

ภาคผนวกที่ 4

เอกสารการสอบเทียบเครื่องมือตรวจวัด

เอกสารการสอบเทียบเครื่องมือตรวจวัดระดับเสียงในบรรยากาศ

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 19/1065

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. : 222129 (NS-03-014)

Microphone : Type 7052NR No.82954

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 : 5 Oct. 2022

Date of Calibration : 1 Nov. 2022

1 / 9
R

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 19/1065

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%.

Date of Calibration : 1 Nov. 2022

2 / 9
Ph

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 19/1065

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 | 113.6 | 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 114.5 dB.

2. Self-generated noise

2.1 Normal test

| Measured value (dB) | Uncertainty (±dB) | Maximum-permitted uncertainty of measurement (±dB) |
|------------------------|----------------------|---|
| 20.1 | 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 | 15.9 | 0.10 | N/A |
| C-Weight | 20.5 | 0.10 | N/A |
| Flat | 26.0 | 0.10 | N/A |

Date of Calibration : 1 Nov. 2022

3/9
Pn

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

FM.BL.MTC.002 Rev.4

Head Office
35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

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

Office
196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 19/1065

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 | 0.1 | 0.1 | 0.1 | 1.5 | 0.45 | 0.6 |
| 1 000 | -0.6 | -0.6 | -0.6 | 1.0 | 0.45 | 0.6 |
| 8 000 | -4.4 | -4.6 | -4.4 | 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 | -0.1 | 0.0 | 0.1 | 2.0 | 0.20 | 0.6 |
| 125 | -0.3 | 0.1 | 0.1 | 1.5 | 0.20 | 0.6 |
| 250 | -0.1 | 0.1 | 0.1 | 1.5 | 0.20 | 0.6 |
| 500 | -0.1 | 0.0 | 0.1 | 1.5 | 0.20 | 0.6 |
| 1 000 | 0.0 | 0.0 | 0.1 | 1.0 | 0.20 | 0.6 |
| 2 000 | -0.1 | 0.0 | 0.1 | 2.0 | 0.20 | 0.6 |
| 4 000 | -0.3 | -0.3 | 0.0 | 3.0 | 0.20 | 0.6 |
| 8 000 | -0.5 | -0.5 | -0.1 | 5.0 | 0.20 | 0.7 |

Date of Calibration : 1 Nov. 2022

4 / 9
Ph

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 19/1065

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 |

Date of Calibration : 1 Nov. 2022

5 / 9
Ph

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 19/1065

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 | 122.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 121 | 121.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 120 | 120.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 119 | 119.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 114 | 113.9 | -0.1 | 1.1 | 0.30 | 0.3 |
| 109 | 108.9 | -0.1 | 1.1 | 0.30 | 0.3 |
| 104 | 103.9 | -0.1 | 1.1 | 0.30 | 0.3 |
| 99 | 98.9 | -0.1 | 1.1 | 0.30 | 0.3 |
| 94 | 94.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 89 | 88.8 | -0.2 | 1.1 | 0.30 | 0.3 |
| 84 | 83.9 | -0.1 | 1.1 | 0.30 | 0.3 |
| 79 | 78.9 | -0.1 | 1.1 | 0.30 | 0.3 |
| 74 | 74.0 | 0.0 | 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 | 58.9 | -0.1 | 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 |

Date of Calibration : 1 Nov. 2022

6 / 9

Ph

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 19/1065

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 | 43.8 | -0.2 | 1.1 | 0.30 | 0.3 |
| 39 | 39.1 | 0.1 | 1.1 | 0.30 | 0.3 |
| 34 | 34.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 33 | 33.3 | 0.3 | 1.1 | 0.30 | 0.3 |
| 32 | 32.3 | 0.3 | 1.1 | 0.30 | 0.3 |
| 31 | 31.6 | 0.6 | 1.1 | 0.30 | 0.3 |
| 30 | 30.9 | 0.9 | 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 | 94.0 | 0.0 | 1.1 | 0.30 | 0.3 |

Date of Calibration : 1 Nov. 2022

7 / 9
Ph.

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 19/1065

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 | 44.8 | -0.2 | 1.1 | 0.30 | 0.3 |
| 30-120 | 35.0 | 35.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 20-110 | 25.0 | 25.5 | 0.5 | 1.1 | 0.30 | 0.3 |
| 20-100 | 25.0 | 25.4 | 0.4 | 1.1 | 0.30 | 0.3 |
| 20-90 | 25.0 | 25.5 | 0.5 | 1.1 | 0.30 | 0.3 |
| 20-80 | 25.0 | 25.6 | 0.6 | 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 | 89.8 | -0.2 | +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 | 110.0 | 0.0 | ±1.0 | 0.20 | 0.3 |
| | 2 | 89.9 | -0.1 | +1.0; -2.5 | 0.20 | 0.3 |
| | 0.25 | 80.8 | -0.2 | +1.5; -5.0 | 0.20 | 0.3 |

Date of Calibration : 1 Nov. 2022

8 / 9
Ph.

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 19/1065

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 | 124.3 | -0.1 | 2.0 | 0.20 | 0.35 |
| Negative half cycle | 124.4 | 124.3 | -0.1 | 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 | | | | |
| 132.0 | 132.1 | -0.1 | 1.5 | 0.20 | 0.25 |

12. High-level stability

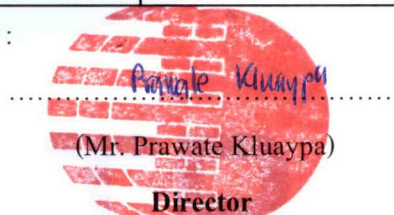
| Time | Measured value (dB) | Deviated value (dB) | Acceptance limit class 2 (+dB) | Uncertainty (+dB) | Maximum-permitted uncertainty of measurement (+dB) |
|-------|---------------------|---------------------|--------------------------------|-------------------|--|
| Begin | 129.0 | 0.0 | 0.3 | 0.10 | 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 : 1 Nov. 2022

Date of Issue : 2 Nov. 2022

Ref : 2011265100504293002

End of Certificate

9 / 9

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 20/1065

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. : 222185 (NS-03-015)

Microphone : Type 7052NR No.84149

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 : 5 Oct. 2022

Date of Calibration : 1 Nov. 2022

1 / 9

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand

Tel. (66) 0 2577 9000

Fax. (66) 0 2577 9009

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

Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand

Tel. (66) 0 2323 1672-80 ext. 115, 116

Fax. (66) 0 2323 9165

E-mail : mtc@tistr.or.th

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand

Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217

Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 20/1065

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%.

Date of Calibration : 1 Nov. 2022

2 / 9 

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 20/1065

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 | 114.1 | 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 114.5 dB.

2. Self-generated noise

2.1 Normal test

| Measured value (dB) | Uncertainty (±dB) | Maximum-permitted uncertainty of measurement (±dB) |
|------------------------|----------------------|---|
| 20.9 | 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 | 16.4 | 0.10 | N/A |
| C-Weight | 21.5 | 0.10 | N/A |
| Flat | 26.3 | 0.10 | N/A |

Date of Calibration : 1 Nov. 2022

3 / 9

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 20/1065

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 | -0.2 | -0.1 | -0.1 | 1.5 | 0.45 | 0.6 |
| 1 000 | 0.0 | 0.0 | 0.0 | 1.0 | 0.45 | 0.6 |
| 8 000 | -1.3 | -1.4 | -1.2 | 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 | -0.3 | -0.1 | 0.0 | 2.0 | 0.20 | 0.6 |
| 125 | -0.4 | 0.1 | 0.0 | 1.5 | 0.20 | 0.6 |
| 250 | -0.2 | 0.0 | 0.0 | 1.5 | 0.20 | 0.6 |
| 500 | -0.2 | 0.1 | 0.0 | 1.5 | 0.20 | 0.6 |
| 1 000 | 0.0 | 0.0 | 0.0 | 1.0 | 0.20 | 0.6 |
| 2 000 | 0.0 | 0.0 | 0.0 | 2.0 | 0.20 | 0.6 |
| 4 000 | -0.2 | -0.3 | -0.1 | 3.0 | 0.20 | 0.6 |
| 8 000 | -0.4 | -0.4 | -0.2 | 5.0 | 0.20 | 0.7 |

Date of Calibration : 1 Nov. 2022

4 / 9

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand

Tel. (66) 0 2577 9000

Fax. (66) 0 2577 9009

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

Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand

Tel. (66) 0 2323 1672-80 ext. 115, 116

Fax. (66) 0 2323 9165

E-mail : mtc@tistr.or.th

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand

Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217

Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 20/1065

5. Long-term stability

| Time | Measured Value (dB) | Deviated value (dB) | Acceptance limit class 2 (±dB) | Uncertainty (±dB) | Maximum-permitted uncertainty of measurement (±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 Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limit class 2 (±dB) | Uncertainty (±dB) | Maximum-permitted uncertainty of measurement (±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 Weighting | Measured value (dB) | Deviated value (dB) | Acceptance limit class 2 (±dB) | Uncertainty (±dB) | Maximum-permitted uncertainty of measurement (±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 |

Date of Calibration : 1 Nov. 2022

5 / 9

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 20/1065

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 | 89.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 84 | 84.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 79 | 79.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 74 | 74.1 | 0.1 | 1.1 | 0.30 | 0.3 |
| 69 | 69.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 64 | 63.8 | -0.2 | 1.1 | 0.30 | 0.3 |
| 59 | 58.9 | -0.1 | 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 |

Date of Calibration : 1 Nov. 2022

6 / 9

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand

Tel. (66) 0 2577 9000

Fax. (66) 0 2577 9009

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

Office/Laboratory

Soi 1C, Bangpoo Industrial Estate, Sukhumvit Road,
Amphoe Muang, Changwat Samutprakan 10280, Thailand

Tel. (66) 0 2323 1672-80 ext. 115, 116

Fax. (66) 0 2323 9165

E-mail : mtc@tistr.or.th

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand

Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217

Fax. (66) 0 2579 8592

E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 20/1065

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 | 43.8 | -0.2 | 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 | 31.4 | 0.4 | 1.1 | 0.30 | 0.3 |
| 30 | 30.5 | 0.5 | 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 | 94.0 | 0.0 | 1.1 | 0.30 | 0.3 |

Date of Calibration : 1 Nov. 2022

7/9

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 20/1065

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 | 44.9 | -0.1 | 1.1 | 0.30 | 0.3 |
| 30-120 | 35.0 | 35.0 | 0.0 | 1.1 | 0.30 | 0.3 |
| 20-110 | 25.0 | 25.5 | 0.5 | 1.1 | 0.30 | 0.3 |
| 20-100 | 25.0 | 25.4 | 0.4 | 1.1 | 0.30 | 0.3 |
| 20-90 | 25.0 | 25.5 | 0.5 | 1.1 | 0.30 | 0.3 |
| 20-80 | 25.0 | 25.5 | 0.5 | 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 | 89.8 | -0.2 | +1.5; -5.0 | 0.20 | 0.3 |
| Slow | 200 | 109.5 | -0.1 | ±1.0 | 0.20 | 0.3 |
| | 2 | 89.8 | -0.2 | +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 |

Date of Calibration : 1 Nov. 2022

8 / 9

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

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

FM.BL.MTC.002 Rev.4

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

THAILAND INSTITUTE OF SCIENTIFIC AND TECHNOLOGICAL RESEARCH (TISTR)

Request No. 21-66/0012

MTC No. EEL. BP. 20/1065

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 | 125.2 | -0.2 | 3.0 | 0.20 | 0.35 |
| Positive half cycle | 124.4 | 124.3 | -0.1 | 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 | | | | |
| 131.0 | 131.1 | -0.1 | 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 :

Tawikiat Iamsamran

(Mr. Tawikiat Iamsamran)

Approved by :

Prawate Kluaypa

(Mr. Prawate Kluaypa)

Director

Electrical and Electronic Standards Laboratory

Industrial Metrology and Testing Service Centre

Date of Calibration : 1 Nov. 2022

Date of Issue : 2 Nov. 2022

Ref : 2011265100504293003

End of Certificate

9 / 9

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

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

Head Office

35 Mu 3 Tambon Khlong Ha, Amphoe Khlong Luang,
Changwat Pathumthani 12120, Thailand
Tel. (66) 0 2577 9000
Fax. (66) 0 2577 9009
E-mail : rumpai@tistr.or.th Website:www.tistr.or.th

Office/Laboratory

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

Office

196 Phahonyothin Road, Chatuchak, Bangkok 10900,
Thailand
Tel. (66) 0 2579 1121-30 ext. 5219, 5225, 5217
Fax. (66) 0 2579 8592
E-mail : sumalee@tistr.or.th

CERTIFICATE OF CALIBRATION

Certificate No. : 66S0205-3

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. : 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. : 66S0330-3

Job No. : 66S0330

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. : 222195

Date of received : 08-Mar-2023

Identity No. : NS-03-025

Date of calibration : 10-Mar-2023

Range : See to Data

Date of issued : 13-Mar-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 | 94.3 | 0.3 | 0.20 |
| | 104 | 104.0 | 0.0 | 0.20 |
| | 114 | 113.7 | -0.3 | 0.20 |
| C | 94 | 94.1 | 0.1 | 0.20 |
| | 104 | 104.0 | 0.0 | 0.20 |
| | 114 | 114.0 | 0.0 | 0.20 |
| Z | 94 | 94.3 | 0.3 | 0.20 |
| | 104 | 104.3 | 0.3 | 0.20 |
| | 114 | 114.3 | 0.3 | 0.20 |

UUC = Unit Under Calibration*

- The End -

CERTIFICATE OF CALIBRATION

Certificate No. : 66S0330-5

Job No. : 66S0330

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 : Tenmars

Relative humidity : (50 ± 15) %

Model : ST-109R

Atmospheric pressure : -

Serial No. : 221201934

Date of received : 08-Mar-2023

Identity No. : NS-11-001

Date of calibration : 10-Mar-2023

Range : See to Data

Date of issued : 13-Mar-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

[x] 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 | 94.5 | 0.5 | 0.20 |
| | 104 | 104.5 | 0.5 | 0.20 |
| | 114 | 114.4 | 0.4 | 0.20 |
| C | 94 | 94.4 | 0.4 | 0.20 |
| | 104 | 104.4 | 0.4 | 0.20 |
| | 114 | 114.5 | 0.5 | 0.20 |
| Z | 94 | 94.4 | 0.4 | 0.20 |
| | 104 | 104.4 | 0.4 | 0.20 |
| | 114 | 114.5 | 0.5 | 0.20 |

UUC = Unit Under Calibration*

- The End -

CERTIFICATE OF CALIBRATION

Certificate No. : 66S0330-8

Job No. : 66S0330

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 : Scarlet Tech

Relative humidity : (50 ± 15) %

Model : ST-11D

Atmospheric pressure : -

Serial No. : 820892

Date of received : 08-Mar-2023

Identity No. : NS-12-003

Date of calibration : 10-Mar-2023

Range : See to Data

Date of issued : 13-Mar-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 | 94.1 | 0.1 | 0.20 |
| | 104 | 104.0 | 0.0 | 0.20 |
| | 114 | 114.0 | 0.0 | 0.20 |
| B | 94 | 93.8 | -0.2 | 0.00 |
| | 104 | 103.7 | -0.3 | 0.00 |
| | 114 | 113.7 | -0.3 | 0.00 |
| Z | 94 | 93.9 | -0.1 | 0.00 |
| | 104 | 103.9 | -0.1 | 0.00 |
| | 114 | 113.9 | -0.1 | 0.00 |

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 30065

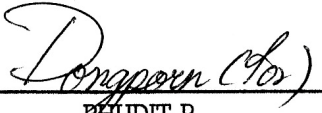
PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : SOUND LEVEL METER
MANUFACTURER : ACO
MODEL : TYPE 6226
SERIAL No. : 150005
ID No. : CEM-SI-05

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 30065

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : SOUND LEVEL METER
MANUFACTURER : ACO
MODEL : TYPE 6226 SERIAL NUMBER : 150005
ID No. : CEM-SI-05
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

G.Ruamkit Panich Co.,Ltd.

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

CERTIFICATE No : GR 17 E 30068

PAGE : 1 OF 2

Certificate of Calibration

EQUIPMENT : SOUND LEVEL METER
MANUFACTURER : ACO
MODEL : TYPE 6226
SERIAL No. : 150008
ID No. : CEM-SI-08

SUBMITTED BY : C.E.M TECHNOLOGY (THAILAND) CO.,LTD.
219/43 MOO 12, PETCHKASEM RD., OMNOI,
KRATHUMBAN SAMUTSAKORN 74130

CALIBRATED BY : 
SURAWIT K.

CALIBRATION DATE : 9-May-23

APPROVED BY : 
PHUDIT 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 30068

PAGE : 2 OF 2

Calibration Report

EQUIPMENT : SOUND LEVEL METER
MANUFACTURER : ACO
MODEL : TYPE 6226 SERIAL NUMBER : 150008
ID No. : CEM-SI-08
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

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

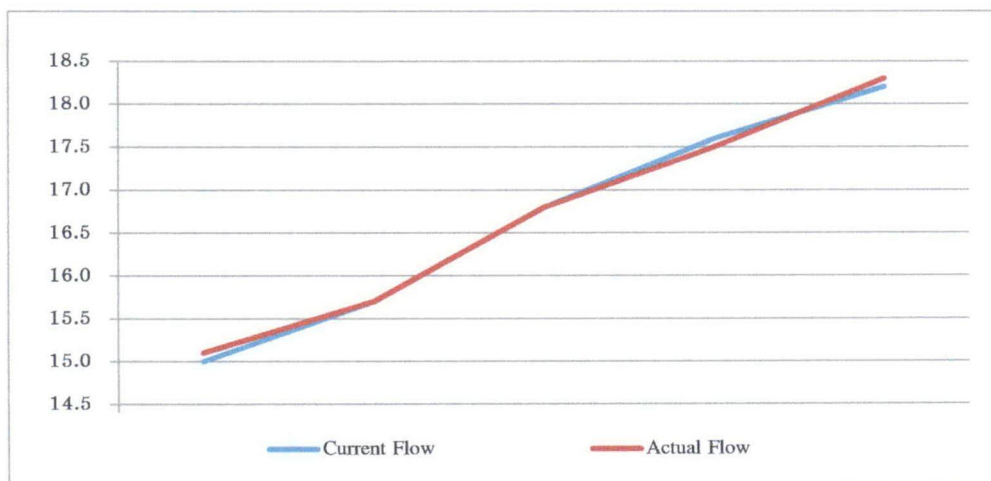
Model : DCL-H

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 : 2-Sep-22

Certificate No. : 0922-006

Page : 1/1

Instruments

Instruments : PM2.5-PM10 Air Sampler

Manufacturer : BGI

Model : PQ-200

Serial No. : 140AB25409410

Environmental

Temperature : 25.7 °C

Humidity : 54.1 %RH

Calibration System

Instruments : Drycal

Manufacturer : Bios

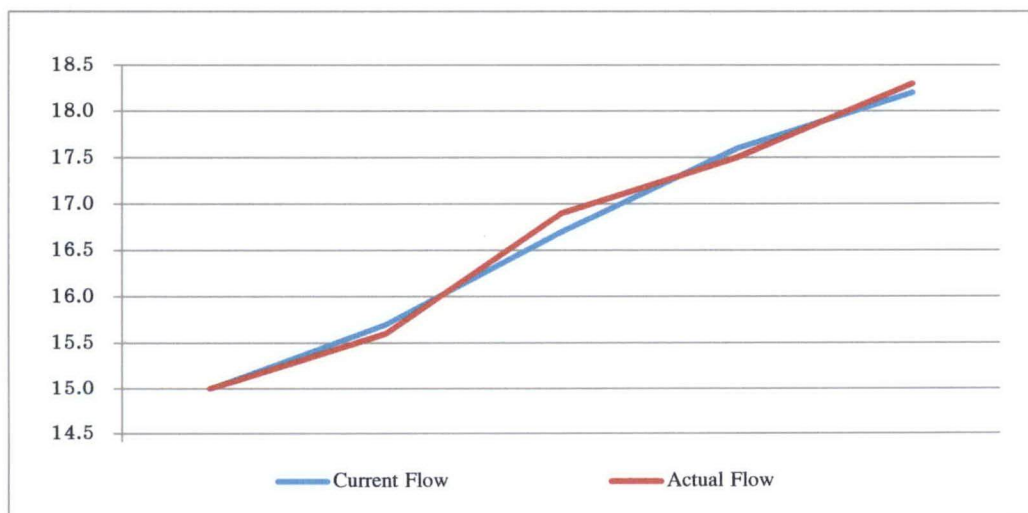
Model : DCL-H

Serial No. : 102591

Calibration due date : 7-Sep-22

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 | 16.9 |
| | 17.5 | 17.6 | 17.5 |
| | 15.8 | 15.7 | 15.6 |
| | 18.3 | 18.2 | 18.3 |
| | 15.0 | 15.0 | 15.0 |



Calibrated by :


 (Mr. Tong Piima)

Certificate of Calibration

Calibrated Date : 2-Sep-22

Certificate No. : 0922-007

Page : 1/1

Instruments

Instruments : PM2.5-PM10 Air Sampler

Manufacturer : TEOM Control Unit (RP)

Model : 1400a

Serial No. : 140AB254490411

Environmental

Temperature : 25.4 °C

Humidity : 52.9 %RH

Calibration System

Instruments : Drycal

Manufacturer : Bios

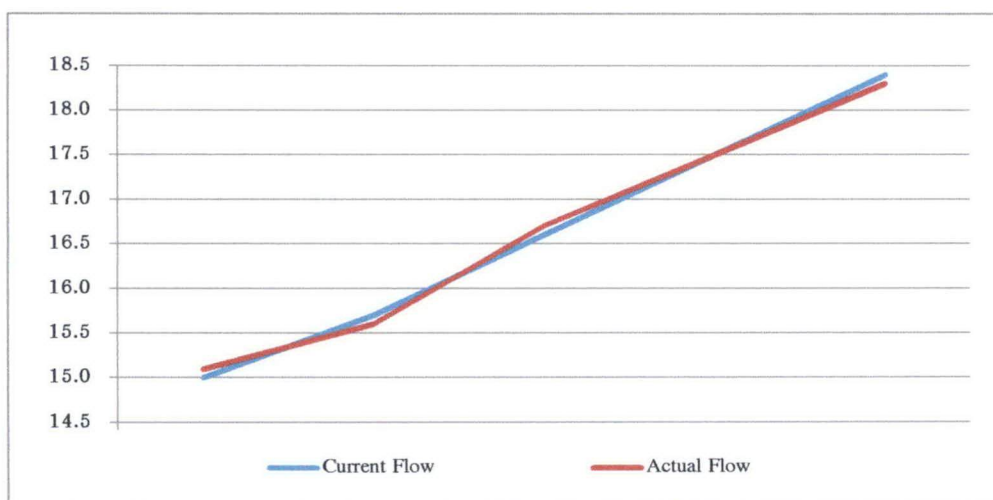
Model : DCL-H

Serial No. : 102591

Calibration due date : 7-Sep-22

Flow Tetsing

| Filter | Set Flow Instrument (L/min) | Current Flow Instrument reading (L/min) | Actual Flow Reference Standard (L/min) |
|--------|--------------------------------|--|---|
| 47 mm. | 16.7 | 16.6 | 16.7 |
| | 17.5 | 17.5 | 17.5 |
| | 15.8 | 15.7 | 15.6 |
| | 18.3 | 18.4 | 18.3 |
| | 15.0 | 15.0 | 15.1 |



Calibrated by :


 (Mr. Tong Piima)

Certificate of Calibration

Calibrated Date : 2-Sep-22

Certificate No. : 0922-008

Page : 1/1

Instruments

Instruments : PM2.5-PM10 Air Sampler

Manufacturer : TEOM Control Unit (RP)

Model : 1400a

Serial No. : 140AB254490412

Environmental

Temperature : 24.1 °C

Humidity : 52.1 %RH

Calibration System

Instruments : Drycal

Manufacturer : Bios

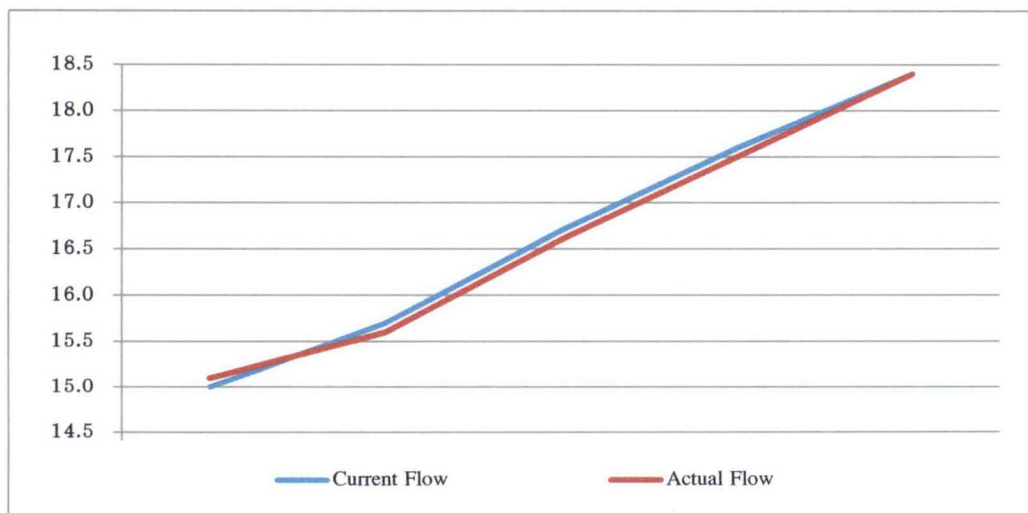
Model : DCL-H

Serial No. : 102591

Calibration due date : 7-Sep-22

Flow Tetsing

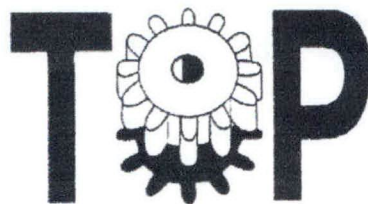
| Filter | Set Flow Instrument (L/min) | Current Flow Instrument reading (L/min) | Actual Flow Reference Standard (L/min) |
|--------|--------------------------------|--|---|
| 47 mm. | 16.7 | 16.7 | 16.6 |
| | 17.5 | 17.6 | 17.5 |
| | 15.8 | 15.7 | 15.6 |
| | 18.3 | 18.4 | 18.4 |
| | 15.0 | 15.0 | 15.1 |



Calibrated by :

Tong Piima

(Mr. Tong Piima)



Trade & Engineering

PM10 High Volume Sampler Verification

Site Information

Location: -

Site ID: -

Date: 4 October 2022

Sampler: TE-6070 PM10

Serial No: 3211

Tech: Tong P.

Site Conditions

Barometric Pressure (in Hg): 26.54

Temperature (deg F): 77.9

Average Press. (in Hg): 29.45

Average Temp. (deg F): 77.0

Corrected Pressure (mm Hg): 760.4

Temperature (deg K): 298.5

Corrected Average (mm Hg): 759.8

Average Temp. (deg K): 298.0

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 | 7.30 | 1.079 | 55.0 | 34.46 | Slope 30.9235 |
| 2 | 5.50 | 0.938 | 50.0 | 31.33 | Intercept 1.6630 |
| 3 | 4.30 | 0.830 | 44.0 | 27.57 | Corr. Coeff 0.9941 |
| 4 | 3.70 | 0.771 | 41.0 | 25.69 | SFR 1.131 |
| 5 | 2.80 | 0.672 | 35.0 | 21.93 | SSP 58.48 |

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

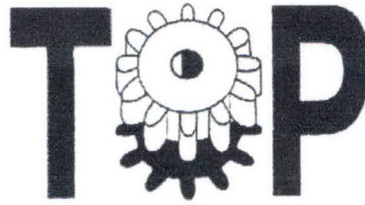
I = chart response

Tav = daily average temperature

Pav = daily average pressure

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

| | |
|-----------------------------------|-------------|
| Average I(chart): | 55.1 |
| Average Flow over Sample (m3/min) | 1.062113613 |
| Enter Total Time (Hrs): | 24.0 |
| Total flow over sample (m3/min) | 1529.443603 |
| Total flow over sample (CFM) | 54004.65361 |



Trade & Engineering

PM10 High Volume Sampler Verification

Site Information

Location: - Site ID: - Date: 4 October 2022
Sampler: TE-6070 PM10 Serial No: 3245 Tech: Tong P.

Site Conditions

Barometric Pressure (in Hg): 29.47 Corrected Pressure (mm Hg): 759.0
Temperature (deg F): 76.9 Temperature (deg K): 297.9
Average Press. (in Hg): 28.70 Corrected Average (mm Hg): 760.2
Average Temp. (deg F): 77.0 Average Temp. (deg K): 298.0

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 | 7.40 | 1.086 | 56.0 | 35.09 | Slope 32.3113 |
| 2 | 5.60 | 0.946 | 50.0 | 31.33 | Intercept 0.4536 |
| 3 | 4.40 | 0.840 | 45.0 | 28.19 | Corr. Coeff 0.9961 |
| 4 | 3.60 | 0.761 | 40.0 | 25.06 | SFR 1.132 |
| 5 | 2.70 | 0.660 | 34.0 | 21.30 | SSP 59.08 |

of Observations: 5

Calculations

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

$$SFR = 1.13(Ps/Pa)(Ta/Ts)$$
$$SSP = (m*SFR+b)(\text{Sqrt}(Pa/Ta))$$

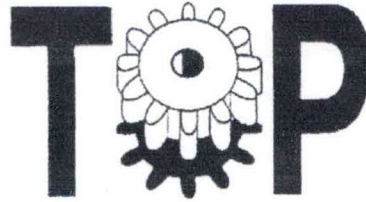
m = sampler slope
b = sampler intercept
I = chart response
Tav = daily average temperature
Pav = daily average pressure

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 = 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)

Average I(chart): 55.6
Average Flow over Sample (m3/min)
1.063332321
Enter Total Time (Hrs): 24.0
Total flow over sample (m3/min)
1531.198543
Total flow over sample (CFM)
54066.62055

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:** 4 October 2022
Sampler: TE-6070 PM10 **Serial No:** 3286 **Tech:** Tong P.

Site Conditions

Barometric Pressure (in Hg): 27.00 **Corrected Pressure (mm Hg):** 760.1
Temperature (deg F): 77.6 **Temperature (deg K):** 298.3
Average Press. (in Hg): 30.00 **Corrected Average (mm Hg):** 761.2
Average Temp. (deg F): 77.9 **Average Temp. (deg K):** 298.5

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 | 7.50 | 1.093 | 56.0 | 35.08 | Slope 31.5206 |
| 2 | 5.90 | 0.971 | 51.0 | 31.95 | Intercept 0.9099 |
| 3 | 4.60 | 0.858 | 45.0 | 28.19 | Corr. Coeff 0.9973 |
| 4 | 3.80 | 0.781 | 40.0 | 25.06 | SFR 1.131 |
| 5 | 2.90 | 0.684 | 36.0 | 22.55 | SSP 58.36 |

of Observations: 5

Calculations

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

$$SFR = 1.13(Ps/Pa)(Ta/Ts)$$
$$SSP = (m*SFR+b)(\text{Sqrt}(Pa/Ta))$$

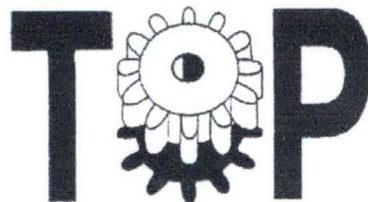
m = sampler slope
b = sampler intercept
I = chart response
Tav = daily average temperature
Pav = daily average pressure

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 = 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)

Average I(chart): 55.4
Average Flow over Sample (m3/min)
1.071752758
Enter Total Time (Hrs): 24.0
Total flow over sample (m3/min)
1543.323972
Total flow over sample (CFM)
54494.76945

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: 4 October 2022

Sampler: TE-6070 PM10

Serial No: 3310

Tech: Tong P.

Site Conditions

Barometric Pressure (in Hg): 29.47

Temperature (deg F): 77.0

Average Press. (in Hg): 28.70

Average Temp. (deg F): 77.1

Corrected Pressure (mm Hg): 760.1

Temperature (deg K): 298.0

Corrected Average (mm Hg): 761.3

Average Temp. (deg K): 298.1

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 | 7.60 | 1.100 | 57.0 | 35.69 | Slope 32.3375 |
| 2 | 5.80 | 0.962 | 51.0 | 31.93 | Intercept 0.5255 |
| 3 | 4.60 | 0.858 | 46.0 | 28.80 | Corr. Coeff 0.9972 |
| 4 | 3.80 | 0.781 | 41.0 | 25.67 | SFR 1.132 |
| 5 | 2.80 | 0.671 | 35.0 | 21.91 | SSP 59.28 |

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): 55.6
Average Flow over Sample (m3/min)
1.059570151
Enter Total Time (Hrs): 24.0
Total flow over sample (m3/min)
1525.781017
Total flow over sample (CFM)
53875.32771

Certificate of Analyzer Performance Testing

Calibrated Date : 30-Jan-23

Certificate No. : 0123-001

Page : 1/1

Analyzer Instruments

Analyzer Type : THC Analyzer

Manufacturer : Thermo Environmental

Model : 51

Serial No. : 51HT-73244-373

Environmental

Temperature : 24.7 °C

Humidity : 54.4 %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

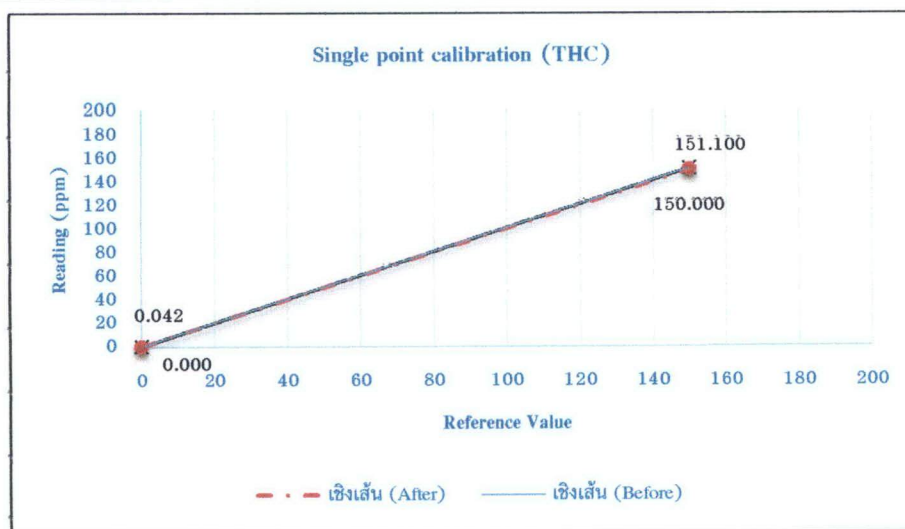
Propane Conc. : 150 ppm

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 | 0.042 | 0.000 | 0.042 | 151 | 150 | 0.733 |
| After | | | | | | |
| THC | 0.000 | 0.000 | 0.000 | 150 | 150 | 0.000 |



Calibrated by :

Tong Piima

(Mr. Tong Piima)

Certificate of Analyzer Performance Testing

Calibrated Date : 8-Apr-22

Certificate No. : 0322-067

Page : 1/1

Analyzer Instruments

Analyzer Type : THC Analyzer

Manufacturer : Thermo Environmental

Model : 8800

Serial No. : 0500710288

Environmental

Temperature : 26.1 °C

Humidity : 54.6 %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

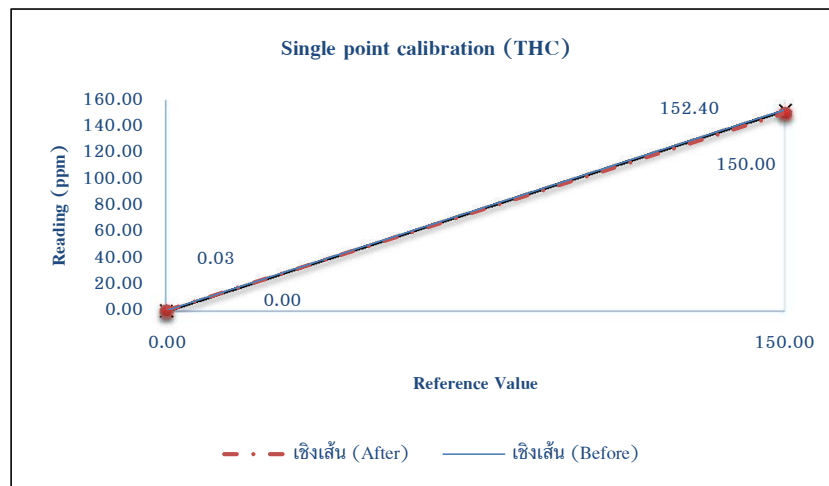
Propane Conc. : 150 ppm

Cylinder No. : 21W281046


Expire Date : 26-Sep-25

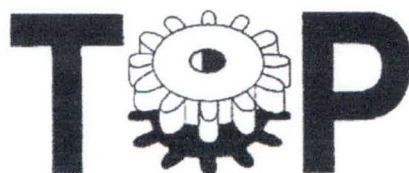
Calibration Check

| Gas | Zero | | | Span | | |
|--------|------------------------|-------------------------|--------------|------------------------|-------------------------|--------------|
| | Reading Value (ppm) | Expected Value (ppm) | Drift (%) | Reading Value (ppm) | Expected Value (ppm) | Drift (%) |
| Before | | | | | | |
| THC | 0.03 | 0.00 | 0.03 | 152.40 | 150.00 | 1.60 |
| After | | | | | | |
| THC | 0.00 | 0.00 | 0.00 | 150.00 | 150.00 | 0.00 |



Calibrated by :


 (Mr. Tong Puima)



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

Site Information

Location: - Site ID: - Date: 9 Jan 23
Sampler: TE-5000 TSP Serial No: 3263 Tech: Tong.P

Site Conditions

Barometric Pressure (in Hg): 28.00 Corrected Pressure (mm Hg): 711.2
Temperature (deg F): 76.0 Temperature (deg K): 297.6
Average Press. (in Hg): 26.00 Corrected Average (mm Hg): 660.4
Average Temp (Deg F): 75.1 Average Temp: (Deg K): 297.1

Calibration Orifice

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

Calibration Information

| Plate or Test # | H2O (in) | Qstd (m3/min) | I (chart) | IC (corrected) | Linear Regression |
|-----------------|----------|---------------|-----------|----------------|---------------------|
| 1 | 5.80 | 1.482 | 60.0 | 58.08 | Slope: 28.6275 |
| 2 | 4.00 | 1.233 | 53.0 | 51.31 | Intercept: 15.8460 |
| 3 | 2.60 | 0.996 | 46.0 | 44.53 | Corr. Coeff: 0.9996 |
| 4 | 2.10 | 0.896 | 43.0 | 41.62 | |
| 5 | 1.50 | 0.759 | 38.5 | 37.27 | |

of Observations: 5

Calculations

$Q_{std} = 1/m[\text{Sqrt}(H_2O(P_a/P_{std})(T_{std}/T_a)) - b]$
 $IC = I[\text{Sqrt}(P_a/P_{std})(T_{std}/T_a)]$

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:

$1/m((I)[\text{Sqrt}(298/T_{av})(P_{av}/760)] - b)$

m = sampler slope

b = sampler intercept

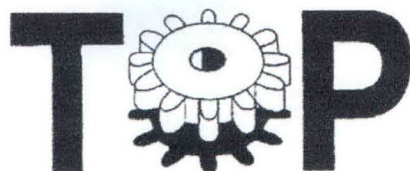
I = chart response

Tav = daily average temperature

Pav = daily average pressure

enter Average I (chart): 44.0
Average Flow Calculation m3/min
0.881394911
Average Flow Calculation in cfm
31.12270125
Sample Time (Hrs): 24.0
Total flow in 24 hours m3/min
1269.208672
Total flow in 24 hours cfm
44816.6898

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

| | | |
|-----------------------------|------------------------|-----------------------|
| Location: - | Site ID: - | Date: 9 Jan 23 |
| Sampler: TE-5000 TSP | Serial No: 3267 | Tech: Tong.P |

Site Conditions

| | |
|---|--|
| Barometric Pressure (in Hg): 28.00 | Corrected Pressure (mm Hg): 711.2 |
| Temperature (deg F): 76.0 | Temperature (deg K): 297.6 |
| Average Press. (in Hg): 27.00 | Corrected Average (mm Hg): 685.8 |
| Average Temp (Deg F): 75.0 | Average Temp (Deg K): 297.0 |

Calibration Orifice

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

Calibration Information

| Plate or Test # | H2O (in) | Qstd (m3/min) | I (chart) | IC (corrected) | Linear Regression |
|-----------------|----------|---------------|-----------|----------------|----------------------------|
| 1 | 6.80 | 1.604 | 62.2 | 60.21 | Slope: 33.1580 |
| 2 | 5.00 | 1.377 | 55.5 | 53.73 | Intercept: 7.5236 |
| 3 | 3.60 | 1.170 | 48.3 | 46.76 | Corr. Coeff: 0.9980 |
| 4 | 3.10 | 1.086 | 45.1 | 43.66 | |
| 5 | 2.50 | 0.976 | 40.6 | 39.30 | |

of Observations: 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

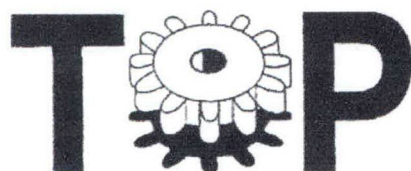
I = chart response

Tav = daily average temperature

Pav = daily average pressure

| | |
|--|-------------|
| nter Average I (chart): | 44.0 |
| Average Flow Calculation m3/min | 1.035675716 |
| Average Flow Calculation in cfm | 36.57046973 |
| Sample Time (Hrs): | 24.0 |
| Total flow in 24 hours m3/min | 1491.373032 |
| Total flow in 24 hours cfm | 52661.47642 |

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

| | | |
|-----------------------------|------------------------|------------------------|
| Location: - | Site ID: - | Date: 17 Oct 22 |
| Sampler: TE-5000 TSP | Serial No: 3271 | Tech: Tong.P |

Site Conditions

| | |
|---|--|
| Barometric Pressure (in Hg): 28.60 | Corrected Pressure (mm Hg): 758.6 |
| Temperature (deg F): 75.7 | Temperature (deg K): 297.4 |
| Average Press. (in Hg): 28.40 | Corrected Average (mm Hg): 760.1 |
| Average Temp (Deg F): 76.2 | Average Temp (Deg K): 297.7 |

Calibration Orifice

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

Calibration Information

| Plate or Test # | H2O (in) | Qstd (m3/min) | I (chart) | IC (corrected) | Linear Regression |
|-----------------|----------|---------------|-----------|----------------|----------------------------|
| 1 | 7.70 | 1.763 | 55.0 | 55.00 | Slope: 28.9848 |
| 2 | 5.90 | 1.544 | 49.0 | 49.00 | Intercept: 4.1522 |
| 3 | 4.80 | 1.394 | 45.0 | 45.00 | Corr. Coeff: 0.9993 |
| 4 | 3.60 | 1.208 | 39.0 | 39.00 | |
| 5 | 3.00 | 1.104 | 36.0 | 36.00 | |

of Observations: 5

Calculations

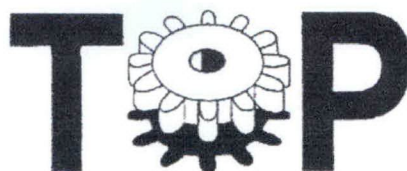
$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta)) - b]$
 $IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$

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

| | |
|--|-------------|
| nter Average I (chart): | 40.6 |
| Average Flow Calculation m3/min | 1.258264079 |
| Average Flow Calculation in cfm | 44.4302282 |
| Sample Time (Hrs): | 24.0 |
| Total flow in 24 hours m3/min | 1811.900274 |
| Total flow in 24 hours cfm | 63979.5286 |

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

| | | |
|-----------------------------|------------------------|------------------------|
| Location: - | Site ID: - | Date: 19 Oct 22 |
| Sampler: TE-5000 TSP | Serial No: 3279 | Tech: Tong.P |

Site Conditions

| | |
|---|--|
| Barometric Pressure (in Hg): 29.00 | Corrected Pressure (mm Hg): 736.6 |
| Temperature (deg F): 76.0 | Temperature (deg K): 297.6 |
| Average Press. (in Hg): 29.00 | Corrected Average (mm Hg): 736.6 |
| Average Temp (Deg F): 77.0 | Average Temp: (Deg K): 298.2 |

Calibration Orifice

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

Calibration Information

| Plate or Test # | H2O (in) | Qstd (m3/min) | I (chart) | IC (corrected) | Linear Regression |
|--------------------|-------------|------------------|--------------|-------------------|-----------------------------|
| 1 | 7.50 | 1.714 | 52.0 | 51.23 | Slope: 28.0882 |
| 2 | 5.60 | 1.482 | 47.0 | 46.30 | Intercept: 3.8314 |
| 3 | 4.40 | 1.315 | 42.0 | 41.38 | Corr. Coeff: 0.9960 |
| 4 | 3.30 | 1.140 | 36.0 | 35.47 | |
| 5 | 2.70 | 1.032 | 33.0 | 32.51 | |
| | | | | | # of Observations: 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

| | |
|--|-------------|
| nter Average I (chart): | 40.1 |
| Average Flow Calculation m3/min | 1.268735746 |
| Average Flow Calculation in cfm | 44.79999045 |
| Sample Time (Hrs): | 24.0 |
| Total flow in 24 hours m3/min | 1826.979474 |
| Total flow in 24 hours cfm | 64511.98624 |

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

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

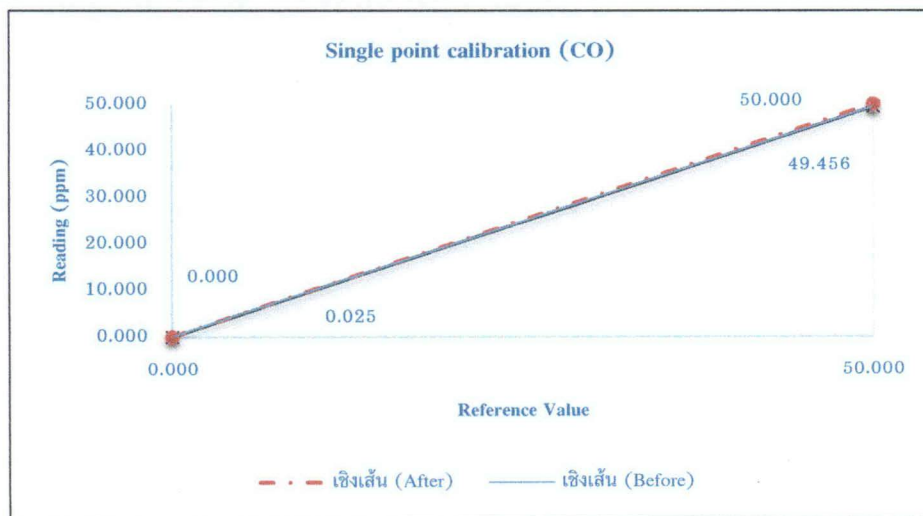
SO2 Conc. : 2 ppm

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 | 0.025 | 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 : 21-Jan-23

Certificate No. : 0123-003

Page : 1/1

Analyzer Instruments

Analyzer Type : CO Analyzer

Manufacturer : Thermo Environmental

Model : 48C

Serial No. : 71021-367

Environmental

Temperature : 26.4 °C

Humidity : 52.7 %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

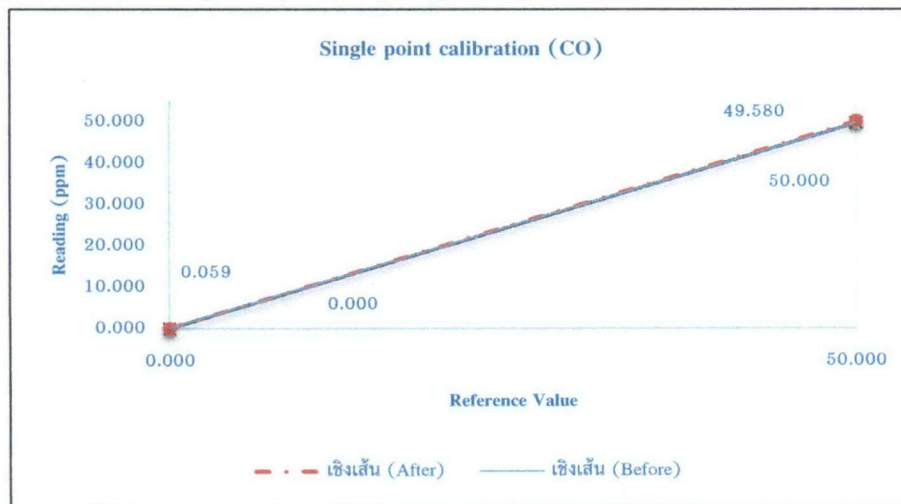
SO2 Conc. : 2 ppm

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 | 0.059 | 0.000 | 0.06 | 49.580 | 50.000 | -0.84 |
| 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 : 11-Mar-23

Certificate No. : 0323-003

Page : 1/1

Analyzer Instruments

Analyzer Type : NO/NO_x 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

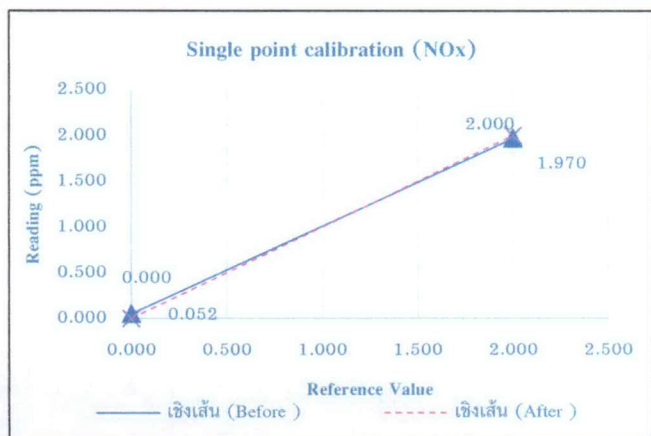
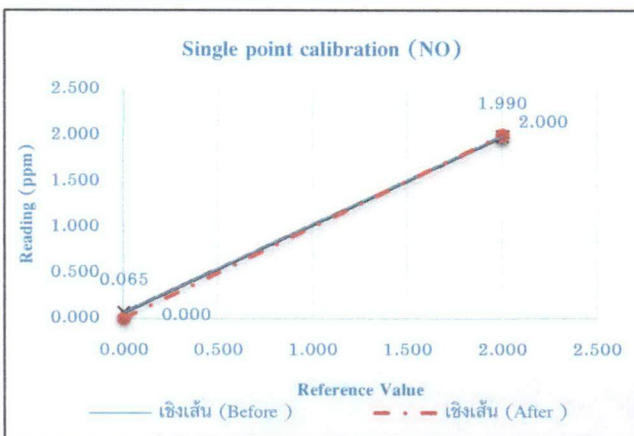
Standard Gas

NO Conc. : 2 ppm
SO₂ : 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 _x | 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 _x | 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 : 4-Jul-23

Certificate No. : 0723-001

Page : 1/1

Analyzer Instruments

Analyzer Type : NO/NO/NO_x Analyzer

Manufacturer : Thermo Environmental

Model : 42C

Serial No. : 63470-339

Environmental

Temperature : 25.1 °C

Humidity : 40.4 %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

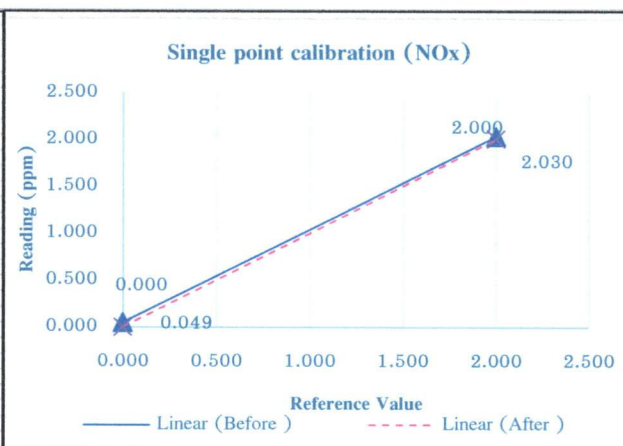
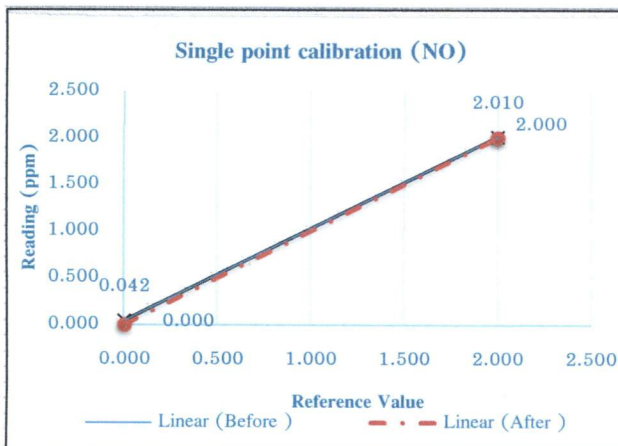
SO₂ : 2 ppm

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 | 0.042 | 0.000 | 0.04 | 2.01 | 2.00 | 0.50 |
| NO _x | 0.049 | 0.000 | 0.05 | 2.03 | 2.00 | 1.50 |
| After | | | | | | |
| NO | 0.000 | 0.000 | 0.00 | 2.00 | 2.00 | 0.00 |
| NO _x | 0.000 | 0.000 | 0.00 | 2.00 | 2.00 | 0.00 |



Calibrated by :


(Mr. Tong Piima)

Certificate of Analyzer Performance Testing

Calibrated Date : 1-Sep-22

Certificate No. : 0922-002

Page : 1/1

Analyzer Instruments

Analyzer Type : SO2 Analyzer

Manufacturer : Thermo Environmental

Model : 43C

Serial No. : 77419-385

Environmental

Temperature : 25.2 °C

Humidity : 52.0 %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

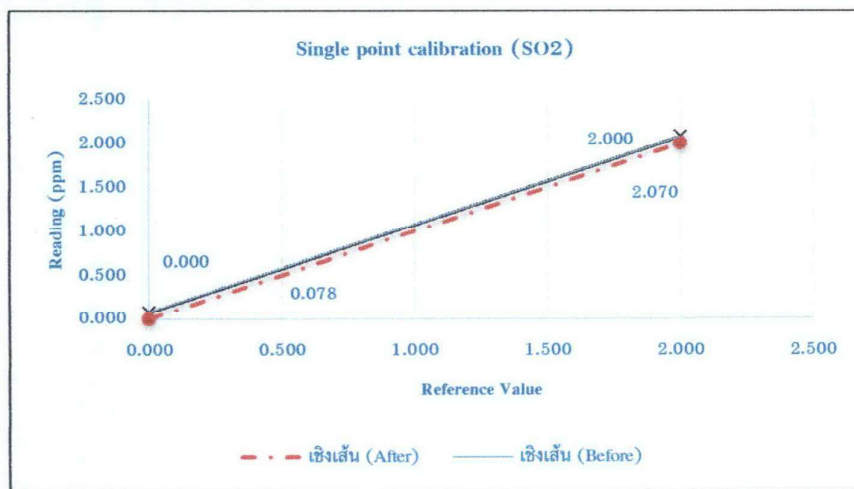
SO2 Conc. : 2 ppm

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 | 0.078 | 0.000 | 0.08 | 2.07 | 2.000 | 3.50 |
| After | | | | | | |
| SO2 | 0.000 | 0.000 | 0.00 | 2.00 | 2.000 | 0.00 |



Calibrated by :


(Mr. Tong Piima)

เอกสารการสอบเทียบเครื่องมือตรวจวัดความชื้นสะท้อน

Calibration Certificate

Part Number: 721A2601

Description: Micromate with DIN Geophone

Serial Number: UM21467

Calibration Date: MAY 29 2023

Calibration Reference Equipment: 714J7403

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: _____

Xiaoming Yang



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



Merci d'avoir choisi Instantel!

Votre engagement avec
« les moniteurs les plus fiables au monde »
vous servira pour les années à venir.

Grâce à votre achat, vous êtes à la pointe de la technologie en matière de moniteurs. Au nom de tous les collaborateurs d'Instantel, nous vous remercions d'avoir fait choisir nos produits pour la réalisation de vos projets. Les produits Instantel incluent les éléments les plus aboutis du domaine tels que:

- 1) Plus de 30 années au service des secteurs du bâtiment, d'activités minières et de géotechnologie
- 2) Des conceptions durables et résistantes
- 3) Des produits faciles à utiliser grâce à une interface intuitive
- 4) Des options étendues de conformité réglementaire
- 5) Un programme d'assistance, un service technique et une aide en ligne complets
- 6) Logiciel THOR® disponible en téléchargement gratuit sur le site Web d'Instantel: www.instantel.com
- 7) Garantie d'un an sur les pièces; si un moniteur ou un capteur est ramené à l'usine pour étalonnage jusqu'à un an après la date d'achat, la garantie sera automatiquement prolongée d'un an supplémentaire

Instantel est **RESPECTUEUX DE L'ENVIRONNEMENT!** Instantel n'envoie plus de manuels en version papier. Les manuels de l'opérateur pour chaque produit et pour THOR sont disponibles en téléchargement sur le site Web d'Instantel à l'adresse www.instantel.com/resources.

Nous nous engageons pour que votre satisfaction en tant que client soit la meilleure possible. En cas de questions ou de commentaires, n'hésitez pas à nous contacter. Veuillez appeler notre numéro gratuit **+1 800 267 9111** ou nous envoyer un e-mail à service@instantel.com ou sales@instantel.com.

Nous vous remercions de nouveau et avons hâte de collaborer avec vous!

Certificate No.: CP20230080EA

Operation No.: CP2022100031

Certificate of Calibration

Equipment: Vibration Meter

Manufacturer: Instantel

Model/Type: Micromate

Serial No.: UM15904

ID No.: VB-01-002

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

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

Received Date: 26 October 2022

Calibrated Date: 7 - 9 February 2023

Issued Date: 15 February 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.: CP20230080EA

Calibration Report

Equipment: Vibration Meter
Manufacturer: Instantel
Model: Micromate
Serial No.: UM15904
ID No.: VB-01-002
Ambient Temperature: (23 ± 5) °C
Relative Humidity: (50 ± 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 | 8305-001 | 30120 | AV-0013-21 | 30-May-2023 |
| 2) Measuring Amplifier | 2525 | 3016651 | AV-0007-22 | 9-Jun-2023 |
| 3) PULSE Multi-analyzer system | 3560-C | 2705645 | CQ20230003EA | 25-Dec-2023 |
| 4) Humidity and Temperature Transmitter | HMT331 | K3810009 | CD20220120EA | 22-Apr-2023 |

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.: CP20230080EA

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 | 9.997 | 10.514 | 0.517 | 1.50 | Longitudinal (L) |
| 5.0 | 10.000 | 10.027 | 10.908 | 0.881 | 1.50 | |
| 6.3 | 10.000 | 10.015 | 10.813 | 0.798 | 1.50 | |
| 8.0 | 10.000 | 10.027 | 10.489 | 0.462 | 1.50 | |
| 10.0 | 10.000 | 9.986 | 10.483 | 0.497 | 1.50 | |
| 12.5 | 10.000 | 10.003 | 10.341 | 0.338 | 1.50 | |
| 16.0 | 10.000 | 9.984 | 10.215 | 0.231 | 1.50 | |
| | 20.000 | 20.025 | 20.248 | 0.223 | 1.50 | |
| | 30.000 | 29.981 | 30.298 | 0.317 | 1.50 | |
| | 50.000 | 49.922 | 50.507 | 0.585 | 1.50 | |
| 20.0 | 10.000 | 9.996 | 10.199 | 0.203 | 1.50 | |
| 25.0 | 10.000 | 9.980 | 10.191 | 0.211 | 1.50 | |
| 31.5 | 10.000 | 9.974 | 10.183 | 0.209 | 1.50 | |
| 40.0 | 10.000 | 10.006 | 10.270 | 0.264 | 1.50 | |
| 50.0 | 10.000 | 10.000 | 10.199 | 0.199 | 1.50 | |
| 52.0 | 10.000 | 10.013 | 10.286 | 0.273 | 1.50 | |
| 63.0 | 10.000 | 9.976 | 10.325 | 0.349 | 1.50 | |
| 80.0 | 10.000 | 9.976 | 10.317 | 0.341 | 1.50 | |

Certificate No.: CP20230080EA

Calibration Report

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

| Frequency | Nominal | Standard | UUC | Deviation | Uncertainty | Direction |
|-----------|---------|----------|--------|-----------|-------------|----------------|
| (Hz) | (mm/s) | (mm/s) | (mm/s) | (mm/s) | ± (%) | |
| 4.0 | 10.000 | 10.055 | 10.656 | 0.601 | 1.50 | Transverse (T) |
| 5.0 | 10.000 | 10.015 | 10.593 | 0.578 | 1.50 | |
| 6.3 | 10.000 | 9.979 | 10.743 | 0.764 | 1.50 | |
| 8.0 | 10.000 | 10.034 | 10.412 | 0.378 | 1.50 | |
| 10.0 | 10.000 | 9.969 | 10.341 | 0.372 | 1.50 | |
| 12.5 | 10.000 | 9.990 | 10.254 | 0.264 | 1.50 | |
| 16.0 | 10.000 | 9.998 | 10.238 | 0.240 | 1.50 | |
| | 20.000 | 19.983 | 20.304 | 0.321 | 1.50 | |
| | 30.000 | 29.995 | 30.455 | 0.460 | 1.50 | |
| | 50.000 | 50.007 | 50.633 | 0.626 | 1.50 | |
| 20.0 | 10.000 | 10.027 | 10.238 | 0.211 | 1.50 | |
| 25.0 | 10.000 | 9.984 | 10.183 | 0.199 | 1.50 | |
| 31.5 | 10.000 | 9.986 | 10.199 | 0.213 | 1.50 | |
| 40.0 | 10.000 | 9.994 | 10.215 | 0.221 | 1.50 | |
| 50.0 | 10.000 | 9.976 | 10.231 | 0.255 | 1.50 | |
| 52.0 | 10.000 | 9.980 | 10.286 | 0.306 | 1.50 | |
| 63.0 | 10.000 | 9.970 | 10.380 | 0.410 | 1.50 | |
| 80.0 | 10.000 | 9.994 | 10.467 | 0.473 | 1.50 | |

Certificate No.: CP20230080EA

Calibration Report

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

| Frequency | Nominal | Standard | UUC | Deviation | Uncertainty | Direction |
|-----------|---------|----------|--------|-----------|-------------|--------------|
| (Hz) | (mm/s) | (mm/s) | (mm/s) | (mm/s) | ± (%) | |
| 4.0 | 10.000 | 9.966 | 9.718 | -0.248 | 1.50 | Vertical (V) |
| 5.0 | 10.000 | 10.028 | 10.223 | 0.195 | 1.50 | |
| 6.3 | 10.000 | 9.969 | 10.388 | 0.419 | 1.50 | |
| 8.0 | 10.000 | 10.006 | 10.041 | 0.035 | 1.50 | |
| 10.0 | 10.000 | 9.993 | 9.971 | -0.022 | 1.50 | |
| 12.5 | 10.000 | 9.979 | 9.947 | -0.032 | 1.50 | |
| 16.0 | 10.000 | 10.004 | 10.049 | 0.045 | 1.50 | |
| | 20.000 | 19.969 | 20.012 | 0.043 | 1.50 | |
| | 30.000 | 29.981 | 29.888 | -0.093 | 1.50 | |
| | 50.000 | 49.978 | 49.868 | -0.110 | 1.50 | |
| 20.0 | 10.000 | 10.015 | 10.152 | 0.137 | 1.50 | |
| 25.0 | 10.000 | 9.977 | 9.655 | -0.322 | 1.50 | |
| 31.5 | 10.000 | 10.014 | 10.081 | 0.067 | 1.50 | |
| 40.0 | 10.000 | 10.020 | 10.238 | 0.218 | 1.50 | |
| 50.0 | 10.000 | 10.031 | 10.380 | 0.349 | 1.50 | |
| 52.0 | 10.000 | 9.982 | 10.294 | 0.312 | 1.50 | |
| 63.0 | 10.000 | 9.987 | 10.428 | 0.441 | 1.50 | |
| 80.0 | 10.000 | 9.994 | 10.751 | 0.757 | 1.50 | |

Remark

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

-- End of Report --



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

975 Moo 4, Bangpoo Industrial Estate, Soi 8, Sukhumvit Road km 37

Phraek Sa, Mueang Samut Prakan, Samut Prakan 10280

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

Certificate No.: CP20230148EA

Operation No.: CP2023020060

Certificate of Calibration

Equipment: Vibration Meter

Manufacturer: Instantel

Model/Type: Micromate

Serial No.: UM16048

ID No.: VB-01-003

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

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

Received Date: 28 February 2023

Calibrated Date: 7 - 9 March 2023

Issued Date: 14 March 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.: CP20230148EA

Calibration Report

Equipment: Vibration Meter
Manufacturer: Instantel
Model: Micromate
Serial No.: UM16048
ID No.: VB-01-003
Ambient Temperature: (23 ± 5) °C
Relative Humidity: (50 ± 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 | 8305-001 | 30120 | AV-0013-21 | 30-May-2023 |
| 2) Measuring Amplifier | 2525 | 3016651 | AV-0007-22 | 9-Jun-2023 |
| 3) PULSE Multi-analyzer system | 3560-C | 2705645 | CQ20230003EA | 25-Dec-2023 |
| 4) Humidity and Temperature Transmitter | HMT331 | K3810009 | CD20220120EA | 22-Apr-2023 |

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.: CP20230148EA

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 | 10.008 | 10.554 | 0.546 | 1.50 | Longitudinal (L) |
| 5.0 | 10.000 | 10.004 | 10.514 | 0.510 | 1.50 | |
| 6.3 | 10.000 | 10.007 | 10.633 | 0.626 | 1.50 | |
| 8.0 | 10.000 | 10.008 | 10.365 | 0.357 | 1.50 | |
| 10.0 | 10.000 | 10.006 | 10.341 | 0.335 | 1.50 | |
| 12.5 | 10.000 | 9.997 | 10.262 | 0.265 | 1.50 | |
| 16.0 | 10.000 | 9.998 | 10.262 | 0.264 | 1.50 | |
| | 20.000 | 19.997 | 20.548 | 0.551 | 1.50 | |
| | 30.000 | 29.995 | 30.786 | 0.791 | 1.50 | |
| | 50.000 | 49.992 | 51.153 | 1.161 | 1.50 | |
| 20.0 | 10.000 | 10.003 | 10.294 | 0.291 | 1.50 | |
| 25.0 | 10.000 | 10.000 | 10.341 | 0.341 | 1.50 | |
| 31.5 | 10.000 | 10.010 | 10.372 | 0.362 | 1.50 | |
| 40.0 | 10.000 | 9.998 | 10.420 | 0.422 | 1.50 | |
| 50.0 | 10.000 | 10.017 | 10.428 | 0.411 | 1.50 | |
| 52.0 | 10.000 | 10.001 | 10.522 | 0.521 | 1.50 | |
| 63.0 | 10.000 | 10.010 | 10.688 | 0.678 | 1.50 | |
| 80.0 | 10.000 | 10.004 | 10.680 | 0.676 | 1.50 | |

Certificate No.: CP20230148EA

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 | 9.970 | 10.853 | 0.883 | 1.50 | Transverse (T) |
| 5.0 | 10.000 | 9.998 | 10.869 | 0.871 | 1.50 | |
| 6.3 | 10.000 | 10.000 | 10.901 | 0.901 | 1.50 | |
| 8.0 | 10.000 | 10.003 | 10.538 | 0.535 | 1.50 | |
| 10.0 | 10.000 | 10.000 | 10.467 | 0.467 | 1.50 | |
| 12.5 | 10.000 | 10.004 | 10.412 | 0.408 | 1.50 | |
| 16.0 | 10.000 | 10.001 | 10.428 | 0.427 | 1.50 | |
| | 20.000 | 19.997 | 20.761 | 0.764 | 1.50 | |
| | 30.000 | 29.995 | 31.031 | 1.036 | 1.50 | |
| | 50.000 | 49.978 | 51.516 | 1.538 | 1.50 | |
| 20.0 | 10.000 | 10.008 | 10.491 | 0.483 | 1.50 | |
| 25.0 | 10.000 | 10.000 | 10.475 | 0.475 | 1.50 | |
| 31.5 | 10.000 | 10.008 | 10.530 | 0.522 | 1.50 | |
| 40.0 | 10.000 | 10.004 | 10.609 | 0.605 | 1.50 | |
| 50.0 | 10.000 | 9.994 | 10.593 | 0.599 | 1.50 | |
| 52.0 | 10.000 | 10.001 | 10.688 | 0.687 | 1.50 | |
| 63.0 | 10.000 | 10.008 | 10.845 | 0.837 | 1.50 | |
| 80.0 | 10.000 | 10.008 | 10.940 | 0.932 | 1.50 | |

Certificate No.: CP20230148EA

Calibration Report

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

| Frequency | Nominal | Standard | UUC | Deviation | Uncertainty | Direction |
|-----------|---------|----------|--------|-----------|-------------|--------------|
| (Hz) | (mm/s) | (mm/s) | (mm/s) | (mm/s) | ± (%) | |
| 4.0 | 10.000 | 10.006 | 10.711 | 0.705 | 1.50 | Vertical (V) |
| 5.0 | 10.000 | 10.003 | 10.554 | 0.551 | 1.50 | |
| 6.3 | 10.000 | 10.008 | 10.562 | 0.554 | 1.50 | |
| 8.0 | 10.000 | 9.991 | 10.128 | 0.137 | 1.50 | |
| 10.0 | 10.000 | 10.008 | 10.065 | 0.057 | 1.50 | |
| 12.5 | 10.000 | 10.001 | 10.057 | 0.056 | 1.50 | |
| 16.0 | 10.000 | 10.004 | 10.065 | 0.061 | 1.50 | |
| | 20.000 | 19.997 | 20.114 | 0.117 | 1.50 | |
| | 30.000 | 30.010 | 30.148 | 0.138 | 1.50 | |
| | 50.000 | 49.992 | 50.269 | 0.277 | 1.50 | |
| 20.0 | 10.000 | 9.993 | 10.175 | 0.182 | 1.50 | |
| 25.0 | 10.000 | 10.003 | 9.766 | -0.237 | 1.50 | |
| 31.5 | 10.000 | 10.003 | 10.120 | 0.117 | 1.50 | |
| 40.0 | 10.000 | 10.006 | 10.262 | 0.256 | 1.50 | |
| 50.0 | 10.000 | 10.001 | 10.333 | 0.332 | 1.50 | |
| 52.0 | 10.000 | 10.000 | 10.374 | 0.374 | 1.50 | |
| 63.0 | 10.000 | 9.998 | 10.451 | 0.453 | 1.50 | |
| 80.0 | 10.000 | 10.001 | 10.751 | 0.750 | 1.50 | |

Remark

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

-- End of Report --