701

Serial No. : 514811458

Serial No. : 179

### Standard Gas

NO Conc. : 2 ppm

Cylinder No. : CC750227

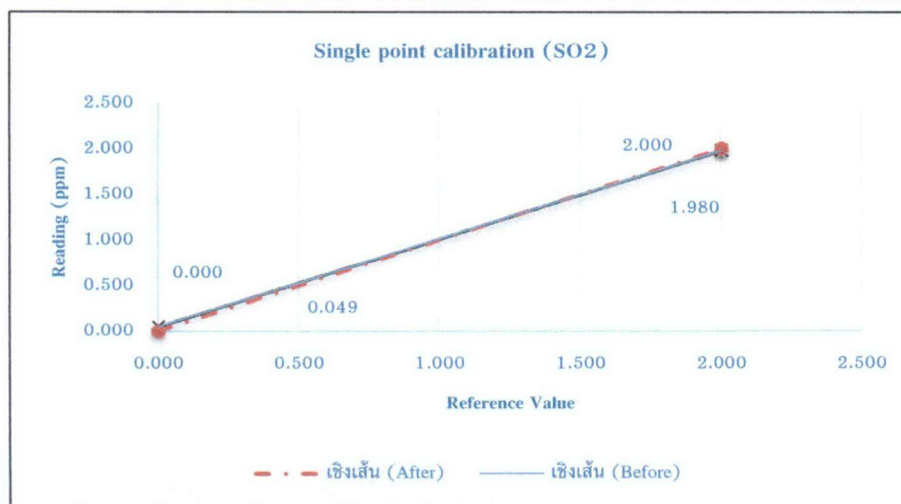
SO2 Conc. : 2 ppm

Expire Date : 21-Nov-23

CO Conc. : 50 ppm

### Calibration Check

Gas	Zero			Span		
	Reading Value (ppm)	Expected Value (ppm)	Drift (%)	Reading Value (ppm)	Expected Value (ppm)	Drift (%)
Before						
SO2	0.049	0.000	0.05	1.98	2.000	-1.00
After						
SO2	0.000	0.000	0.00	2.00	2.000	0.00



Calibrated by :

*Tong Piima*  
(Mr Tong Piima)



เอกสารการสอบเทียบเครื่องมือตรวจวัดความชื้นสะท้อน

# Calibration Certificate

Part Number: 721A2601

Description: Micromate with DIN Geophone

Serial Number: UM20453

Calibration Date: April 21, 2023

Calibration Reference Equipment: SRV-AFR 714J7401

\*Calibrated with Geo UM6231

*Instantel certifies that the above product was calibrated in accordance with the applicable Instantel procedures. These procedures are part of a quality system that is designed to assure that the product listed above meets or exceeds Instantel specifications.*

*Instantel further certifies that the measurement instruments used during the calibration of this product are traceable to the National Institute of Standards and Technology; or National Research Council of Canada. Evidence of traceability is on file at Instantel and is available upon request.*

*The environment in which this product was calibrated is maintained within the operating specifications of the instrument.*

*Please note that the sensor check function is intended to check that the sensors are connected to the unit, installed in the proper orientation and sufficiently level to operate properly. This function should not be confused with a formal calibration, which requires the sensors be checked against a reference that is traceable to a known standard.*

*Instantel recommends that products be returned to Instantel or an authorized service and calibration facility for annual calibration.*

Calibrated By: \_\_\_\_\_

Yaksh Patel

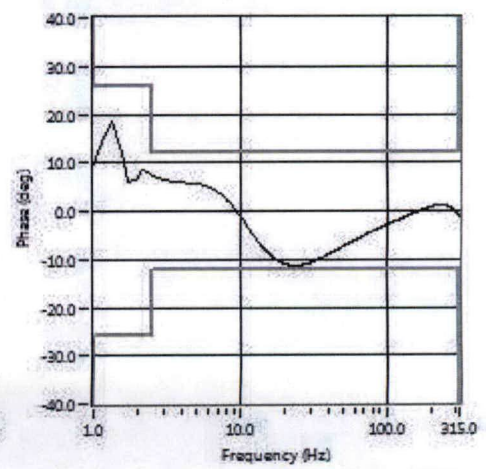
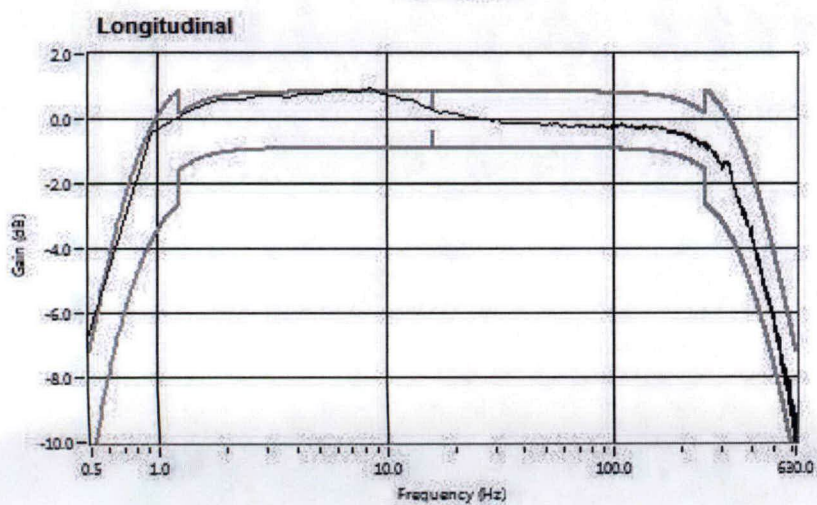
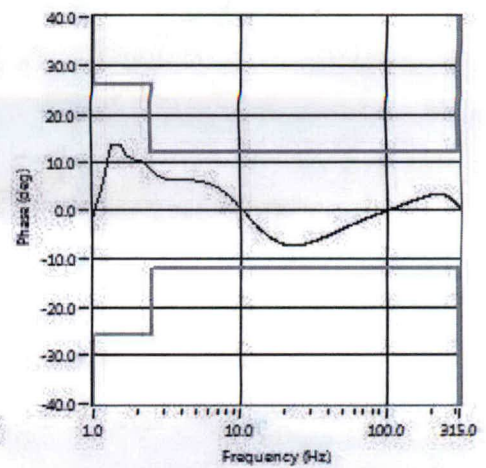
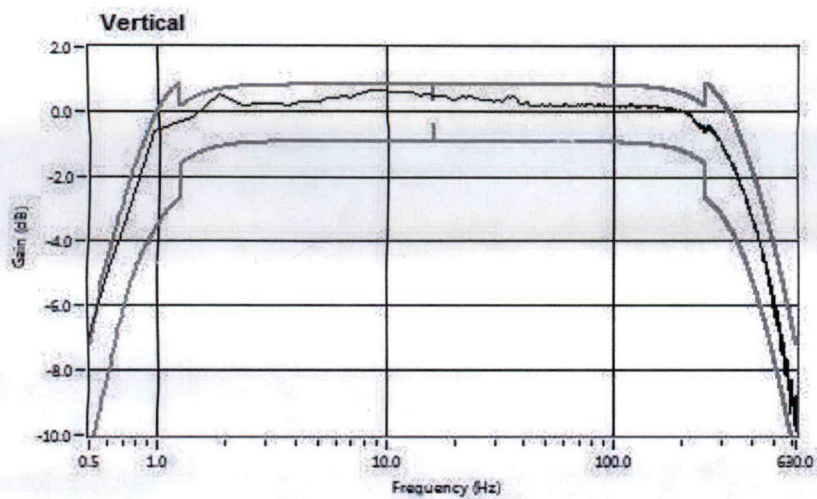
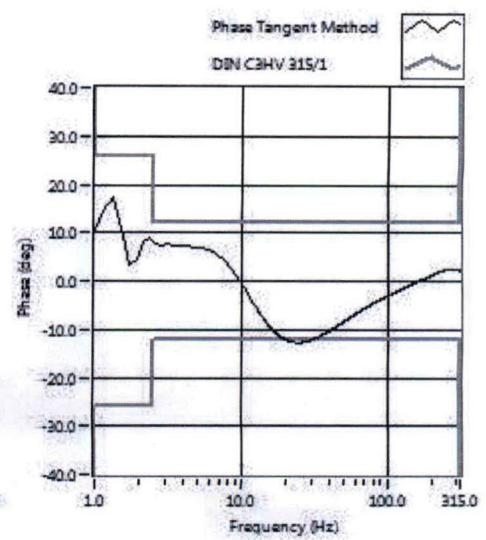
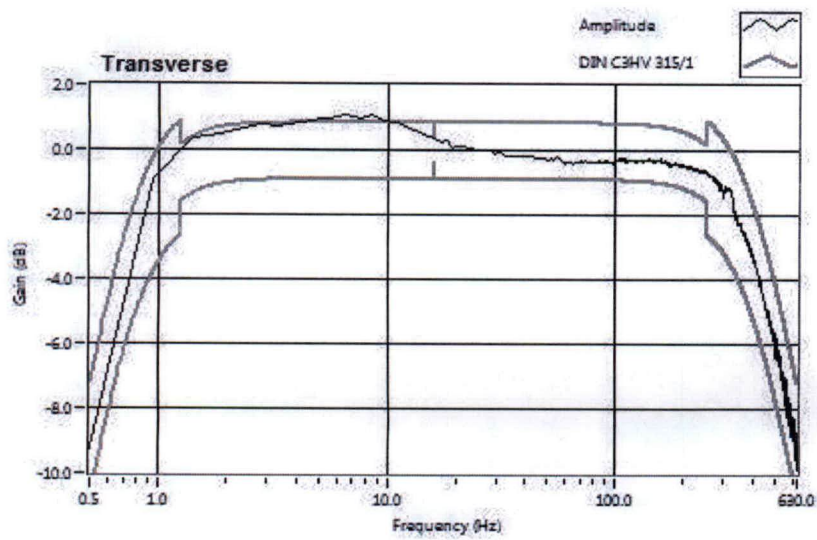


**Instantel®**

309 Legget Drive, Ottawa, Ontario, K2K 3A3, (613) 592-4642



# Frequency Response of UM20453 (As Found)





**ELECTRICAL AND ELECTRONICS INSTITUTE  
FOUNDATION FOR INDUSTRIAL DEVELOPMENT**

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Tel: +66 2709 4860 Fax: +66 2324 0917

Certificate No.: CP20230379EA

Operation No.: CP2023100002

## Certificate of Calibration

Equipment: Vibration Meter

Manufacturer: Instantel

Model/Type: Micromate

Serial No.: UM14163

ID No.: VB-01-001

Customer: C.E.M. Technology (Thailand) Co.,Ltd.

Address: 31/8 Moo 13 T.Rai Khung, A.Sam Phran,  
Nakorn Phatom 73210

Received Date: 6 October 2023

Calibrated Date: 18 - 20 October 2023

Issued Date: 31 October 2023

Calibrated by: Ms. Juntaporn Kunhakom

Approved by: \_\_\_\_\_

( Mr. Sittichai Swaksuriyawong )  
Group Manager

This report was prepared electronically using applicable electronic signature. Printing or copy of file are considered as a copy of the document.

The reported uncertainty of measurement was based on standard uncertainty multiplied by a coverage factor ( $k$ ) providing a level of confidence of approximately 95%. This certificate may not be reproduced other than in full except with the prior written approval of the Electrical and Electronics Institute, Foundation for Industrial Development.



Certificate No.: CP20230379EA

### Calibration Report

Equipment: Vibration Meter  
Manufacturer: Instantel  
Model: Micromate  
Serial No.: UM14163  
ID No.: VB-01-001  
Ambient Temperature: (  $23 \pm 5$  ) °C  
Relative Humidity: (  $50 \pm 15$  ) %

**Method of Calibration :-**

In-house method : CC-SV004 by comparison with standard accelerometer.

**Condition of this result of calibration**

1. Reference standards instrument :-

<u>Instrument</u>	<u>Model</u>	<u>Serial No.</u>	<u>Cert. No.</u>	<u>Due Date</u>
1) Standard Accelerometer	8305	2708237	AV-0001-23	20-Jul-2024
2) Measuring Amplifier	2525	2685967	AV-0044-23	20-Jul-2024
3) PULSE Multi-analyzer system	3560-C	2705645	CQ20230003EA	25-Dec-2023
4) Humidity and Temperature Transmitter	HMT331	K3810009	CD20230166EA	14-Jun-2024

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

3. This certification is traceable to the international system of unit maintained at :-

- National Institute of Metrology (Thailand)

Certificate No.: CP20230379EA

### Calibration Report

Result of Calibration:-

Function : Frequency response and Linearity test at 16 Hz

Frequency (Hz)	Nominal (mm/s)	Standard (mm/s)	UUC (mm/s)	Deviation (mm/s)	Uncertainty $\pm$ (%)	Direction
4.0	10.000	10.006	10.412	0.406	1.50	Longitudinal (L)
5.0	10.000	9.984	10.254	0.270	1.50	
6.3	10.000	9.991	10.483	0.492	1.50	
8.0	10.000	10.013	10.215	0.202	1.50	
10.0	10.000	10.008	10.199	0.191	1.50	
12.5	10.000	10.000	10.104	0.104	1.50	
16.0	10.000	9.993	10.073	0.080	1.50	
	20.000	19.983	20.146	0.163	1.50	
	30.000	29.995	30.219	0.224	1.50	
	50.000	49.992	50.396	0.404	1.50	
20.0	10.000	10.006	10.112	0.106	1.50	
25.0	10.000	10.003	10.097	0.094	1.50	
31.5	10.000	10.000	10.160	0.160	1.50	
40.0	10.000	10.008	10.302	0.294	1.50	
50.0	10.000	10.006	10.357	0.351	1.50	
52.0	10.000	9.994	10.412	0.418	1.50	
63.0	10.000	10.008	10.711	0.703	1.50	
80.0	10.000	9.984	11.097	1.113	1.50	

Certificate No.: CP20230379EA

### Calibration Report

Function : Frequency response and Linearity test at 16 Hz (Cont.)

Frequency (Hz)	Nominal (mm/s)	Standard (mm/s)	UUC (mm/s)	Deviation (mm/s)	Uncertainty ± (%)	Direction
4.0	10.000	9.997	10.372	0.375	1.50	Transverse (T)
5.0	10.000	9.991	10.325	0.334	1.50	
6.3	10.000	10.000	10.501	0.501	1.50	
8.0	10.000	10.008	10.357	0.349	1.50	
10.0	10.000	10.015	10.294	0.279	1.50	
12.5	10.000	9.997	10.231	0.234	1.50	
16.0	10.000	10.004	10.191	0.187	1.50	
	20.000	20.011	20.248	0.237	1.50	
	30.000	29.995	30.298	0.303	1.50	
	50.000	49.978	50.562	0.584	1.50	
20.0	10.000	10.001	10.144	0.143	1.50	
25.0	10.000	9.997	10.120	0.123	1.50	
31.5	10.000	9.998	10.144	0.146	1.50	
40.0	10.000	10.013	10.246	0.233	1.50	
50.0	10.000	9.991	10.388	0.397	1.50	
52.0	10.000	10.006	10.404	0.398	1.50	
63.0	10.000	10.013	10.696	0.683	1.50	
80.0	10.000	9.991	11.098	1.107	1.50	

Certificate No.: CP20230379EA

### Calibration Report

Function : Frequency response and Linearity test at 16 Hz (Cont.)

Frequency (Hz)	Nominal (mm/s)	Standard (mm/s)	UUC (mm/s)	Deviation (mm/s)	Uncertainty ± (%)	Direction
4.0	10.000	10.008	10.002	-0.006	1.50	Vertical (V)
5.0	10.000	9.991	10.136	0.145	1.50	
6.3	10.000	9.997	10.365	0.368	1.50	
8.0	10.000	10.008	10.270	0.262	1.50	
10.0	10.000	9.990	10.278	0.288	1.50	
12.5	10.000	9.997	10.238	0.241	1.50	
16.0	10.000	9.994	10.175	0.181	1.50	
	20.000	19.997	20.445	0.448	1.50	
	30.000	29.995	30.597	0.602	1.50	
	50.000	49.992	51.043	1.051	1.50	
20.0	10.000	10.003	10.231	0.228	1.50	
25.0	10.000	9.997	9.726	-0.271	1.50	
31.5	10.000	10.000	10.057	0.057	1.50	
40.0	10.000	9.996	10.168	0.172	1.50	
50.0	10.000	9.996	10.199	0.203	1.50	
52.0	10.000	9.994	10.309	0.315	1.50	
63.0	10.000	9.984	10.396	0.412	1.50	
80.0	10.000	9.998	10.672	0.674	1.50	

Remark

1. UUC: Unit Under Calibration
2. The coverage factor  $k = 2.00$

- - End of Report - -