

Appendix C

Calibration Certificates of Monitoring Equipment



TISCH ENVIRONMENTAL, INC.
145 SOUTH MIAMI AVE
VILLAGE OF CLEVELAND, OH
45002
513.467.9000
877.263.7610 TOLL FREE
513.467.9009 FAX

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Mar 24, 2015 Rootmeter S/N 0438320 Ta (K) - 292
Operator Tisch Orifice I.D. - 1941 Pa (mm) - 756.92

| PLATE OR Run # | VOLUME START (m3) | VOLUME STOP (m3) | DIFF VOLUME (m3) | DIFF TIME (min) | METER DIFF Hg (mm) | ORFICE DIFF H2O (in.) |
|----------------------|-------------------------|------------------------|------------------------|-----------------------|-----------------------------|--------------------------------|
| 1 | NA | NA | 1.00 | 1.4880 | 3.2 | 2.00 |
| 2 | NA | NA | 1.00 | 1.0510 | 6.4 | 4.00 |
| 3 | NA | NA | 1.00 | 0.9360 | 7.9 | 5.00 |
| 4 | NA | NA | 1.00 | 0.8920 | 8.8 | 5.50 |
| 5 | NA | NA | 1.00 | 0.7360 | 12.7 | 8.00 |

DATA TABULATION

| Vstd | (x axis) Qstd | (y axis) | Va | (x axis) Qa | (y axis) |
|-------------------------------------|------------------|----------|---------------------------|----------------|----------|
| 1.0121 | 0.6802 | 1.4258 | 0.9958 | 0.6692 | 0.8784 |
| 1.0078 | 0.9589 | 2.0163 | 0.9916 | 0.9434 | 1.2422 |
| 1.0057 | 1.0745 | 2.2543 | 0.9895 | 1.0571 | 1.3888 |
| 1.0046 | 1.1262 | 2.3644 | 0.9884 | 1.1080 | 1.4566 |
| 0.9993 | 1.3578 | 2.8515 | 0.9832 | 1.3358 | 1.7568 |
| Qstd slope (m) = 2.10265 | | | Qa slope (m) = 1.31664 | | |
| intercept (b) = -0.00335 | | | intercept (b) = -0.00206 | | |
| coefficient (r) = 0.99999 | | | coefficient (r) = 0.99999 | | |
| y axis = SQRT[H2O(Pa/760) (298/Ta)] | | | y axis = SQRT[H2O(Ta/Pa)] | | |

CALCULATIONS

$$Vstd = \text{Diff. Vol}[(Pa - \text{Diff. Hg})/760] (298/Ta)$$

$$Qstd = Vstd/\text{Time}$$

$$Va = \text{Diff Vol} [(Pa - \text{Diff Hg})/Pa]$$

$$Qa = Va/\text{Time}$$

For subsequent flow rate calculations:

$$Qstd = 1/m\{ [\text{SQRT}(H2O(Pa/760) (298/Ta))] - b\}$$

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

TSP Sampler Calibration

SITE

Location: Lian Tang 3 Date: May 5, 2015
 Sampler: TE-5170 MFC (Serial # : 2359) Tech: Sam Wong

CONDITIONS

| | | | |
|------------------------------|-------|-----------------------------|------|
| Barometric Pressure (in Hg): | 39.75 | Corrected Pressure (mm Hg): | 1010 |
| Temperature (deg F): | 86 | Temperature (deg K): | 303 |
| Average Press. (in Hg): | 39.75 | Corrected Average (mm Hg): | 1010 |
| Average Temp. (deg F): | 86 | Average Temp. (deg K): | 303 |

CALIBRATION ORIFICE

| | | |
|-----------------|-----------------|----------------|
| Make: Tisch | Qstd Slope: | 2.10265 |
| Model: TE-5025A | Qstd Intercept: | -0.00335 |
| Serial#: 1941 | Date Certified: | March 24, 2015 |

CALIBRATIONS

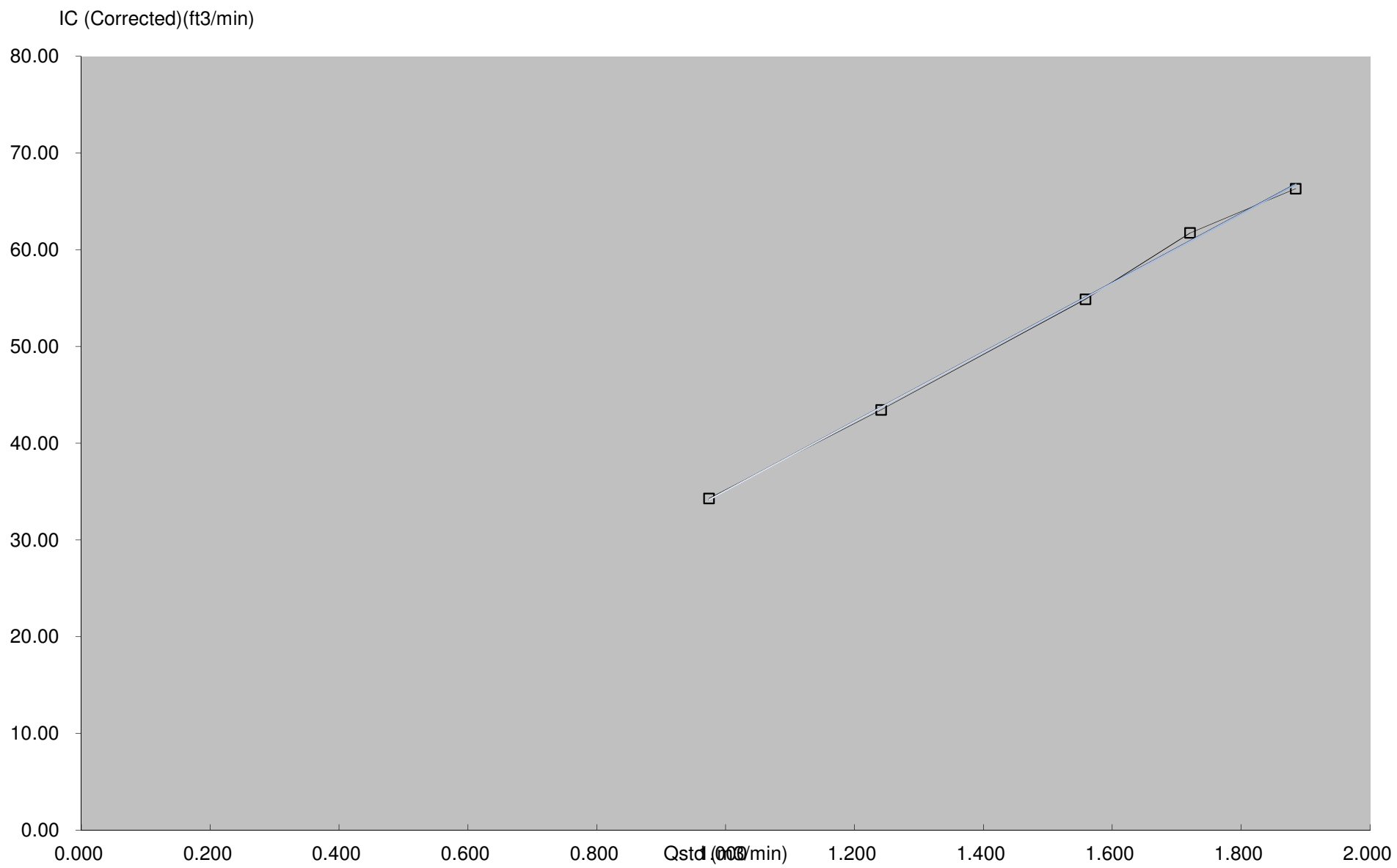
| Plate or Test # | H2O (in) | Qstd (m3/min) | I (chart) | IC (corrected) | LINEAR REGRESSION |
|--------------------|-------------|------------------|--------------|-------------------|----------------------|
| 1 | 12.00 | 1.885 | 58.0 | 66.30 | |
| 2 | 10.00 | 1.721 | 54.0 | 61.72 | Slope = 35.7973 |
| 3 | 8.20 | 1.558 | 48.0 | 54.87 | Intercept = -0.7069 |
| 4 | 5.20 | 1.241 | 38.0 | 43.44 | Corr. coeff.= 0.9992 |
| 5 | 3.20 | 0.974 | 30.0 | 34.29 | # 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





Calibration Certificate

Certificate No. **407497**

Page 1 of 2 Pages

Customer : Enovative Environmental Service Limited

Address : Flat 6, 3/F, Block E, Wah Lok Industrial Centre, 31-35 Shan Mei Street, Shatin, N.T., Hong Kong.

Order No. : Q43167

Date of receipt : 10-Oct-14

Item Tested

Description : Sound Level Calibrator

Manufacturer : B&K

Model : Type 4231

Serial No. : 2685684

Test Conditions

Date of Test : 18-Oct-14

Supply Voltage : --

Ambient Temperature : (23 ± 3)°C

Relative Humidity : (50 ± 25) %

Test Specifications

Calibration check.

Ref. Document/Procedure : F21, Z02, IEC 942.

Test Results

All results were within the IEC 942 Class1 specification.

The results are shown in the attached page(s).

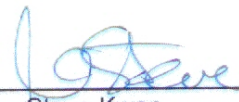
Main Test equipment used:

| <u>Equipment No.</u> | <u>Description</u> | <u>Cert. No.</u> | <u>Traceable to</u> |
|----------------------|-----------------------------|------------------|---------------------|
| S014 | Spectrum Analyzer | 405316 | NIM-PRC & SCL-HKSAR |
| S205 | Ref. Sound Level Calibrator | PHCO40002 | SCL-HKSAR |
| S041 | Universal Counter | 405317 | SCL-HKSAR |
| S206 | Sound Level Meter | 405322 | SCL-HKSAR |
| S031 | 6½ dgt. Multimeter | 39256 | NIM-PRC |

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI).
The test results apply to the above Unit-Under-Test only

Calibrated by : 
Dorothy Cheuk

Approved by : 
Steve Kwan

Date: 18-Oct-14

This Certificate is issued by:
Hong Kong Calibration Ltd.
Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street, Kwai Chung, NT, Hong Kong.
Tel: 2425 8801 Fax: 2425 8646

The copyright of this certificate is owned by Hong Kong Calibration Ltd.. It may not be reproduced except in full.



Calibration Certificate

Certificate No. 407497

Page 2 of 2 Pages

Results :

1. Level Accuracy

| UUT Nominal Value (dB) | Measured Value (dB) | IEC 942 Class 1 Spec. |
|------------------------|---------------------|-----------------------|
| 94 | 94.1 | ± 0.3 dB |
| 114 | 114.1 | |

Uncertainty : ± 0.1 dB

2. Frequency

| UUT Nominal Value | Measured Value | IEC 942 Class 1 Spec. |
|-------------------|----------------|-----------------------|
| 1 kHz | 1.000 kHz | ± 2 % |

Uncertainty : ± 3.6 x 10⁻⁶

3. Level Stability : 0.0 dB

IEC 942 Class 1 Spec. : ± 0.1 dB

Uncertainty : ± 0.01 dB

4. Total Harmonic Distortion : < 0.6 %

IEC 942 Class 1 Spec. : < 3 %

Uncertainty : ± 2.3 % of reading

Remark : 1. UUT : Unit-Under-Test

2. The uncertainty claimed is for a confidence probability of not less than 95%.

3. Atmospheric Pressure : 1005 hPa.

----- END -----



Calibration Certificate

Certificate No. 406516

Page 1 of 4 Pages

Customer : Enovative Environmental Service Limited

Address : Flat 6, 3/F, Block E, Wah Lok Industrial Centre, 31-35 Shan Mei Street, Shatin, N.T., Hong Kong.

Order No. : Q42822

Date of receipt : 1-Sep-14

Item Tested

Description : Sound Level Meter (N12-RION-004)

Manufacturer : Rion

Model : NL-52

Serial No. : 00220553

Test Conditions

Date of Test : 24-Sep-14

Supply Voltage : --

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

Relative Humidity : $(50 \pm 25) \%$

Test Specifications

Calibration check.

Ref. Document/Procedure: Z01, IEC 61672.

Test Results

All results were within the IEC 61672 Type1 specification.

The results are shown in the attached page(s).

Main Test equipment used:

| Equipment No. | Description | Cert. No. | Traceable to |
|---------------|-----------------------------|-----------|--------------|
| S017 | Multi-Function Generator | C127181 | SCL-HKSAR |
| S205 | Ref. Sound Level Calibrator | PHCO40002 | SCL-HKSAR |

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI).
The test results apply to the above Unit-Under-Test only

Calibrated by : Dorothy Cheuk
Dorothy Cheuk

Approved by : Steve Kwan
Steve Kwan

This Certificate is issued by:

Hong Kong Calibration Ltd.

Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street, Kwai Chung, NT, Hong Kong.

Tel: 2425 8801 Fax: 2425 8646

Date: 25-Sep-14



Calibration Certificate

Certificate No. 406516

Page 2 of 4 Pages

Results :

1. Self-generated noise: 16.0 dBA (Mfr's Spec ≤ 17 dBA)

2. Acoustical signal test

| UUT Setting | | | | Applied Value (dB) | UUT Reading (dB) |
|-------------|---------------------|----------------|---------------|--------------------|------------------|
| Range (dB) | Frequency Weighting | Time Weighting | Octave Filter | | |
| 30-130 | A | F | OFF | 94.2 | 94.2 |
| | | S | OFF | | 94.2 |
| | C | F | OFF | | 94.2 |
| | Z | F | OFF | | 94.2 |
| | A | F | OFF | 114.2 | 114.2 |
| | | S | OFF | | 114.2 |
| | C | F | OFF | | 114.2 |
| | Z | F | OFF | | 114.2 |

IEC 61672 Type 1 Spec. : ± 1.1 dB

Uncertainty : ± 0.1 dB

3 Electrical signal tests of frequency weightings (A weighting)

| Frequency | Attenuation (dB) | IEC 61672 Type 1 Spec. |
|-----------|------------------|------------------------------------|
| 31.5 Hz | -39.7 | - 39.4 dB, ± 2 dB |
| 63 Hz | -26.3 | - 26.2 dB, ± 1.5 dB |
| 125 Hz | -16.2 | - 16.1 dB, ± 1.5 dB |
| 250 Hz | -8.7 | - 8.6 dB, ± 1 dB |
| 500 Hz | -3.2 | - 3.2 dB, ± 1.4 dB |
| 1 kHz | 0.0 (Ref) | 0 dB, ± 1.1 dB |
| 2 kHz | +1.2 | + 1.2 dB, ± 1.6 dB |
| 4 kHz | +1.0 | + 1.0 dB, ± 1.6 dB |
| 8 kHz | -1.0 | - 1.1 dB, + 2.1 dB \sim -3.1 dB |
| 16 kHz | -8.0 | - 6.6 dB, + 3.5 dB \sim -17.0 dB |

Uncertainty : ± 0.1 dB



Calibration Certificate

Certificate No. 406516

Page 3 of 4 Pages

4. Frequency & Time weightings at 1 kHz

4.1 Frequency Weighting (Fast)

| UUT Setting | Applied Value (dB) | UUT Reading (dB) | Difference (dB) | IEC 61672 Type 1 Spec. |
|-------------|--------------------|------------------|-----------------|------------------------|
| A | 94.2 | 94.2 (Ref.) | - - | ± 0.4 dB |
| C | 94.2 | 94.2 | 0.0 | |
| Z | 94.2 | 94.2 | 0.0 | |

4.2 Time Weighting (A-weighted)

| UUT Setting | Applied Value (dB) | UUT Reading (dB) | Difference (dB) | IEC 61672 Type 1 Spec. |
|----------------|--------------------|------------------|-----------------|------------------------|
| Fast | 94.2 | 94.2 (Ref.) | - - | ± 0.3 dB |
| Slow | 94.2 | 94.2 | 0.0 | |
| Time-averaging | 94.2 | 94.2 | 0.0 | |

Uncertainty : ± 0.1 dB

5. Level linearity on the reference level range

| UUT Range | Applied Value (dB) | UUT Reading (dB) | Difference (dB) | IEC 61672 Type 1 Spec. |
|--------------------------|--------------------|------------------|-----------------|------------------------|
| 30-130 dB (Ref Level) | 129.0 | 129.0 | 0.0 | ± 1.1 dB |
| | 124.0 | 124.0 | 0.0 | |
| | 119.0 | 119.0 | 0.0 | |
| | 114.0 | 114.0 (Ref) | - - | |
| | 109.0 | 109.0 | 0.0 | |
| | 104.0 | 104.0 | 0.0 | |
| | 99.0 | 99.0 | 0.0 | |
| | 94.0 | 94.0 | 0.0 | |
| | 89.0 | 89.0 | 0.0 | |
| | 84.0 | 84.0 | 0.0 | |
| | 79.0 | 79.0 | 0.0 | |
| | 74.0 | 74.0 | 0.0 | |
| | 69.0 | 69.0 | 0.0 | |
| | 64.0 | 64.0 | 0.0 | |
| | 59.0 | 59.0 | 0.0 | |
| | 54.0 | 54.0 | 0.0 | |
| | 49.0 | 49.1 | +0.1 | |
| | 44.0 | 44.1 | +0.1 | |

Uncertainty : ± 0.1 dB



Calibration Certificate

Certificate No. 406516

Page 4 of 4 Pages

6. Toneburst response (4kHz)

| UUT Setting | Tone Burst Duration(ms) | UUT Reading(dB) | Difference (dB) | IEC 61672 Type 1 Spec. |
|----------------|-------------------------|-----------------|-----------------|--------------------------|
| Fast | Steady | 127.0(Ref) | -- | -- |
| | 200 | 126.0 | -1.0 | -1.0 ± 0.8dB |
| | 2 | 109.0 | -18.0 | -18.0, +1.3 dB ~ -1.8 dB |
| | 0.25 | 99.9 | -27.1 | -27.0, +1.3 dB ~ -3.3 dB |
| Slow | Steady | 127.0(Ref) | -- | -- |
| | 200 | 119.6 | -7.4 | -7.4 ± 0.8dB |
| | 2 | 100.0 | -27.0 | -27.0, +1.3 dB ~ -3.3 dB |
| Time averaging | Steady | 127.0(Ref) | -- | -- |
| | 200 | 120.4 | -6.6 | -7.0±0.8dB |
| | 2 | 100.3 | -26.7 | -27.0, +1.3 dB ~ -1.8 dB |
| | 0.25 | 91.0 | -36.0 | -36.0, +1.3 dB ~ -3.3 dB |

Uncertainty : ± 0.1 dB

7. Overload indication (30-130 dB range, A-weighted, Time-average, 4kHz)

| UUT Reading at overload (dB) | | Difference (dB) | IEC 61672 Type 1 Spec. |
|------------------------------|---------------------|-----------------|------------------------|
| + ve one half cycle | - ve one half cycle | | |
| 136.1 | 137.2 | 1.1 | < 1.8 dB |

The overload indicator latched on until reset

Uncertainty : ± 0.1 dB

Remarks : 1. UUT : Unit-Under-Test

2. The uncertainty claimed is for a confidence probability of not less than 95%.

3. Atmospheric Pressure : 1001 hPa.

4. Preamplifier model : NH-25 , S/N : 10553

5. Firmware Version: 1.2

6. Power Supply Check: OK

7. The UUT was adjusted with the laboratory's sound calibrator at the reference sound pressure level before the calibration.

----- END -----