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ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - May 22, 2017 Rootsmeter S/N 0438320 Ta (K) - 295  
 Operator Tisch Orifice I.D. - 0988 Pa (mm) - 754.38

| 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             | 1.3910          | 3.2                | 2.00                  |
| 2              | NA                | NA               | 1.00             | 0.9810          | 6.4                | 4.00                  |
| 3              | NA                | NA               | 1.00             | 0.8750          | 7.9                | 5.00                  |
| 4              | NA                | NA               | 1.00             | 0.8330          | 8.8                | 5.50                  |
| 5              | NA                | NA               | 1.00             | 0.6890          | 12.7               | 8.00                  |

DATA TABULATION

| Vstd                                | (x axis) Qstd | (y axis) | Va                        | (x axis) Qa | (y axis) |
|-------------------------------------|---------------|----------|---------------------------|-------------|----------|
| 0.9984                              | 0.7178        | 1.4161   | 0.9957                    | 0.7158      | 0.8844   |
| 0.9942                              | 1.0135        | 2.0027   | 0.9915                    | 1.0107      | 1.2507   |
| 0.9921                              | 1.1338        | 2.2391   | 0.9894                    | 1.1308      | 1.3983   |
| 0.9910                              | 1.1897        | 2.3484   | 0.9883                    | 1.1865      | 1.4666   |
| 0.9858                              | 1.4307        | 2.8322   | 0.9831                    | 1.4269      | 1.7687   |
| Qstd slope (m) = 1.98425            |               |          | Qa slope (m) = 1.24250    |             |          |
| intercept (b) = -0.00930            |               |          | intercept (b) = -0.00581  |             |          |
| coefficient (r) = 0.99998           |               |          | coefficient (r) = 0.99998 |             |          |
| 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:

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

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





## EQUIPMENT CALIBRATION RECORD

Type: Laser Dust Monitor  
 Manufacturer/Brand: SIBATA  
 Model No.: LD-3  
 Equipment No.: A.005.07a  
 Sensitivity Adjustment Scale Setting: 557 CPM

Operator: Mike Shek (MSKM)

### Standard Equipment

Equipment: Rupprecht & Patashnick TEOM®  
 Venue: Cyberport (Pui Ying Secondary School)  
 Model No.: Series 1400AB  
 Serial No.: Control: 140AB219899803  
 Sensor: 1200C143659803 K<sub>0</sub>: 12500  
 Last Calibration Date\*: 6 May 2017

\*Remarks: Recommended interval for hardware calibration is 1 year

### Calibration Result

Sensitivity Adjustment Scale Setting (Before Calibration): 557 CPM  
 Sensitivity Adjustment Scale Setting (After Calibration): 557 CPM

| Hour | Date<br>(dd-mm-yy) | Time          | Ambient Condition |             | Concentration <sup>1</sup><br>(mg/m <sup>3</sup> )<br>Y-axis | Total Count <sup>2</sup> | Count/<br>Minute <sup>3</sup><br>X-axis |
|------|--------------------|---------------|-------------------|-------------|--|--------------------------|---|
|      |                    |               | Temp<br>(°C)      | R.H.<br>(%) |  |                          |   |
| 1    | 06-05-17           | 12:30 - 13:30 | 27.5              | 78          | 0.04741  | 1894                     | 31.57                                   |
| 2    | 06-05-17           | 13:30 - 14:30 | 27.6              | 78          | 0.04823  | 1933                     | 32.22                                   |
| 3    | 06-05-17           | 14:30 - 15:30 | 27.6              | 79          | 0.04968  | 1987                     | 33.12                                   |
| 4    | 06-05-17           | 15:30 - 16:30 | 27.6              | 79          | 0.04785  | 1915                     | 31.92                                   |

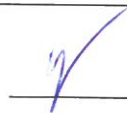
- Note:
1. Monitoring data was measured by Rupprecht & Patashnick TEOM®
  2. Total Count was logged by Laser Dust Monitor
  3. Count/minute was calculated by (Total Count/60)

By Linear Regression of Y or X

Slope (K-factor): 0.0015  
 Correlation coefficient: 0.9957

Validity of Calibration Record: 6 May 2018

Remarks:

QC Reviewer: YW Fung Signature:  Date: 08 May 2017

## EQUIPMENT CALIBRATION RECORD

Type: Laser Dust Monitor  
 Manufacturer/Brand: SIBATA  
 Model No.: LD-3  
 Equipment No.: A.005.09a  
 Sensitivity Adjustment Scale Setting: 797 CPM

Operator: Mike Shek (MSKM)

### Standard Equipment

Equipment: Rupprecht & Patashnick TEOM®  
 Venue: Cyberport (Pui Ying Secondary School)  
 Model No.: Series 1400AB  
 Serial No: Control: 140AB219899803  
 Sensor: 1200C143659803 K<sub>o</sub>: 12500  
 Last Calibration Date\*: 6 May 2017

\*Remarks: Recommended interval for hardware calibration is 1 year

### Calibration Result

Sensitivity Adjustment Scale Setting (Before Calibration): 797 CPM  
 Sensitivity Adjustment Scale Setting (After Calibration): 797 CPM

| Hour | Date<br>(dd-mm-yy) | Time          | Ambient Condition |             | Concentration <sup>1</sup><br>(mg/m <sup>3</sup> )<br>Y-axis | Total Count <sup>2</sup> | Count/<br>Minute <sup>3</sup><br>X-axis |
|------|--------------------|---------------|-------------------|-------------|--|--------------------------|---|
|      |                    |               | Temp<br>(°C)      | R.H.<br>(%) |  |                          |   |
| 1    | 06-05-17           | 12:00 - 13:00 | 27.5              | 78          | 0.04715  | 1881                     | 31.35                                   |
| 2    | 06-05-17           | 13:00 - 14:00 | 27.6              | 78          | 0.04843  | 1939                     | 32.32                                   |
| 3    | 06-05-17           | 14:00 - 15:00 | 27.6              | 79          | 0.04987  | 1992                     | 33.20                                   |
| 4    | 06-05-17           | 15:00 - 16:00 | 27.6              | 79          | 0.04794  | 1916                     | 31.93                                   |

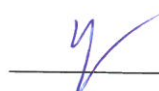
- Note:
1. Monitoring data was measured by Rupprecht & Patashnick TEOM®
  2. Total Count was logged by Laser Dust Monitor
  3. Count/minute was calculated by (Total Count/60)

By Linear Regression of Y or X

Slope (K-factor): 0.0015  
 Correlation coefficient: 0.9961

Validity of Calibration Record: 6 May 2018

Remarks:

QC Reviewer: YW Fung Signature:  Date: 08 May 2017



## CERTIFICATE OF CALIBRATION

N.009.04

Certificate No.: 17CA0407 01 Page 1 of 2

### Item tested

|                       |                            |   |            |
|-----------------------|----------------------------|---|------------|
| Description:          | Sound Level Meter (Type 1) | , | Microphone |
| Manufacturer:         | B & K                      | , | B & K      |
| Type/Model No.:       | 2238                       | , | 4188       |
| Serial/Equipment No.: | 2285692                    | , | 2250455    |
| Adaptors used:        | -                          | , | -          |

### Item submitted by

Customer Name: AECOM ASIA CO., LTD.  
Address of Customer: -  
Request No.: -  
Date of receipt: 07-Apr-2017

Date of test: 10-Apr-2017

### Reference equipment used in the calibration

| Description:                    | Model:   | Serial No. | Expiry Date: | Traceable to: |
|---------------------------------|----------|------------|--------------|---------------|
| Multi function sound calibrator | B&K 4226 | 2288444    | 18-Jun-2017  | CIGISMEC      |
| Signal generator                | DS 360   | 33873      | 18-Apr-2017  | CEPREI        |
| Signal generator                | DS 360   | 61227      | 18-Apr-2017  | CEPREI        |

### Ambient conditions

Temperature: 22 ± 1 °C  
Relative humidity: 50 ± 10 %  
Air pressure: 1010 ± 5 hPa

### Test specifications

- The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
- The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsiveness of the Sound Level Meter.

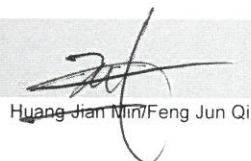
### Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:

  
Huang Jian Min/Feng Jun Qi

Date: 11-Apr-2017

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



# CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 17CA0407 01 Page 2 of 2

## 1, Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

| Test:                   | Subtest:   | Status:           | Expanded Uncertainty (dB) | Coverage Factor |
|-------------------------|--|-------------------|---------------------------|-----------------|
| Self-generated noise    | A  | Pass              | 0.3                       |                 |
|                         | C  | Pass              | 1.0                       | 2.1             |
|                         | Lin  | Pass              | 2.0                       | 2.2             |
| Linearity range for Leq | At reference range, Step 5 dB at 4 kHz           | Pass              | 0.3                       |                 |
|                         | Reference SPL on all other ranges                | Pass              | 0.3                       |                 |
|                         | 2 dB below upper limit of each range             | Pass              | 0.3                       |                 |
|                         | 2 dB above lower limit of each range             | Pass              | 0.3                       |                 |
| Linearity range for SPL | At reference range, Step 5 dB at 4 kHz           | Pass              | 0.3                       |                 |
|                         | A  | Pass              | 0.3                       |                 |
|                         | C  | Pass              | 0.3                       |                 |
| Frequency weightings    | Lin  | Pass              | 0.3                       |                 |
|                         | Time weightings                                  | Single Burst Fast | Pass                      | 0.3             |
|                         | Single Burst Slow                                | Pass              | 0.3                       |                 |
| Peak response           | Single 100µs rectangular pulse                   | Pass              | 0.3                       |                 |
|                         | R.M.S. accuracy                                  | Crest factor of 3 | Pass                      | 0.3             |
| Time weighting I        | Single burst 5 ms at 2000 Hz                     | Pass              | 0.3                       |                 |
|                         | Repeated at frequency of 100 Hz                  | Pass              | 0.3                       |                 |
| Time averaging          | 1 ms burst duty factor 1/10 <sup>3</sup> at 4kHz | Pass              | 0.3                       |                 |
|                         | 1 ms burst duty factor 1/10 <sup>4</sup> at 4kHz | Pass              | 0.3                       |                 |
| Pulse range             | Single burst 10 ms at 4 kHz                      | Pass              | 0.4                       |                 |
| Sound exposure level    | Single burst 10 ms at 4 kHz                      | Pass              | 0.4                       |                 |
| Overload indication     | SPL  | Pass              | 0.3                       |                 |
|                         | Leq  | Pass              | 0.4                       |                 |

## 2, Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

| Test:             | Subtest                | Status | Expanded Uncertainty (dB) | Coverage Factor |
|-------------------|------------------------|--------|---------------------------|-----------------|
| Acoustic response | Weighting A at 125 Hz  | Pass   | 0.3                       |                 |
|                   | Weighting A at 8000 Hz | Pass   | 0.5                       |                 |

## 3, Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Lai Sheng Jie

Date: 10-Apr-2017

Checked by:

Lam Tze Wai

Date: 11-Apr-2017

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



## CERTIFICATE OF CALIBRATION

Certificate No.: 16CA1201 01

Page: 1 of 2

### Item tested

Description: Acoustical Calibrator (Class 1)  
Manufacturer: Rion Co., Ltd.  
Type/Model No.: NC-73  
Serial/Equipment No.: 10307223 (CN.004.08)  
Adaptors used: -

### Item submitted by

Customer: AECOM ASIA CO. LTD.  
Address of Customer: -  
Request No.: -  
Date of receipt: 01-Dec-2016

Date of test: 05-Dec-2016

### Reference equipment used in the calibration

| Description:            | Model:   | Serial No. | Expiry Date: | Traceable to: |
|-------------------------|----------|------------|--------------|---------------|
| Lab standard microphone | B&K 4180 | 2412857    | 14-Apr-2017  | SCL           |
| Preamplifier            | B&K 2673 | 2239857    | 28-Apr-2017  | CEPREI        |
| Measuring amplifier     | B&K 2610 | 2346941    | 26-Apr-2017  | CEPREI        |
| Signal generator        | DS 360   | 61227      | 18-Apr-2017  | CEPREI        |
| Digital multi-meter     | 34401A   | US36087050 | 18-Apr-2017  | CEPREI        |
| Audio analyzer          | 8903B    | GB41300350 | 19-Apr-2017  | CEPREI        |
| Universal counter       | 53132A   | MY40003662 | 19-Apr-2017  | CEPREI        |

### Ambient conditions

Temperature:  $22 \pm 1$  °C  
Relative humidity:  $55 \pm 10$  %  
Air pressure:  $1005 \pm 5$  hPa

### Test specifications

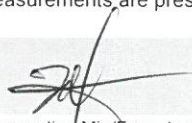
- The Sound Calibrator has been calibrated in accordance with the requirements as specified in IEC 60942 1997 Annex B and the lab calibration procedure SMTP004-CA-156.
- The calibrator was tested with its axis vertical facing downwards at the specific frequency using insert voltage technique.
- The results are rounded to the nearest 0.01 dB and 0.1 Hz and have not been corrected for variations from a reference pressure of 1013.25 hectoPascals as the maker's information indicates that the instrument is insensitive to pressure changes.

### Test results

This is to certify that the sound calibrator conforms to the requirements of annex B of IEC 60942: 1997 for the conditions under which the test was performed. This does not imply that the sound calibrator meets IEC 60942 under any other conditions.

Details of the performed measurements are presented on page 2 of this certificate.

Approved Signatory:

  
Huang Jian Min / Feng Jun Qi

Date: 08-Dec-2016

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.





## CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 16CA1201 01

Page: 2 of 2

### 1, Measured Sound Pressure Level

The output Sound Pressure Level in the calibrator head was measured at the setting and frequency shown using a calibrated laboratory standard microphone and insert voltage technique. The results are given in below with the estimated uncertainties.

| Frequency Shown<br>Hz | Output Sound Pressure Level Setting<br>dB | Measured Output Sound Pressure Level<br>dB | (Output level in dB re 20 $\mu$ Pa)  |
|-----------------------|---|--|--------------------------------------|
|                       |   |  | Estimated Expanded Uncertainty<br>dB |
| 1000                  | 94.00                                     | 94.22                                      | 0.10                                 |

### 2, Sound Pressure Level Stability - Short Term Fluctuations

The Short Term Fluctuations was determined by measuring the maximum and minimum of the fast weighted DC output of the B&K 2610 measuring amplifier over a 20 second time interval as required in the standard. The Short Term Fluctuation was found to be:

At 1000 Hz STF = 0.002 dB

Estimated expanded uncertainty 0.005 dB

### 3, Actual Output Frequency

The determination of actual output frequency was made using a B&K 4180 microphone together with a B&K 2673 preamplifier connected to a B&K 2610 measuring amplifier. The AC output of the B&K 2610 was taken to an universal counter which was used to determine the frequency averaged over 20 second of operation as required by the standard. The actual output frequency at 1 KHz was:

At 1000 Hz Actual Frequency = 986.6 Hz

Estimated expanded uncertainty 0.1 Hz Coverage factor k = 2.2

### 4, Total Noise and Distortion

For the Total Noise and Distortion measurement, the unfiltered AC output of the B&K 2610 measuring amplifier was connected to an Agilent Type 8903 B distortion analyser. The TND result at 1 KHz was:

At 1000 Hz TND = 0.5 %

Estimated expanded uncertainty 0.7 %

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Fung Chi Yip

Date: 05-Dec-2016

Checked by:

Lam Tze Wai

Date: 08-Dec-2016

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.