

# Appendix C Calibration Certificates of Monitoring Equipment



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

### ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Ma Operator		5 Rootsmeter Orifice I.I	0/11	138320 1941	Ta (K) - Pa (mm) -	292 - 756.92
====== OR Run # 1 2 3 4 5	VOLUME START (m3) NA NA NA NA NA NA	VOLUME STOP (m3) NA NA NA NA NA NA	DIFF VOLUME (m3) 1.00 1.00 1.00 1.00 1.00	DIFF TIME (min) 1.4880 1.0510 0.9360 0.8920 0.7360	METER DIFF Hg (mm) 3.2 6.4 7.9 8.8 12.7	ORFICE DIFF H2O (in.) 2.00 4.00 5.00 5.50 8.00

#### DATA TABULATION

Vstd	(x axis) Qstd	(y axis)		Va	(x axis) Qa	(y axis)
1.0121 1.0078 1.0057 1.0046 0.9993	0.6802 0.9589 1.0745 1.1262 1.3578	1.4258 2.0163 2.2543 2.3644 2.8515		0.9958 0.9916 0.9895 0.9884 0.9832	0.6692 0.9434 1.0571 1.1080 1.3358	0.8784 1.2422 1.3888 1.4566 1.7568
Qstd slop intercept coefficie	t (b) =	2.10265 -0.00335 0.99999	ı e n	Qa slop intercep coefficio	t (b) =	1.31664 -0.00206 0.99999
y axis =	SQRT [H20 (1	Pa/760) (298/5	[a)]	y axis =	SQRT [H20 (1	[a/Pa)]

#### CALCULATIONS

Vstd = Diff. Vol[(Pa-Diff. Hg)/760](298/Ta)
Qstd = Vstd/Time

Va = Diff Vol [(Pa-Diff Hg)/Pa] Qa = Va/Time

For subsequent flow rate calculations:

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

#### TSP Sampler Calibration

SITE	
Location: Lian Tang 3 Sampler: TE-5170 MFC (Serial # : 2359)	Date: July 6, 2015 Tech: Sam Wong
Sampier. IE-SI/O MFC (Seriar # . 2555)	Teen. Sain wong

		CON	DITIONS		
Barometric Pressure	(in Hg):	39.50	Corrected Pressure	(mm Hg):	1003
Temperature	(deg F):	94	Temperature	(deg K):	307
Average Press.	(in Hg):	39.50	Corrected Average	(mm Hg):	1003
Average Temp.	(deg F):	94	Average Temp.	(deg K):	307

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

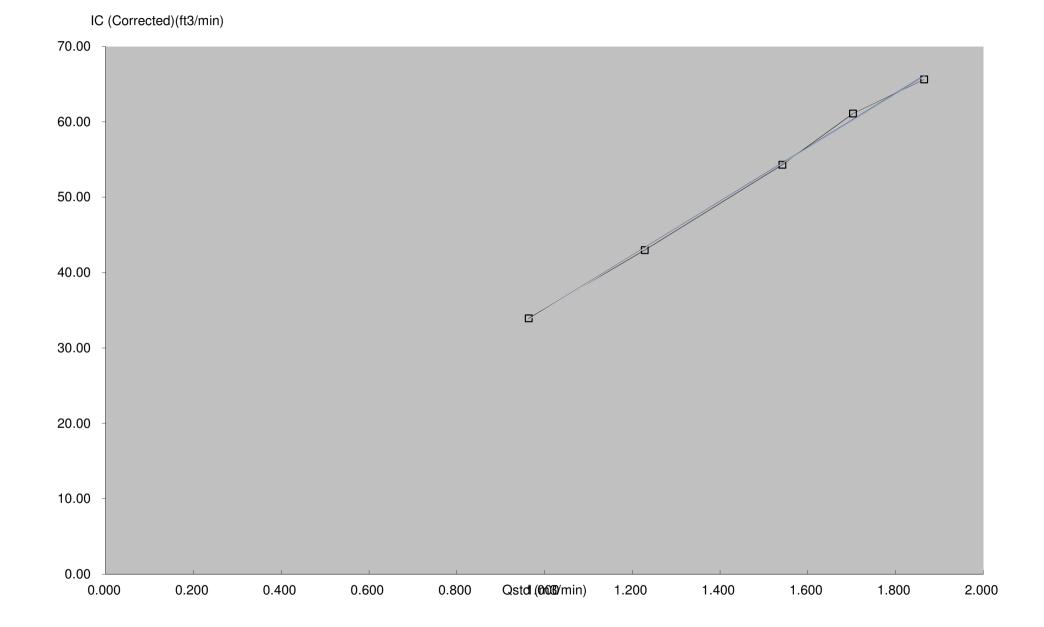
CALIBRATIONS						
Plate or Test #	H2O (in)	Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
1	12.00	1.865	58.0	65.61	Slope =	35.7973
2	10.00	1.703	54.0	61.08	Intercept =	-0.7001
3	8.20	1.542	48.0	54.30	Corr. coeff.=	0.9992
4	5.20	1.228	38.0	42.99		
5	3.20	0.964	30.0	33.94	<pre># of Observations:</pre>	5

Calculations

IC = I[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)[Sqrt(298/Tav)(Pav/760)]-b)

Qstd = 1/m[Sqrt(H2O(Pa/Pstd)(Tstd/Ta))-b]

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





Certificate No.	Page	1 of	2 Pages	5		
Customer :	Enovative Environmental Service	e Limited				
Address :	Flat 6, 3/F, Block E, Wah Lok Ind	dustrial Centre, 31-3	5 Shan Mei Stree	et, Shatin,	N.T., Hor	ıg Kong.
Order No. :	Q43167		Date of receipt	•	10-Oc	xt-14
Item Tested						
Manufacturer :	Sound Level Calibrator B&K Type 4231		Serial No.	: 2685	684	
Test Conditi	ons					
Date of Test :	18-Oct-14		Supply Voltage	:		
Ambient Temp	erature: (23 ± 3)°C		Relative Humid	lity: (50 ±	25) %	
Test Specifie	cations					
Calibration chec Ref. Document/	k. Procedure : F21, Z02, IEC 942.					
Test Results	3					
	within the IEC 942 Class1 specifi shown in the attached page(s).	ication.				
Main Test equip	oment used:					
Equipment No.	Description	Cert. No.		Traceable	<u>e to</u>	
S014	Spectrum Analyzer	405316		NIM-PRC	& SCL-H	KSAR
S205	Ref. Sound Level Calibrator	PHCO40002		SCL-HKS	SAR	
S041	Universal Counter	405317		SCL-HKS	SAR	
S206	Sound Level Meter	405322		SCL-HKS	SAR	
S031	61/2 dgt. Multimeter	39256		NIM-PRO		
<b>7</b> 1	this Calibration Certificate only relate to	the values measured at	the time of the test ar	nd anv unce	rtainties quo	ted
will not include allow	wance for the equipment long term drift, v andling, or the capability of any other labo	ariations with environme	ental changes, vibration	on and shoc	k during tran	sponation,

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

for any loss or damage resulting from the use of the equipment.

Approved by : Steve Kwan

Date: 18-Oct-14

This Certificate is issued by: Hong Kong Calibration Ltd.

Unit 88, 24/F., Weil 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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### Certificate No. 407497

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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 :  $\pm 0.1 \text{ dB}$ 

### 2. Frequency

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

Uncertainty :  $\pm$  3.6 x 10 <sup>-6</sup>

- 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 -----

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Certificate No.	406516		Page	1 c	of 4	Pages
	Enovative Environmental Servic Flat 6, 3/F, Block E, Wah Lok In Q42822		35 Shan Mei Stre Date of receipt			., Hong Kong. 1-Sep-14
Item Tested						
Manufacturer :	Sound Level Meter (N12-RION Rion NL-52	<b>1</b> -004)	Serial No.	: 01	022055	3
Test Conditi	ons					
Date of Test : Ambient Temp			Supply Voltage Relative Humic			%
Test Specifi	cations					
Calibration cheo Ref. Document/	sk. Procedure: Z01, IEC 61672.					
Test Results	5					
	within the IEC 61672 Type1 spec shown in the attached page(s).	ification.				
Main Test equip	ment used:					
Equipment No. S017 S205	Description Multi-Function Generator Ref. Sound Level Calibrator	<u>Cert. No.</u> C127181 PHCO40002		<u>Tracea</u> SCL-H SCL-H	IKSAR	
will not include allow overloading, mis-ha for any loss or dama	this Calibration Certificate only relate to t vance for the equipment long term drift, vandling, or the capability of any other labor age resulting from the use of the equipme used for calibration are traceable to Inter	ariations with environmer atory to repeat the meas ent.	ntal changes, vibratio urement. Hong Kon	on and sh	lock durin	g transportation.
The test results app	ly to the above Unit-Under-Test only					

Calibrated by : Dorothy Cheuk

Approved by :

re Steve Kwan

Date: 25-Sep-14

This Certificate is issued by: Hong Kong Calibration Ltd.

Unii 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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Results :

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

### 2. Acoustical signal test

	UUT S	etting			
	Frequency	Time	Octave	Applied	UUT
Range (dB)	Weighting	Weighting	Filter	Value (dB)	Reading (dB)
30-130	А	F	OFF	94.2	94.2
		S	OFF	9	94.2
	С	F	OFF		94.2
	Z	F	OFF		94.2
	А	F	OFF	114.2	114.2
		S	OFF		114.2
	С	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, ± 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)	$0  dB, \pm 1.1  dB$
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 ~ -3.1 dB
16 kHz	-8.0	- 6.6 dB, + 3.5 dB ~ - 17.0 dB

Uncertainty :  $\pm 0.1 \text{ dB}$ 



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### 4. Frequency & Time weightings at 1 kHz

4.1 Frequency Weighting (Fast)

UUT	Applied	UUT	Difference	IEC 61672
Setting	Value (dB)	Reading (dB)	(dB)	Type 1 Spec.
А	94.2	94.2 (Ref.)		± 0.4 dB
С	94.2	94.2	0.0	
Z	94.2	94.2	0.0	

### 4.2 Time Weighting (A-weighted)

UUT	Applied	UUT	Difference	IEC 61672
Setting	Value (dB)	Reading (dB)	(dB)	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 :  $\pm 0.1 \text{ dB}$ 

### 5. Level linearity on the reference level range

	Applied			
UUT Range	Value (dB)	UUT Reading (dB)	Difference (dB)	IEC 61672 Type 1 Spec.
30-130 dB	129.0	129.0	0.0	± 1.1 dB
(Ref Level)	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 :  $\pm 0.1 \text{ dB}$ 

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#### 6. Toneburst response (4kHz)

UUT	Tone Burst	UUT	Difference	IEC 61672
Setting	Duration(ms)	Reading(dB)	(dB)	Type 1 Spec.
Fast	Steady	127.0(Ref)		
	200	126.0	-1.0	$-1.0 \pm 0.8$ dB
-	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	$-7.4 \pm 0.8$ dB
	2	100.0	-27.0	-27.0, +1.3 dB ~ -3.3 dB
Time	Steady	127.0(Ref)		
averaging	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 :  $\pm 0.1 \text{ dB}$ 

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

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

The overload indicator latched on until reset

Uncertainty :  $\pm 0.1 \text{ dB}$ 

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.

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