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## **MATERIALAB CONSULTANTS LIMITED**

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**MaterialLab**

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Report No.: 0125/14/ED/0056G

### **Appendix A**

#### **Calibration Certificates for Baseline Environmental Monitoring Equipments**

# Certificate of Calibration

## 校正證書

Certificate No. : C136321

證書編號

### ITEM TESTED / 送檢項目 (Job No. / 序引編號 : IC13-2604)

Description / 儀器名稱 : Sound Level Meter

Manufacturer / 製造商 : Brüel & Kjær

Model No. / 型號 : 2250

Serial No. / 編號 : 2704792

Supplied By / 委託者 : EDMS Consulting Ltd.

Unit 1C, 24/F., World Wide House, 19 Des Voeux Road Central,  
Hong Kong

### TEST CONDITIONS / 測試條件

Temperature / 溫度 :  $(23 \pm 2)^{\circ}\text{C}$

Relative Humidity / 相對濕度 :  $(55 \pm 20)\%$

Line Voltage / 電壓 : ---

### TEST SPECIFICATIONS / 測試規範

Calibration check

DATE OF TEST / 測試日期 : 7 October 2013

### TEST RESULTS / 測試結果

The results apply to the particular unit-under-test only.

All results are within manufacturer's specification.

The results are detailed in the subsequent page(s).

The test equipment used for calibration are traceable to National Standards via :

- The Government of The Hong Kong Special Administrative Region Standard & Calibration Laboratory
- Rohde & Schwarz Laboratory, Germany
- Fluke Everett Service Center, USA
- Agilent Technologies, USA

Tested By  
測試

:   
K C Lee

Certified By  
核證

:   
K M Wu

Date of Issue  
簽發日期

8 October 2013

The test equipment used for calibration are traceable to the Nation Standards as specified in this certificate. This certificate shall not be reproduced except in full, without the prior written approval of this laboratory.

本證書所載校正用之測試器材均可溯源至國際標準。局部複印本證書需先獲本實驗室所書面批准。

Sun Creation Engineering Limited – Calibration & Testing Laboratory

c/o 4/F, Tsing Shan Wan Exchange Building, 1 Hing On Lane, Tuen Mun, New Territories, Hong Kong

輝創工程有限公司 – 校正及檢測實驗室

c/o 香港新界屯門興安里一號青山灣機樓四樓

Tel/電話: 2927 2606

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Website/網址: www.suncreation.com

# Certificate of Calibration

## 校正證書

Certificate No. : C136321  
證書編號

- The unit-under-test (UUT) was allowed to stabilize in the laboratory for over 12 hours, and switched on to warm up for over 10 minutes before the commencement of the test.
- Self-calibration using laboratory acoustic calibrator was performed before the test 6.1.1.2 to 6.3.2.
- The results presented are the mean of 3 measurements at each calibration point.
- Test equipment :

Equipment ID	Description	Certificate No.
CL280	40 MHz Arbitrary Waveform Generator	C130019
CL281	Multifunction Acoustic Calibrator	DC130171

- Test procedure : MA101N.

- Results :

- Sound Pressure Level

- Reference Sound Pressure Level

- Before Self-calibration

UUT Setting		Applied Value		UUT Reading
Range (dB)	Main	Level (dB)	Freq. (kHz)	(dB)
20 - 140	LAF (SPL)	94.00	1	94.9

- After Self-calibration

UUT Setting		Applied Value		UUT Reading	IEC 61672 Class 1
Range (dB)	Main	Level (dB)	Freq. (kHz)	(dB)	Spec. (dB)
20 - 140	LAF (SPL)	94.00	1	94.0	$\pm 1.1$

- Linearity

UUT Setting		Applied Value		UUT Reading
Range (dB)	Main	Level (dB)	Freq. (kHz)	(dB)
20 - 140	LAF (SPL)	94.00	1	94.0 (Ref.)
		104.00		104.0
		114.00		114.0

IEC 61672 Class 1 Spec. :  $\pm 0.6$  dB per 10 dB step and  $\pm 1.1$  dB for overall different.

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# Certificate of Calibration

## 校正證書

Certificate No. : C136321

證書編號

### 6.2 Time Weighting

UUT Setting		Applied Value		UUT Reading	IEC 61672 Class 1
Range (dB)	Main	Level (dB)	Freq. (kHz)	(dB)	Spec. (dB)
20 - 140	LAF (SPL)	94.00	1	94.0	Ref.
	LAS (SPL)			94.0	$\pm 0.3$

### 6.3 Frequency Weighting

#### 6.3.1 A-Weighting

UUT Setting		Applied Value		UUT Reading	IEC 61672 Class 1 Spec.
Range (dB)	Main	Level (dB)	Freq.	(dB)	(dB)
20 - 140	LAF (SPL)	94.00	63 Hz	67.8	$-26.2 \pm 1.5$
			125 Hz	77.8	$-16.1 \pm 1.5$
			250 Hz	85.3	$-8.6 \pm 1.4$
			500 Hz	90.7	$-3.2 \pm 1.4$
			1 kHz	94.0	Ref.
			2 kHz	95.2	$+1.2 \pm 1.6$
			4 kHz	94.9	$+1.0 \pm 1.6$
			8 kHz	92.8	$-1.1(+2.1 ; -3.1)$
			12.5 kHz	89.3	$-4.3(+3.0 ; -6.0)$

#### 6.3.2 C-Weighting

UUT Setting		Applied Value		UUT Reading	IEC 61672 Class 1 Spec.
Range (dB)	Main	Level (dB)	Freq.	(dB)	(dB)
20 - 140	LCF (SPL)	94.00	63 Hz	93.2	$-0.8 \pm 1.5$
			125 Hz	93.8	$-0.2 \pm 1.5$
			250 Hz	93.9	$0.0 \pm 1.4$
			500 Hz	94.0	$0.0 \pm 1.4$
			1 kHz	94.0	Ref.
			2 kHz	93.8	$-0.2 \pm 1.6$
			4 kHz	93.2	$-0.8 \pm 1.6$
			8 kHz	90.9	$-3.0(+2.1 ; -3.1)$
			12.5 kHz	87.3	$-6.2(+3.0 ; -6.0)$

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# Certificate of Calibration

## 校正證書

Certificate No. : C136321

證書編號

Remarks : - UUT Microphone Model No. : 4189 & S/N : 2161042

- Mfr's Spec. : IEC 61672 Class 1

- Uncertainties of Applied Value : 94 dB : 63 Hz - 125 Hz :  $\pm 0.35$  dB  
250 Hz - 500 Hz :  $\pm 0.30$  dB  
1 kHz :  $\pm 0.20$  dB  
2 kHz - 4 kHz :  $\pm 0.35$  dB  
8 kHz :  $\pm 0.45$  dB  
12.5 kHz :  $\pm 0.70$  dB  
104 dB : 1 kHz :  $\pm 0.10$  dB (Ref. 94 dB)  
114 dB : 1 kHz :  $\pm 0.10$  dB (Ref. 94 dB)

- The uncertainties are for a confidence probability of not less than 95 %.

### Note :

The values given in this 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 environment changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Sun Creation Engineering Limited 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 the Nation Standards as specified in this certificate. This certificate shall not be reproduced except in full, without the prior written approval of this laboratory.

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# Certificate of Conformity and Calibration

<b>Instrument Model:-</b>	<b>CEL-633C</b>		
Serial Number	4637966		
Firmware revision	V129-08		
<b>Microphone Type:-</b>	<b>CEL-251</b>	<b>Preamplifier Type:-</b>	<b>CEL-495</b>
Serial Number	327	Serial Number	002163
<b>Instrument Class/Type:-</b>	<b>1</b>		

## Applicable standards:-

IEC 61672: 2002 / EN 60651 (Electroacoustics - Sound Level Meters)  
 IEC 60651 1979 (Sound Level Meters), ANSI S1.4: 1983 (Specifications For Sound Level Meters)

**Note:-** The test sequences performed in this report are in accordance with the current Sound level meter Standard - IEC61672. The combination of tests performed are considered to confirm the products electro-acoustic performance to all applicable standards including superceeded Sound Level Meter Standards - IEC60651 and IEC60804.

<b>Test Conditions:-</b>	24 °C	<b>Test Engineer:-</b>	Millie Duncan
	30 %RH	<b>Date of Issue:-</b>	March 7, 2014
	1024 mBar		



## Declaration of conformity:-

This test certificate confirms that the instrument specified above has been successfully tested to comply with the manufacturer's published specifications. Tests are performed using equipment traceable to national standards in accordance with Casella's ISO 9001:2008 quality procedures. This product is certified as being compliant to the requirements of the CE Directive.

## Test Summary:-

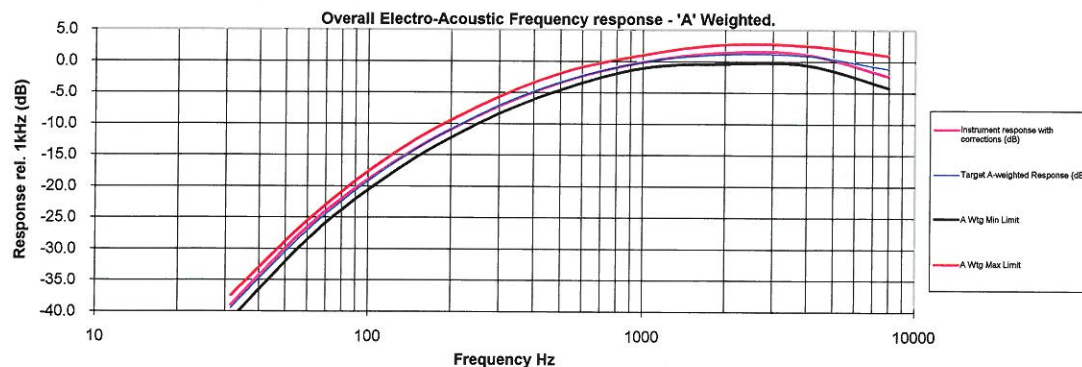
Self Generated Noise Test  
 Electrical Signal Test Of Frequency Weightings  
 Frequency & Time Weightings At 1 kHz  
 Level Linearity On The Reference Level Range  
 Toneburst Response Test  
 C-peak Sound Levels  
 Overload Indication  
 Acoustic Tests

**All Tests Pass**  
**All Tests Pass**  
**All Tests Pass**  
**All Tests Pass**  
**All Tests Pass**  
**All Tests Pass**  
**All Tests Pass**  
**All Tests Pass**

## Combined Electro-Acoustic Frequency Response - A Weighted

Combined Electro-Acoustic Frequency Response - A Weighted (IEC 61672-3:2006)

The following A-Weighted frequency response graph shows this instruments overall frequency response based upon the application of multi-frequency pressure field calibrations. The microphones Pressure to Free field correction coefficients are applied to pressure response. Reference level taken at 1kHz.



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Casella CEL, Inc. a subsidiary of IDEAL Industries, Inc.  
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 Tel: (603) 672-0031 Fax: (603) 672-8053  
 E-mail: [info@casellausa.com](mailto:info@casellausa.com)  
 Web: [www.casellausa.com](http://www.casellausa.com)

# Certificate of Conformity and Calibration

<b>Instrument Model:-</b>	<b>CEL-633A</b>		
Serial Number	4637931		
Firmware revision	V129-08		
<b>Microphone Type:-</b>	<b>CEL-251</b>	<b>Preamplifier Type:-</b>	<b>CEL-495</b>
Serial Number	297	Serial Number	002110
<b>Instrument Class/Type:-</b>	<b>1</b>		

## Applicable standards:-

IEC 61672: 2002 / EN 60651 (Electroacoustics - Sound Level Meters)  
IEC 60651 1979 (Sound Level Meters), ANSI S1.4: 1983 (Specifications For Sound Level Meters)

**Note:-** The test sequences performed in this report are in accordance with the current Sound level meter Standard - IEC61672. The combination of tests performed are considered to confirm the products electro-acoustic performance to all applicable standards including superseded Sound Level Meter Standards - IEC60651 and IEC60804.

<b>Test Conditions:-</b>	24 °C	<b>Test Engineer:-</b>	Millie Duncan
	30 %RH	<b>Date of Issue:-</b>	March 7, 2014
	1024 mBar		



## Declaration of conformity:-

This test certificate confirms that the instrument specified above has been successfully tested to comply with the manufacturer's published specifications. Tests are performed using equipment traceable to national standards in accordance with Casella's ISO 9001:2008 quality procedures. This product is certified as being compliant to the requirements of the CE Directive.

## Test Summary:-

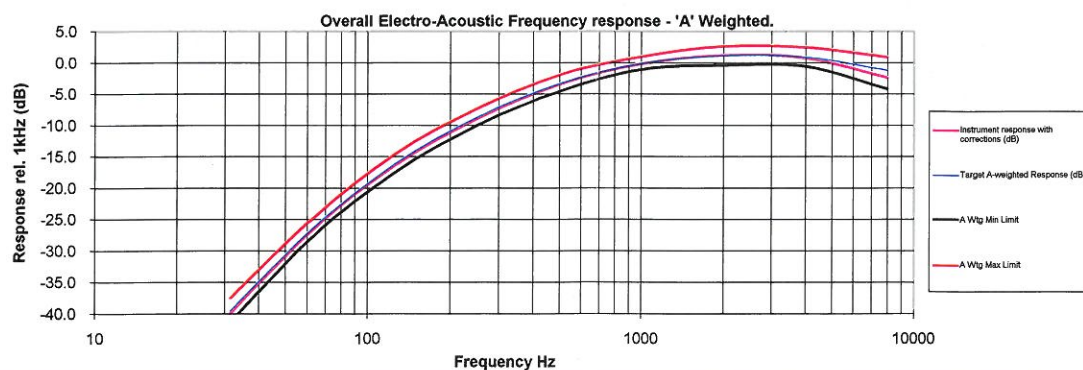
Self Generated Noise Test  
Electrical Signal Test Of Frequency Weighings  
Frequency & Time Weightings At 1 kHz  
Level Linearity On The Reference Level Range  
Toneburst Response Test  
C-peak Sound Levels  
Overload Indication  
Acoustic Tests

**All Tests Pass**  
**All Tests Pass**  
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**All Tests Pass**  
**All Tests Pass**

## Combined Electro-Acoustic Frequency Response - A Weighted

Combined Electro-Acoustic Frequency Response - A Weighted (IEC 61672-3:2006)

The following A-Weighted frequency response graph shows this instruments overall frequency response based upon the application of multi-frequency pressure field calibrations. The microphones Pressure to Free field correction coefficients are applied to pressure response. Reference level taken at 1kHz.



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Web: [www.casellausa.com](http://www.casellausa.com)



# Certificate of Calibration

## 校正證書

Certificate No. : C135285

證書編號

### ITEM TESTED / 送檢項目 (Job No. / 序引編號 : IC13-2139)

Description / 儀器名稱 : Sound Level Meter  
Manufacturer / 製造商 : Brüel & Kjær  
Model No. / 型號 : 2250  
Serial No. / 編號 : 3000103  
Supplied By / 委託者 : EDMS Consulting Ltd.  
Unit 1C, 24/F., World Wide House, 19 Des Voeux Road Central,  
Hong Kong

### TEST CONDITIONS / 測試條件

Temperature / 溫度 :  $(23 \pm 2)^{\circ}\text{C}$

Relative Humidity / 相對濕度 :  $(55 \pm 20)\%$

Line Voltage / 電壓 : ---

### TEST SPECIFICATIONS / 測試規範

Calibration check

DATE OF TEST / 測試日期 : 21 August 2013

### TEST RESULTS / 測試結果

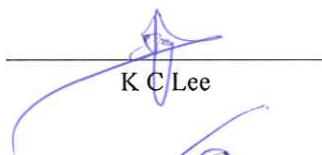
The results apply to the particular unit-under-test only.  
All results are within manufacturer's specification.  
The results are detailed in the subsequent page(s).

The test equipment used for calibration are traceable to National Standards via :

- The Government of The Hong Kong Special Administrative Region Standard & Calibration Laboratory
- Rohde & Schwarz Laboratory, Germany
- Fluke Everett Service Center, USA
- Agilent Technologies, USA

Tested By  
測試

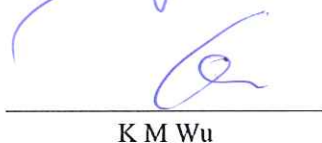
:



K C Lee

Certified By  
核證

:



K M Wu

Date of Issue  
簽發日期

23 August 2013

The test equipment used for calibration are traceable to the Nation Standards as specified in this certificate. This certificate shall not be reproduced except in full, without the prior written approval of this laboratory.

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# Certificate of Calibration

## 校正證書

Certificate No. : C135285  
證書編號

- The unit-under-test (UUT) was allowed to stabilize in the laboratory for over 12 hours, and switched on to warm up for over 10 minutes before the commencement of the test.
- Self-calibration using laboratory acoustic calibrator was performed before the test 6.1.1.2 to 6.3.2.
- The results presented are the mean of 3 measurements at each calibration point.
- Test equipment :

Equipment ID	Description	Certificate No.
CL280	40 MHz Arbitrary Waveform Generator	C130019
CL281	Multifunction Acoustic Calibrator	DC130171

- Test procedure : MA101N.

- Results :

### 6.1 Sound Pressure Level

#### 6.1.1 Reference Sound Pressure Level

##### 6.1.1.1 Before Self-calibration

UUT Setting		Applied Value		UUT Reading
Range (dB)	Main	Level (dB)	Freq. (kHz)	(dB)
20 - 140	LAF (SPL)	94.00	1	94.4

##### 6.1.1.2 After Self-calibration

UUT Setting		Applied Value		UUT Reading	IEC 61672 Class 1
Range (dB)	Main	Level (dB)	Freq. (kHz)	(dB)	Spec. (dB)
20 - 140	LAF (SPL)	94.00	1	94.0	± 1.1

##### 6.1.2 Linearity

UUT Setting		Applied Value		UUT Reading
Range (dB)	Main	Level (dB)	Freq. (kHz)	(dB)
20 - 140	LAF (SPL)	94.00	1	94.0 (Ref.)
		104.00		104.0
		114.00		114.0

IEC 61672 Class 1 Spec. : ± 0.6 dB per 10 dB step and ± 1.1 dB for overall different.

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# Certificate of Calibration

## 校正證書

Certificate No. : C135285

證書編號

### 6.2 Time Weighting

UUT Setting		Applied Value		UUT Reading (dB)	IEC 61672 Class 1 Spec. (dB)
Range (dB)	Main	Level (dB)	Freq. (kHz)		
20 - 140	LAF (SPL)	94.00	1	94.0	Ref.
	LAS (SPL)			94.0	$\pm 0.3$

### 6.3 Frequency Weighting

#### 6.3.1 A-Weighting

UUT Setting		Applied Value		UUT Reading (dB)	IEC 61672 Class 1 Spec. (dB)
Range (dB)	Main	Level (dB)	Freq.		
20 - 140	LAF (SPL)	94.00	63 Hz	67.8	$-26.2 \pm 1.5$
			125 Hz	77.8	$-16.1 \pm 1.5$
			250 Hz	85.3	$-8.6 \pm 1.4$
			500 Hz	90.7	$-3.2 \pm 1.4$
			1 kHz	94.0	Ref.
			2 kHz	95.2	$+1.2 \pm 1.6$
			4 kHz	95.0	$+1.0 \pm 1.6$
			8 kHz	92.8	$-1.1(+2.1 ; -3.1)$
			12.5 kHz	89.3	$-4.3(+3.0 ; -6.0)$

#### 6.3.2 C-Weighting

UUT Setting		Applied Value		UUT Reading (dB)	IEC 61672 Class 1 Spec. (dB)
Range (dB)	Main	Level (dB)	Freq.		
20 - 140	LCF (SPL)	94.00	63 Hz	93.2	$-0.8 \pm 1.5$
			125 Hz	93.8	$-0.2 \pm 1.5$
			250 Hz	94.0	$0.0 \pm 1.4$
			500 Hz	94.0	$0.0 \pm 1.4$
			1 kHz	94.0	Ref.
			2 kHz	93.8	$-0.2 \pm 1.6$
			4 kHz	93.2	$-0.8 \pm 1.6$
			8 kHz	90.9	$-3.0(+2.1 ; -3.1)$
			12.5 kHz	87.4	$-6.2(+3.0 ; -6.0)$

The test equipment used for calibration are traceable to the Nation Standards as specified in this certificate. This certificate shall not be reproduced except in full, without the prior written approval of this laboratory.

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# Certificate of Calibration

## 校正證書

Certificate No. : C135285

證書編號

Remarks : - UUT Microphone Model No. : 4189 & S/N : 2772045

- Mfr's Spec. : IEC 61672 Class 1

- Uncertainties of Applied Value : 94 dB : 63 Hz - 125 Hz :  $\pm 0.35$  dB  
250 Hz - 500 Hz :  $\pm 0.30$  dB  
1 kHz :  $\pm 0.20$  dB  
2 kHz - 4 kHz :  $\pm 0.35$  dB  
8 kHz :  $\pm 0.45$  dB  
12.5 kHz :  $\pm 0.70$  dB  
104 dB : 1 kHz :  $\pm 0.10$  dB (Ref. 94 dB)  
114 dB : 1 kHz :  $\pm 0.10$  dB (Ref. 94 dB)

- The uncertainties are for a confidence probability of not less than 95 %.

### Note :

The values given in this 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 environment changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Sun Creation Engineering Limited 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 the Nation Standards as specified in this certificate. This certificate shall not be reproduced except in full, without the prior written approval of this laboratory.

本證書所載校正用之測試器材均可溯源至國際標準。局部複印本證書需先獲本實驗室所書而批准。

Sun Creation Engineering Limited – Calibration & Testing Laboratory

c/o 4/F, Tsing Shan Wan Exchange Building, 1 Hing On Lane, Tuen Mun, New Territories, Hong Kong

輝創工程有限公司 – 校正及檢測實驗室

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Certificate of  
Conformance and Calibration for

**CEL-120 Acoustic Calibrator**

Applicable Standards :- IEC 60942: 2003 & ANSI S1.40: 2006

CEL-120/1 Class 1 ☒

CEL-120/2 Class 2 ☐

Serial No: 5230742

Firmware: 03

Temperature: 23 °C Pressure: 1010 mb %RH 47

Frequency = 1.00kHz $\pm$ 2Hz T.H.D. = < 1%	Calibration Level
SPL @ 114.0dB Setting	<u>114.01</u> dB
SPL @ 94.0dB Setting (CEL-120/1 only)	<u>93.99</u> dB/N.A

Engineer :- [Signature]

Date: 07 MAR 2014

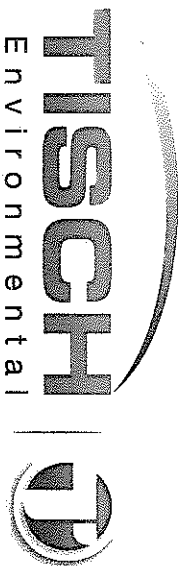
Company test equipment and acoustic working standards, used for conformance testing, are subject to periodic calibration, traceable to UK national standards, in accordance with the company's ISO9001 Quality System.

**DECLARATION OF CONFORMITY**

This certificate confirms that the instrument specified above has been produced and tested to comply with the manufacturer's published specifications and the relevant European Community CE directives.

Casella CEL (U.K.),  
Regent House, Wolsley Road, Kempston, Bedford. MK42 7JY  
Phone: +44 (0) 1234 844100 Fax: +44 (0) 1234 841490  
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198032A-01



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

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Apr 22, 2014 Rootmeter S/N 0438320 Ta (K) - 296  
Operator Tisch Orifice I.D. - 2456 Pa (mm) - 746.76

PLATE OR Run #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER		ORIFICE	
					DIFF Hg (mm)	DIFF H2O (in.)		
1	NA	NA	1.00	1.4450	3.2	2.00		
2	NA	NA	1.00	1.0180	6.4	4.00		
3	NA	NA	1.00	0.9110	7.9	5.00		
4	NA	NA	1.00	0.8670	8.8	5.50		
5	NA	NA	1.00	0.7170	12.8	8.00		

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
0.9850	0.6816	1.4066	0.9957	0.6890	0.8904
0.9808	0.9634	1.9892	0.9914	0.9739	1.2592
0.9787	1.0743	2.2240	0.9893	1.0860	1.4078
0.9775	1.1275	2.3325	0.9882	1.1398	1.4765
0.9722	1.3560	2.8131	0.9828	1.3708	1.7807
Qstd slope (m) = 2.08575			Qa slope (m) = 1.30606		
intercept (b) = -0.01737			intercept (b) = -0.01099		
coefficient (r) = 0.99998			coefficient (r) = 0.99998		
y axis = Sqrt[H2O(Pa/760) (298/Ta)]			y axis = Sqrt[H2O(Ta/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 CALCULATION SPREADSHEET

Location : West Kowloon Cultural District				Date of Calibration: 24-Jul-14			
Location : AM1 (International Commerce Centre)				Next Calibration Date: 23-Oct-14			
Make: Thermo		S/N: 2086		Technician: Sam Tsang			
Model: G310-1							

CONDITIONS							
Sea Level Pressure (hPa):		1000.60		Corrected Pressure (mm Hg):		751	
Temperature (°C):		32		Temperature (K):		305	

CALIBRATION ORIFICE							
Make: Tisch		Qstd Slope:		2.08575			
Model: TE-5025A		Qstd Intercept:		-0.01737			
Calibration Date: 22-Apr-14		Expiry Date:		22-Apr-15			
S/N: 2456							

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m³/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	5.50	-5.70	11.200	1.585	54.00	53.06	Slope = 31.1061 Intercept = 3.0177 Corr. coeff.: 0.9867
13	4.10	-4.80	8.900	1.414	49.00	48.15	
10	3.10	-3.70	6.800	1.237	40.00	39.30	
7	2.10	-2.50	4.600	1.019	34.00	33.41	
5	1.00	-1.60	2.600	0.768	29.00	28.50	

**Calculations:**

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

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

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:**

$1/m(I[\text{Sqrt}(298/\text{Tav})(\text{Pav}/760)] - b)$

m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

**FLOW RATE CHART**

Standard Flow Rate (m³/min)	Actual chart response (IC)
0.768	28.50
1.019	33.41
1.237	39.30
1.414	48.15
1.585	53.06



### TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : West Kowloon Cultural District				Date of Calibration: 21-Jul-14			
Location : AM1 (International Commerce Centre)				Next Calibration Date: 20-Oct-14			
Make: Thermo		S/N: 2091		Technician: Sam Tsang			
Model: G310-1							

CONDITIONS							
Sea Level Pressure (hPa):		1000.60		Corrected Pressure (mm Hg):		751	
Temperature (°C):		32		Temperature (K):		305	

CALIBRATION ORIFICE							
Make:		Tisch		Qstd Slope:		2.08575	
Model:		TE-5025A		Qstd Intercept:		-0.01737	
Calibration Date:		22-Apr-14		Expiry Date:		22-Apr-15	
S/N:		2456					

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m³/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	-0.60	-12.50	11.900	1.633	55.00	54.04	Slope = 33.6737 Intercept = -1.1739 Corr. coeff.: 0.9853
13	-2.20	-11.00	8.800	1.406	49.00	48.15	
10	-3.20	-10.50	7.300	1.281	40.00	39.30	
7	-4.60	-9.70	5.100	1.072	35.00	34.39	
5	-5.20	-8.40	3.200	0.851	29.00	28.50	

**Calculations:**

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

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:**  
 $1/m(I[\text{Sqrt}(298/\text{Tav})(\text{Pav}/760)] - b)$

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

**FLOW RATE CHART**

Standard Flow Rate (m³/min)	Actual chart response (IC)
0.851	28.50
1.072	34.39
1.281	39.30
1.406	48.15
1.633	54.04

### TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : West Kowloon Cultural District				Date of Calibration: 29-Jul-14			
Location : AM2 (The Harbourside Tower 1 (Ground L				Next Calibration Date: 28-Oct-14			
Make: Tisch		S/N: 3834		Technician: Sam Tsang			
Model: TE-5005X							

CONDITIONS							
Sea Level Pressure (hPa):		1000.60		Corrected Pressure (mm Hg):		751	
Temperature (°C):		34		Temperature (K):		307	

CALIBRATION ORIFICE							
Make: Tisch		Qstd Slope:		2.08575			
Model: TE-5025A		Qstd Intercept:		-0.01737			
Calibration Date: 22-Apr-14		Expiry Date:		22-Apr-15			
S/N: 2456							

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m³/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	6.10	-6.40	12.500	1.668	56.00	54.85	Slope = 29.7583 Intercept = 4.3639 Corr. coeff.: 0.9945
13	4.80	-5.20	10.000	1.493	50.00	48.97	
10	3.50	-3.60	7.100	1.260	41.00	40.15	
7	2.40	-2.50	4.900	1.048	36.00	35.26	
5	1.40	-1.50	2.900	0.808	30.00	29.38	

**Calculations:**

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

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:**  
 $1/m(I[\text{Sqrt}(298/\text{Tav})(\text{Pav}/760)] - b)$

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

**FLOW RATE CHART**

Standard Flow Rate (m³/min)	Actual chart response (IC)
0.808	29.38
1.048	35.26
1.260	40.15
1.493	48.97
1.668	54.85

## TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : West Kowloon Cultural District				Date of Calibration: 29-Jul-14			
Location : AM2 (The Harbourside Tower 1 (Ground L				Next Calibration Date: 28-Oct-14			
Make: Tisch		S/N: 3835		Technician: Sam Tsang			
Model: TE-5005X							

CONDITIONS							
Sea Level Pressure (hPa):		1000.60		Corrected Pressure (mm Hg):		751	
Temperature (°C):		34		Temperature (K):		307	

CALIBRATION ORIFICE							
Make: Tisch		Qstd Slope:		2.08575			
Model: TE-5025A		Qstd Intercept:		-0.01737			
Calibration Date: 22-Apr-14		Expiry Date:		22-Apr-15			
S/N: 2456							

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m³/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	4.10	-6.50	10.600	1.537	55.00	53.87	Slope = 42.9274 Intercept = -12.8572 Corr. coeff.: 0.9991
13	4.50	-5.00	9.500	1.456	50.00	48.97	
10	3.40	-3.70	7.100	1.260	42.00	41.13	
7	2.20	-2.60	4.800	1.037	32.00	31.34	
5	1.30	-1.50	2.800	0.794	22.00	21.55	

**Calculations:**

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

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

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:**

$1/m(I[\text{Sqrt}(298/\text{Tav})(\text{Pav}/760)] - b)$

m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

**FLOW RATE CHART**

Standard Flow Rate (m³/min)	Actual chart response (IC)
0.794	21.55
1.037	31.34
1.260	41.13
1.456	48.97
1.537	53.87



## TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : West Kowloon Cultural District				Date of Calibration: 21-Jul-14			
Location : AM3 (The Victoria Towers - Tower 1)				Next Calibration Date: 20-Oct-14			
Make: Tisch		S/N: 3796		Technician: Sam Tsang			
Model: TE-5005X							

CONDITIONS							
Sea Level Pressure (hPa):		1000.60		Corrected Pressure (mm Hg):		751	
Temperature (°C):		32		Temperature (K):		305	

CALIBRATION ORIFICE							
Make: Tisch		Qstd Slope:		2.08575			
Model: TE-5025A		Qstd Intercept:		-0.01737			
Calibration Date: 22-Apr-14		Expiry Date:		22-Apr-15			
S/N: 2456							

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m³/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	-0.50	-12.80	12.300	1.661	60.00	58.96	Slope = 31.8295 Intercept = 4.2691 Corr. coeff.: 0.9822
13	-1.80	-11.30	9.500	1.460	52.00	51.09	
10	-3.20	-10.50	7.300	1.281	42.00	41.27	
7	-4.50	-8.90	4.400	0.997	37.00	36.36	
5	-5.40	-7.90	2.500	0.753	30.00	29.48	

**Calculations:**

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

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

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:**

$1/m(I[\text{Sqrt}(298/\text{Tav})(\text{Pav}/760)] - b)$

m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

**FLOW RATE CHART**

Standard Flow Rate (m³/min)	Actual chart response (IC)
0.75	29.48
0.99	36.36
1.28	41.27
1.46	51.09
1.66	58.96

## TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : West Kowloon Cultural District				Date of Calibration: 21-Jul-14			
Location : AM3 (The Victoria Towers - Tower 1)				Next Calibration Date: 20-Oct-14			
Make: Tisch		S/N: 3802		Technician: Sam Tsang			
Model: TE-5005X							

CONDITIONS							
Sea Level Pressure (hPa):		1000.60		Corrected Pressure (mm Hg):		751	
Temperature (°C):		32		Temperature (K):		305	

CALIBRATION ORIFICE							
Make: Tisch		Qstd Slope:		2.08575			
Model: TE-5025A		Qstd Intercept:		-0.01737			
Calibration Date: 22-Apr-14		Expiry Date:		22-Apr-15			
S/N: 2456							

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m³/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	-0.70	-12.50	11.800	1.627	57.00	56.01	Slope = 33.8879 Intercept = 0.0354 Corr. coeff.: 0.9907
13	-2.00	-11.00	9.000	1.422	50.00	49.13	
10	-3.00	-10.40	7.400	1.290	42.00	41.27	
7	-4.40	-9.30	4.900	1.051	36.00	35.37	
5	-5.30	-8.20	2.900	0.811	29.00	28.50	

**Calculations:**

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

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

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:**

$1/m(I[\text{Sqrt}(298/\text{Tav})(\text{Pav}/760)] - b)$

m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

**FLOW RATE CHART**

Standard Flow Rate (m³/min)	Actual chart response (IC)
0.811	28.50
1.051	35.37
1.290	41.27
1.422	49.13
1.627	56.01

### TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : West Kowloon Cultural District				Date of Calibration: 21-Jul-14			
Location : AM4 (Canton Road Government Primary Sc				Next Calibration Date: 20-Oct-14			
Make: Thermo		S/N: 2088		Technician: Sam Tsang			
Model: G310-1							

CONDITIONS							
Sea Level Pressure (hPa):		1000.60		Corrected Pressure (mm Hg):		751	
Temperature (°C):		32		Temperature (K):		305	

CALIBRATION ORIFICE							
Make:		Tisch		Qstd Slope:		2.08575	
Model:		TE-5025A		Qstd Intercept:		-0.01737	
Calibration Date:		22-Apr-14		Expiry Date:		22-Apr-15	
S/N:		2456					

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m³/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	-0.80	-12.40	11.600	1.613	58.00	56.99	Slope = 41.3084 Intercept = -10.4850 Corr. coeff.: 0.9837
13	-2.10	-11.20	9.100	1.429	51.00	50.11	
10	-3.10	-10.30	7.200	1.272	40.00	39.30	
7	-4.50	-9.50	5.000	1.062	32.00	31.44	
5	-5.20	-8.50	3.300	0.864	28.00	27.51	

**Calculations:**

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

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)

m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

**FLOW RATE CHART**

Standard Flow Rate (m³/min)	Actual chart response (IC)
0.864	27.51
1.062	31.44
1.272	39.30
1.429	50.11
1.613	56.99



### TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : West Kowloon Cultural District				Date of Calibration: 21-Jul-14			
Location : AM4 (Canton Road Government Primary Sc				Next Calibration Date: 20-Oct-14			
Make: Tisch		S/N: 3841		Technician: Sam Tsang			
Model: TE-5005X							

CONDITIONS							
Sea Level Pressure (hPa):		1000.60		Corrected Pressure (mm Hg):		751	
Temperature (°C):		32		Temperature (K):		305	

CALIBRATION ORIFICE							
Make: Tisch		Qstd Slope:		2.08575			
Model: TE-5025A		Qstd Intercept:		-0.01737			
Calibration Date: 22-Apr-14		Expiry Date:		22-Apr-15			
S/N: 2456							

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m³/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	-0.70	-12.30	11.600	1.613	56.00	55.02	Slope = 33.1743 Intercept = 0.7549 Corr. coeff.: 0.9884
13	-2.00	-11.10	9.100	1.429	50.00	49.13	
10	-3.10	-10.30	7.200	1.272	41.00	40.29	
7	-4.30	-9.40	5.100	1.072	37.00	36.36	
5	-5.20	-8.30	3.100	0.838	30.00	29.48	

**Calculations:**

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

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)

m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

**FLOW RATE CHART**

Standard Flow Rate (m³/min)	Actual chart response (IC)
0.838	29.48
1.072	36.36
1.272	40.29
1.429	49.13
1.613	55.02