

Appendix C

Calibration Certificates of Monitoring

Equipment

Certificate of Calibration

Calibration Certification Information			
Cal. Date: February 13, 2018	Rootsmeter S/N: 438320	Ta: 293	°K
Operator: Jim Tisch		Pa: 763.3	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: 1612		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3970	3.2	2.00
2	3	4	1	1.0000	6.3	4.00
3	5	6	1	0.8900	7.9	5.00
4	7	8	1	0.8440	8.7	5.50
5	9	10	1	0.7010	12.6	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
1.0172	0.7281	1.4293	0.9958	0.7128	0.8762
1.0130	1.0130	2.0213	0.9917	0.9917	1.2392
1.0109	1.1358	2.2599	0.9896	1.1120	1.3854
1.0098	1.1964	2.3702	0.9886	1.1713	1.4530
1.0046	1.4331	2.8586	0.9835	1.4030	1.7524
QSTD	m=	2.02017	QA	m=	1.26500
	b=	-0.03691		b=	-0.02263
	r=	0.99988		r=	0.99988

Calculations	
Vstd= $\Delta Vol \left(\frac{Pa - \Delta P}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)$	Va= $\Delta Vol \left(\frac{Pa - \Delta P}{Pa} \right)$
Qstd= $Vstd / \Delta Time$	Qa= $Va / \Delta Time$
For subsequent flow rate calculations:	
Qstd= $1/m \left(\left(\sqrt{\Delta H \left(\frac{Pa}{Pstd} \right) \left(\frac{Tstd}{Ta} \right)} \right) - b \right)$	Qa= $1/m \left(\left(\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)} \right) - b \right)$

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH: calibrator manometer reading (in H2O)	
ΔP: rootsmeter manometer reading (mm Hg)	
Ta: actual absolute temperature (°K)	
Pa: actual barometric pressure (mm Hg)	
b: intercept	
m: slope	

RECALIBRATION
US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30

TSP Sampler Calibration

SITE

Location: **Lian Tang 3** Date: **March 6, 2018**
 Sampler: **TE-5170 MFC (Serial # : 2359)** Tech: **Sam Wong**

CONDITIONS

Barometric Pressure (in Hg):	40.05	Corrected Pressure (mm Hg):	1017
Temperature (deg F):	70	Temperature (deg K):	294
Average Press. (in Hg):	40.05	Corrected Average (mm Hg):	1017
Average Temp. (deg F):	70	Average Temp. (deg K):	294

CALIBRATION ORIFICE

Make: **Tisch** Qstd Slope: **1.99748**
 Model: **TE-5025A** Qstd Intercept: **-0.00957**
 Serial#: **1941** Date Certified: **May 19, 2017**

CALIBRATIONS

Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	12.00	2.024	56.0	65.22	
2	10.00	1.848	52.0	60.56	Slope = 31.3811
3	8.20	1.674	48.0	55.90	Intercept = 2.4073
4	5.20	1.334	38.0	44.25	Corr. coeff.= 0.9987
5	3.20	1.048	30.0	34.94	# of Observations: 5

Calculations

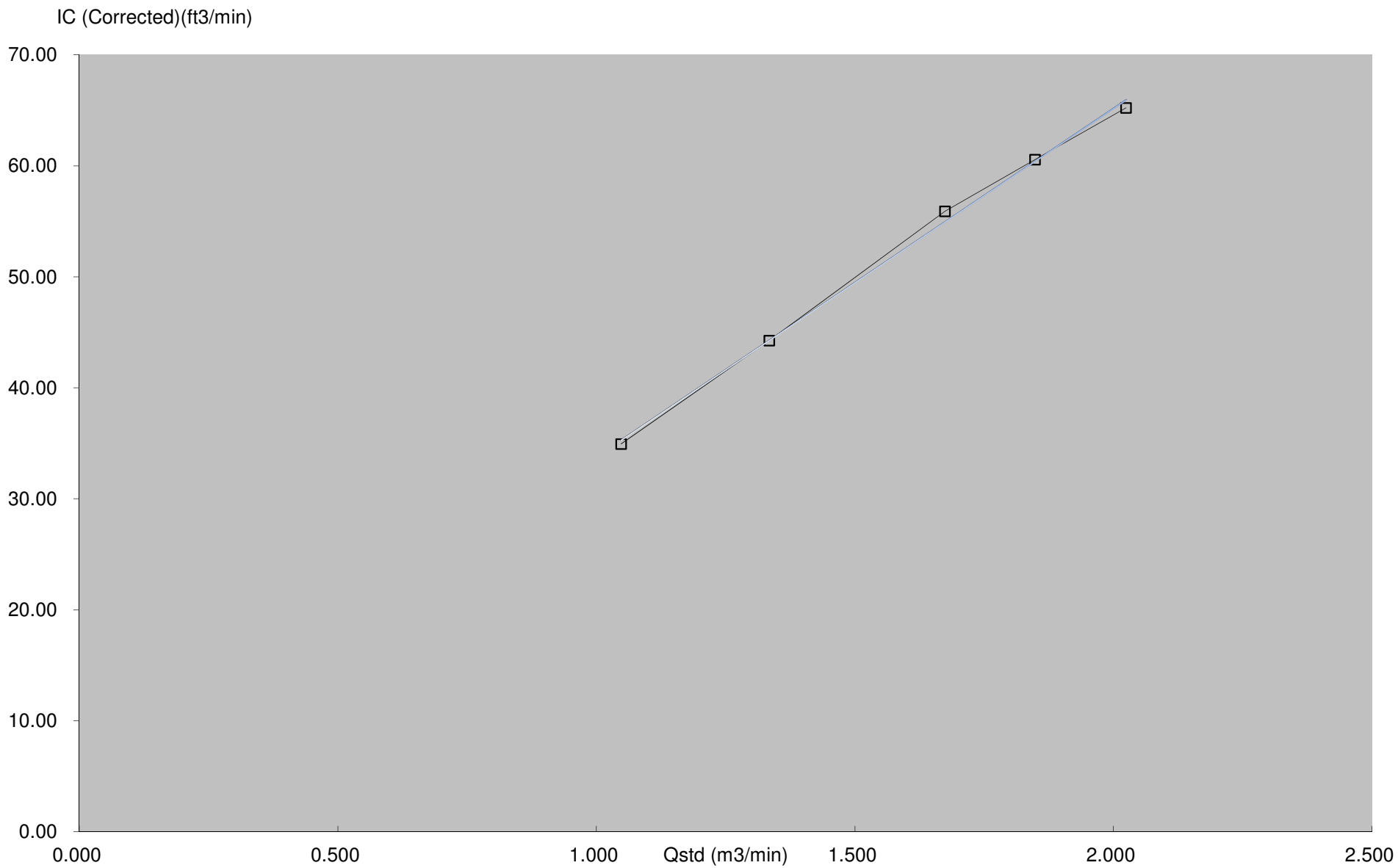
$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd) (Tstd/Ta)) - b]$$

$$IC = I[\text{Sqrt}(Pa/Pstd) (Tstd/Ta)]$$

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



TSP Sampler Calibration

SITE

Location: **Lian Tang 3** Date: **May 6, 2018**
 Sampler: **TE-5170 MFC (Serial # : 2359)** Tech: **Sam Wong**

CONDITIONS

Barometric Pressure (in Hg):	39.85	Corrected Pressure (mm Hg):	1012
Temperature (deg F):	85	Temperature (deg K):	302
Average Press. (in Hg):	39.85	Corrected Average (mm Hg):	1012
Average Temp. (deg F):	85	Average Temp. (deg K):	302

CALIBRATION ORIFICE

Make: **Tisch** Qstd Slope: **2.02017**
 Model: **TE-5025A** Qstd Intercept: **-0.03691**
 Serial#: **1612** Date Certified: **February 13, 2018**

CALIBRATIONS

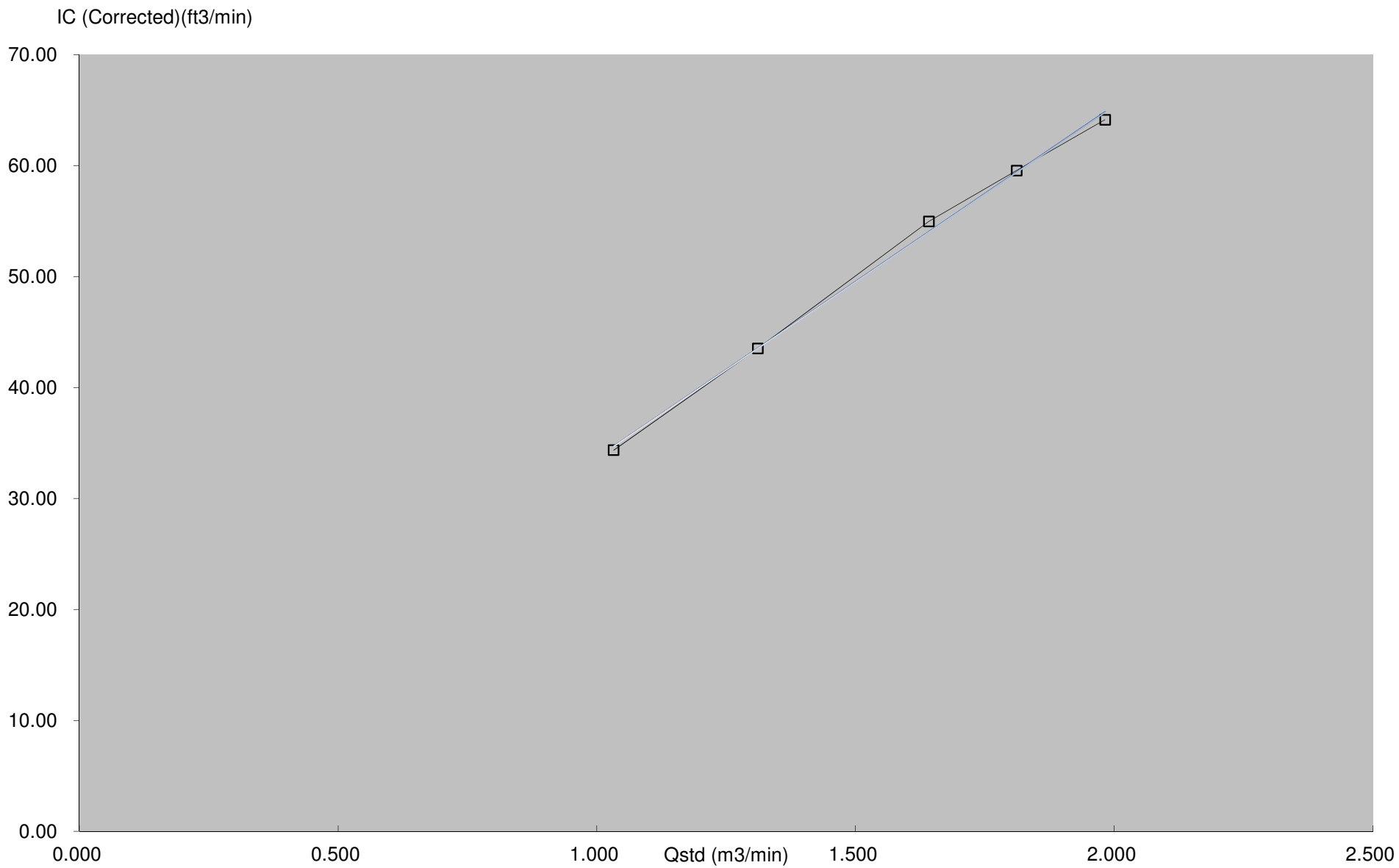
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
1	12.00	1.983	56.0	64.15	
2	10.00	1.811	52.0	59.57	
3	8.20	1.642	48.0	54.99	
4	5.20	1.311	38.0	43.53	
5	3.20	1.033	30.0	34.37	
					Slope = 31.7376
					Intercept = 1.9360
					Corr. coeff.= 0.9987
					# of Observations: 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. **708774**

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. : Q73499

Date of receipt : 1-Sep-17

Item Tested

Description : Sound Level Calibrator

Manufacturer : Rion

I.D. : 215901

Model : NC-74

Serial No. : 34857296

Test Conditions

Date of Test : 4-Sep-17

Supply Voltage : --

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

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

Test Specifications

Calibration check.

Ref. Document/Procedure : F21, Z02, IEC 60942.

Test Results

All results were within the IEC 60942 Class 1 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	707126	NIM-PRC & SCL-HKSAR
S240	Sound Level Calibrator	703741	NIM-PRC & SCL-HKSAR
S041	Universal Counter	707135	SCL-HKSAR
S206	Sound Level Meter	707129	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), or by reference to a natural constant.
The test results apply to the above Unit-Under-Test only

Calibrated by : _____
Elva Chong

Approved by : _____
Alan Chu

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: 4-Sep-17

Calibration Certificate

Certificate No. 708774

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Results :

1. Level Accuracy (at 1 kHz)

UUT Nominal Value	Measured Value	Mfr's Spec.
94 dB	94.1 dB	± 1 dB

Uncertainty : ± 0.2 dB

2. Frequency Accuracy

UUT Nominal Value	Measured Value	Mfr's Spec.
1 kHz	0.998 kHz	± 2 %

Uncertainty : ± 0.1 %

3. Level Stability : 0.0 dB

Uncertainty : ± 0.01 dB

4. Total Harmonic Distortion : $< 1.5\%$

Mfr's Spec. : < 3 %

Uncertainty : ± 2.3 % of reading

Remarks: 1. UUT : Unit-Under-Test
2. The uncertainty claimed is for a confidence probability of not less than 95%.
3. Atmospheric Pressure : 1 025 hPa

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Calibration Certificate

Certificate No. **708773**

Page 1 of 3 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. : Q73499

Date of receipt : 1-Sep-17

Item Tested

Description : Sound Level Meter

Manufacturer : Rion

I.D. : --

Model : NL-52

Serial No. : 00821072

Test Conditions

Date of Test : 5-Sep-17

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 or manufacturer's 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>
S017	Multi-Function Generator	C170120	SCL-HKSAR
S240	Sound Level Calibrator	703741	NIM-PRC & 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), or by reference to a natural constant.
The test results apply to the above Unit-Under-Test only

Calibrated by : _____
Elva Chong

Approved by : _____
Alan Chu

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: 5-Sep-17

Calibration Certificate

Certificate No. 708773

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Results :

1. Self-generated noise: 16.4 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			
20-130	A	F	OFF	94.0	94.1	
		S	OFF		94.1	
	C	F	OFF		94.1	
	Z	F	OFF		94.1	
	A	F	OFF	114.0	114.1	
			OFF		114.1	
		C	F		OFF	114.1
			F		OFF	114.1

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	-26.2	- 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	-1.1	- 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

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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	94.0	94.0 (Ref.)	--	± 0.4 dB
C	94.0	94.0	0.0	
Z	94.0	94.0	0.0	

4.2 Time Weighting (A-weighted)

UUT Setting	Applied Value (dB)	UUT Reading (dB)	Difference (dB)	IEC 61672 Type 1 Spec.
Fast	94.0	94.0 (Ref.)	--	± 0.3 dB
Slow	94.0	94.0	0.0	
Time-averaging	94.0	94.0	0.0	

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 : 1 028hPa.

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

5. Microphone model: UC-59 , S/N : 07040

6. Power Supply Check: OK

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

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