

# **Appendix C**

## **Calibration Certificates of Monitoring Equipment**

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Apr 07, 2014 Rootmeter S/N 0438320 Ta (K) - 294  
Operator Tisch Orifice I.D. - 1612 Pa (mm) - 742.95

| PLATE<br>OR<br>Run # | VOLUME<br>START<br>(m3) | VOLUME<br>STOP<br>(m3) | DIFF<br>VOLUME<br>(m3) | DIFF<br>TIME<br>(min) | METER<br>DIFF<br>Hg<br>(mm) | ORFICE<br>DIFF<br>H2O<br>(in.) |
|----------------------|-------------------------|------------------------|------------------------|-----------------------|-----------------------------|--------------------------------|
| 1                    | NA                      | NA                     | 1.00                   | 1.3940                | 3.2                         | 2.00                           |
| 2                    | NA                      | NA                     | 1.00                   | 0.9790                | 6.4                         | 4.00                           |
| 3                    | NA                      | NA                     | 1.00                   | 0.8800                | 7.8                         | 5.00                           |
| 4                    | NA                      | NA                     | 1.00                   | 0.8350                | 8.8                         | 5.50                           |
| 5                    | NA                      | NA                     | 1.00                   | 0.6910                | 12.7                        | 8.00                           |

DATA TABULATION

| Vstd                                                             | (x axis)<br>Qstd | (y axis) | Va                                                      | (x axis)<br>Qa | (y axis) |
|------------------------------------------------------------------|------------------|----------|---------------------------------------------------------|----------------|----------|
| 0.9866                                                           | 0.7077           | 1.4077   | 0.9957                                                  | 0.7142         | 0.8896   |
| 0.9823                                                           | 1.0034           | 1.9908   | 0.9914                                                  | 1.0127         | 1.2581   |
| 0.9804                                                           | 1.1140           | 2.2258   | 0.9894                                                  | 1.1243         | 1.4066   |
| 0.9791                                                           | 1.1726           | 2.3345   | 0.9881                                                  | 1.1834         | 1.4753   |
| 0.9739                                                           | 1.4094           | 2.8155   | 0.9829                                                  | 1.4224         | 1.7793   |
| Qstd slope (m) = 2.00757                                         |                  |          | Qa slope (m) = 1.25710                                  |                |          |
| intercept (b) = -0.01628                                         |                  |          | intercept (b) = -0.01029                                |                |          |
| coefficient (r) = 0.99989                                        |                  |          | coefficient (r) = 0.99989                               |                |          |
| y axis = $\text{SQRT}[\text{H2O}(\text{Pa}/760)(298/\text{Ta})]$ |                  |          | y axis = $\text{SQRT}[\text{H2O}(\text{Ta}/\text{Pa})]$ |                |          |

CALCULATIONS

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

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

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

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

For subsequent flow rate calculations:

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

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

## TSP Sampler Calibration

### SITE

Location: **Lian Tang 3**      Date: **November 4, 2014**  
 Sampler: **TE-5170 MFC (Serial # : 2359)**      Tech: **Sam Wong**

### CONDITIONS

|                              |              |                             |      |
|------------------------------|--------------|-----------------------------|------|
| Barometric Pressure (in Hg): | <b>40.10</b> | Corrected Pressure (mm Hg): | 1019 |
| Temperature (deg F):         | <b>77</b>    | Temperature (deg K):        | 298  |
| Average Press. (in Hg):      | <b>40.10</b> | Corrected Average (mm Hg):  | 1019 |
| Average Temp. (deg F):       | <b>77</b>    | Average Temp. (deg K):      | 298  |

### CALIBRATION ORIFICE

|          |                 |                 |                      |
|----------|-----------------|-----------------|----------------------|
| Make:    | <b>Tisch</b>    | Qstd Slope:     | <b>2.00757</b>       |
| Model:   | <b>TE-5025A</b> | Qstd Intercept: | <b>-0.01628</b>      |
| Serial#: | <b>1612</b>     | Date Certified: | <b>April 7, 2014</b> |

### CALIBRATIONS

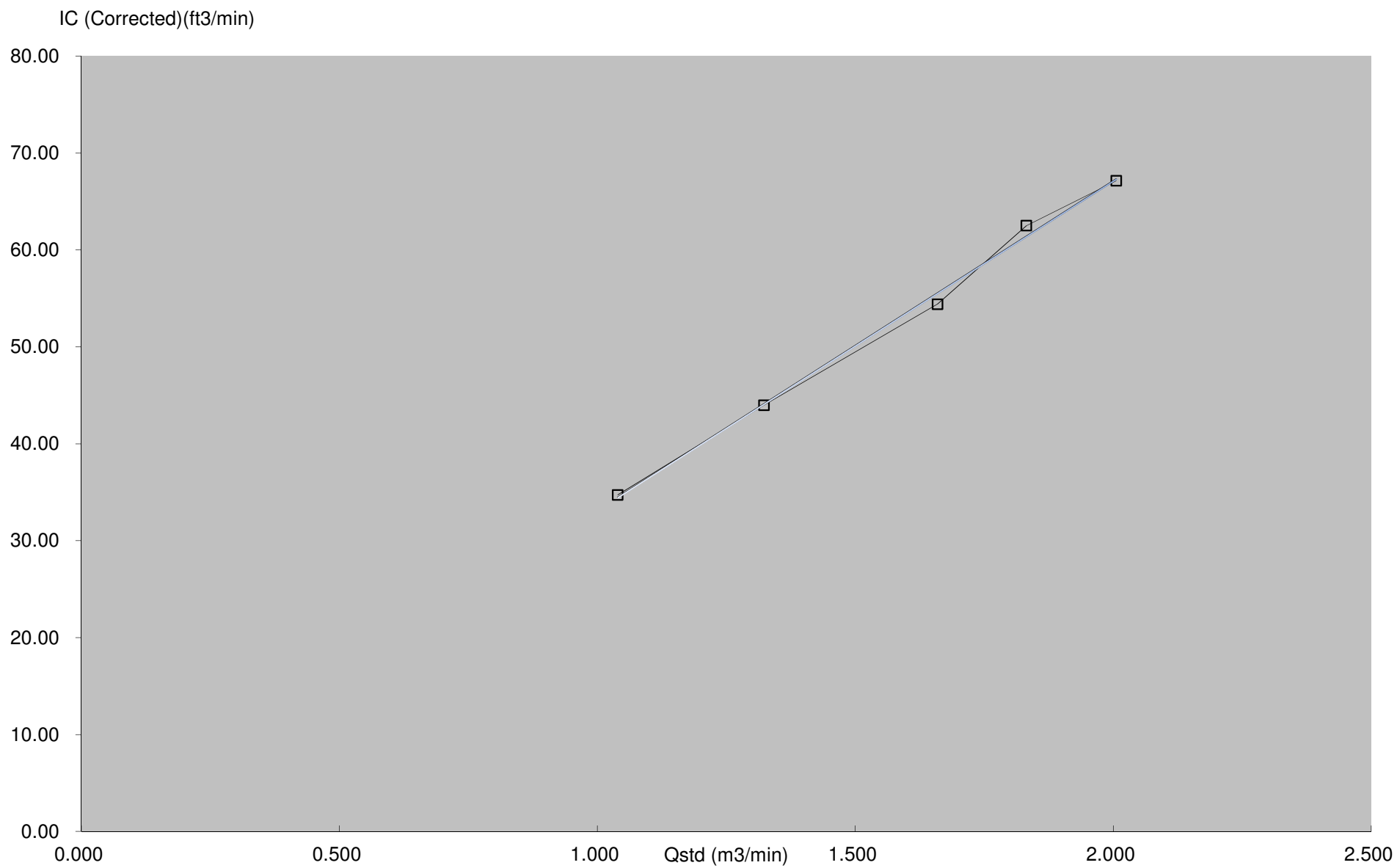
| Plate or<br>Test # | H2O<br>(in)  | Qstd<br>(m3/min) | I<br>(chart) | IC<br>(corrected) | LINEAR<br>REGRESSION        |
|--------------------|--------------|------------------|--------------|-------------------|-----------------------------|
| <b>1</b>           | <b>12.00</b> | 2.006            | <b>58.0</b>  | 67.14             | Slope = 34.0121             |
| <b>2</b>           | <b>10.00</b> | 1.832            | <b>54.0</b>  | 62.51             | Intercept = -0.9052         |
| <b>3</b>           | <b>8.20</b>  | 1.659            | <b>47.0</b>  | 54.41             | Corr. coeff.= 0.9981        |
| <b>4</b>           | <b>5.20</b>  | 1.323            | <b>38.0</b>  | 43.99             |                             |
| <b>5</b>           | <b>3.20</b>  | 1.040            | <b>30.0</b>  | 34.73             | # of Observations: <b>5</b> |

#### 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.

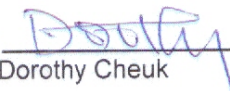
The results are shown in the attached page(s).

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

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# 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<sup>-6</sup>

## 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  $\leq 17$  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. :  $\pm 1.1$  dB

Uncertainty :  $\pm 0.1$  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, $\pm 2$ dB              |
| 63 Hz     | -26.3            | - 26.2 dB, $\pm 1.5$ dB            |
| 125 Hz    | -16.2            | - 16.1 dB, $\pm 1.5$ dB            |
| 250 Hz    | -8.7             | - 8.6 dB, $\pm 1$ dB               |
| 500 Hz    | -3.2             | - 3.2 dB, $\pm 1.4$ dB             |
| 1 kHz     | 0.0 (Ref)        | 0 dB, $\pm 1.1$ dB                 |
| 2 kHz     | +1.2             | + 1.2 dB, $\pm 1.6$ dB             |
| 4 kHz     | +1.0             | + 1.0 dB, $\pm 1.6$ 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 :  $\pm 0.1$  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.)      | - -             | $\pm 0.4$ 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.)      | - -             | $\pm 0.3$ dB           |
| Slow           | 94.2               | 94.2             | 0.0             |                        |
| Time-averaging | 94.2               | 94.2             | 0.0             |                        |

Uncertainty :  $\pm 0.1$  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<br>(Ref Level) | 129.0              | 129.0            | 0.0             | $\pm 1.1$ 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 :  $\pm 0.1$  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 -----