



# Certificate of Calibration

Calibration Certification Information			
<b>Cal. Date:</b> October 17, 2018	<b>Rootsmeter S/N:</b> 438320	<b>Ta:</b> 294 °K	
<b>Operator:</b> Jim Tisch		<b>Pa:</b> 755.7 mm Hg	
<b>Calibration Model #:</b> TE-5025A	<b>Calibrator S/N:</b> 2154		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4590	3.2	2.00
2	3	4	1	1.0410	6.4	4.00
3	5	6	1	0.9310	7.9	5.00
4	7	8	1	0.8840	8.8	5.50
5	9	10	1	0.7320	12.7	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)
1.0035	0.6878	1.4197	0.9958	0.6825	0.8821
0.9993	0.9599	2.0078	0.9915	0.9525	1.2475
0.9973	1.0712	2.2448	0.9895	1.0629	1.3948
0.9961	1.1268	2.3543	0.9884	1.1180	1.4628
0.9909	1.3536	2.8394	0.9832	1.3432	1.7642
<b>QSTD</b>	<b>m=</b>	<b>2.13015</b>	<b>QA</b>	<b>m=</b>	<b>1.33386</b>
	<b>b=</b>	<b>-0.04186</b>		<b>b=</b>	<b>-0.02601</b>
	<b>r=</b>	<b>0.99996</b>		<b>r=</b>	<b>0.99996</b>

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

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

**MATERIALAB CONSULTANTS LIMITED**

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**TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET**

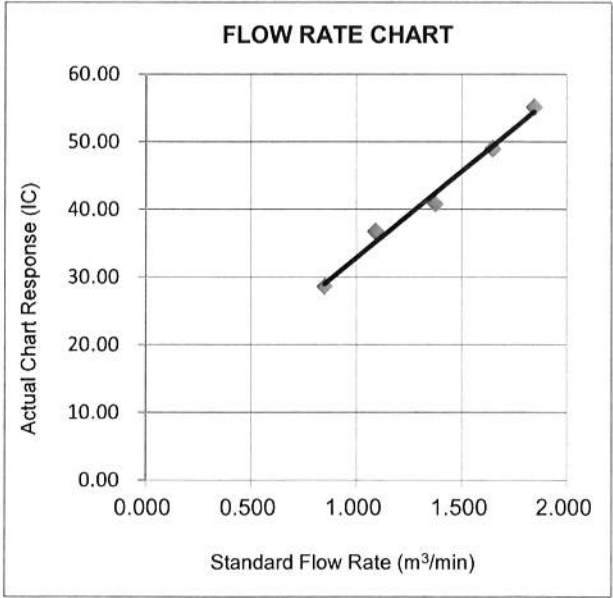
Project : Environmental Monitoring Works For Contract No. KLN/2015/07				Date of Calibration: 29-Dec-18			
Location : KTD2b				Next Calibration Date: 28-Mar-19			
Brand:	Tisch			Technician: Felix Fong			
Model:	TE-5170	S/N:	3838				

CONDITIONS			
Sea Level Pressure (hPa):	1026.1	Corrected Pressure (mm Hg):	770
Temperature (°C):	16	Temperature (K):	289

CALIBRATION ORIFICE			
Make:	Tisch	Qstd Slope:	2.13015
Model:	TE-5025A	Qstd Intercept:	-0.04186
Calibration Date:	17-Oct-18	Expiry Date:	17-Oct-19
S/N:	2154		

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m <sup>3</sup> /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	11.00	-3.50	14.500	1.845	54.00	55.15	Slope = 25.5771 Intercept = 7.2498 Corr. coeff.: 0.9932
13	10.50	-1.00	11.500	1.646	48.00	49.02	
10	8.00	0.00	8.000	1.376	40.00	40.85	
7	6.50	1.50	5.000	1.092	36.00	36.77	
5	5.50	2.50	3.000	0.850	28.00	28.60	

**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



**CHOI KAM HO**  
Project Consultant

**Report Date:** 1<sup>st</sup> January, 2019

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# MaterialLab

## TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Project : Environmental Monitoring Works For Contract No. KLN/2015/07			Date of Calibration: 29-Dec-18		
Location : KTD1a			Next Calibration Date: 28-Mar-19		
Brand:	Tisch		Technician: Felix Fong		
Model:	TE-5170	S/N:	4037		

CONDITIONS					
Sea Level Pressure (hPa):	1026.1	Corrected Pressure (mm Hg):	770		
Temperature (°C):	16	Temperature (K):	289		

CALIBRATION ORIFICE					
Make:	Tisch	Qstd Slope:	2.13015		
Model:	TE-5025A	Qstd Intercept:	-0.04186		
Calibration Date:	17-Oct-18	Expiry Date:	17-Oct-19		
S/N:	2154				

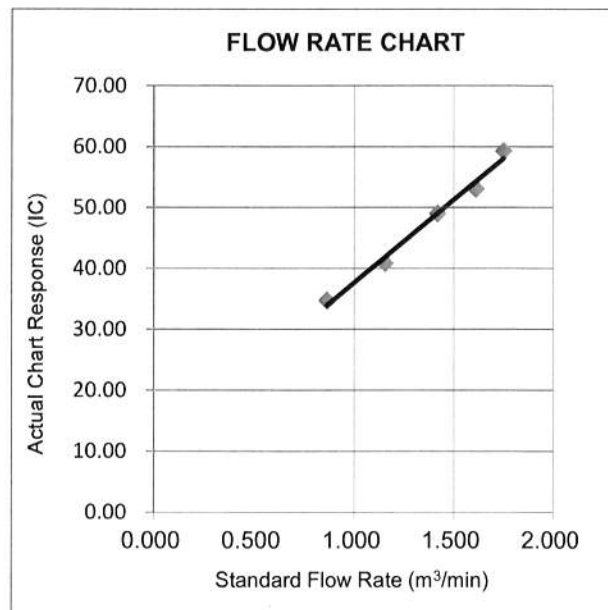
CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m <sup>3</sup> /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	10.00	-3.00	13.000	1.749	58.00	59.27	Slope = 27.2293 Intercept = 10.3971 Corr. coeff.: 0.9942
13	9.50	-1.50	11.000	1.611	52.00	53.14	
10	8.50	0.00	8.500	1.418	48.00	49.05	
7	6.80	1.20	5.600	1.155	40.00	40.87	
5	5.20	2.10	3.100	0.864	34.00	34.74	

### 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



**CHOI KAM HO**  
Project Consultant

**Report Date:** 1<sup>st</sup> January, 2019

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# MaterialLab

## TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Project : Environmental Monitoring Works For Contract No. KLN/2015/07			Date of Calibration: 29-Dec-18		
Location : KER1b			Next Calibration Date: 28-Mar-19		
Brand:	Tisch		Technician: Felix Fong		
Model:	TE-5170	S/N:	3482		

### CONDITIONS

Sea Level Pressure (hPa):	1026.1	Corrected Pressure (mm Hg):	770
Temperature (°C):	16	Temperature (K):	289

### CALIBRATION ORIFICE

Make:	Tisch	Qstd Slope:	2.13015
Model:	TE-5025A	Qstd Intercept:	-0.04186
Calibration Date:	17-Oct-18	Expiry Date:	17-Oct-19
S/N:	2154		

### 43755

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m <sup>3</sup> /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	10.50	-3.20	13.700	1.795	56.00	57.22	Slope = 21.6783 Intercept = 17.4679 Corr. coeff.: 0.9967
13	9.00	-1.60	10.600	1.581	50.00	51.09	
10	8.40	0.20	8.200	1.393	46.00	47.01	
7	6.60	1.80	4.800	1.071	40.00	40.87	
5	5.40	2.20	3.200	0.878	36.00	36.79	

### 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

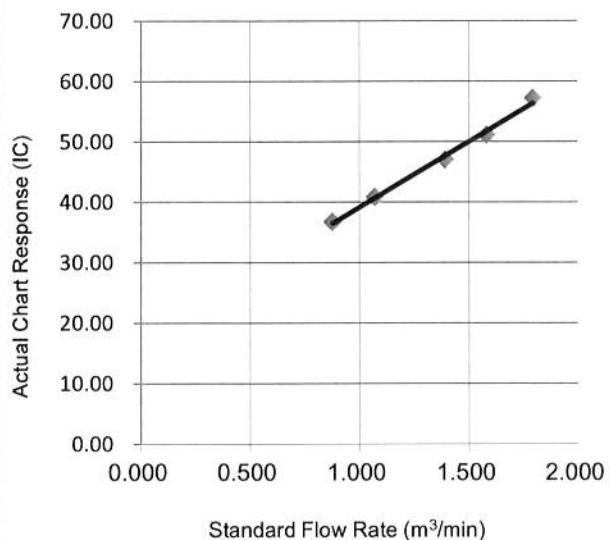
b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure

### FLOW RATE CHART



**CHOI KAM HO**  
Project Consultant

**Report Date:** 1<sup>st</sup> January, 2019



# Certificate of Conformity and Calibration

**Instrument Model:-** CEL-633A  
**Serial Number** 1488269  
**Firmware revision** V006-03  
**Microphone Type:-** CEL-251  
**Serial Number** 2869  
**Preamplifier Type:-** CEL-495  
**Serial Number** 004065

**Instrument Class/Type:-** 1

**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.

**Test Conditions:-** 30 °C  
 58 %RH  
 1003 mBar  
**Test Engineer:-** Chris Taylor  
**Date of Issue:-** September 7, 2018



**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:-**

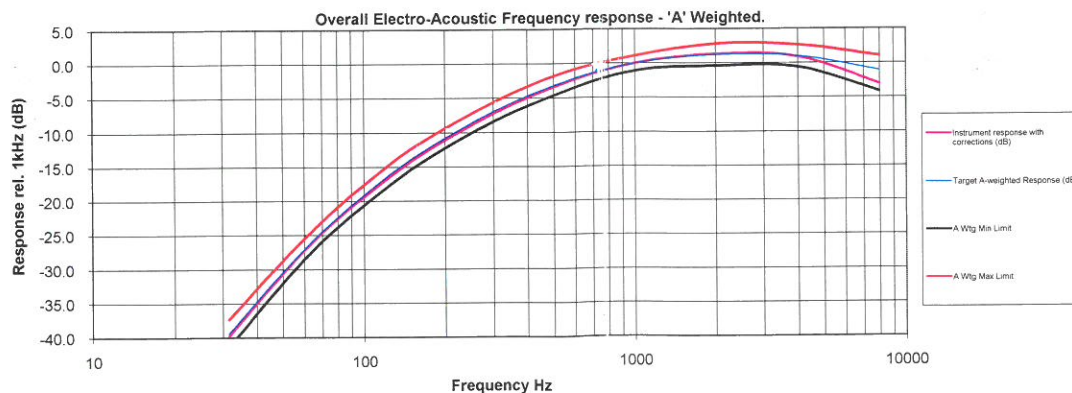
- Self Generated Noise Test
- Electrical Signal Test Of Frequency Weightings
- Frequency & Time Weightings At 1 kHz
- Level Linearity On The Reference Level Range
- Toneburst Response Test
- C-peak Sound Levels
- Overload Indication
- Acoustic Tests

**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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# Certificate of Conformity and Calibration

**Instrument Model:-** CEL-633A  
 Serial Number 1488306  
 Firmware revision V006-03

**Microphone Type:-** CEL-251  
 Serial Number 2874

**Preamplifier Type:-** CEL-495  
 Serial Number 003930

**Instrument Class/Type:-** 1

**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.

**Test Conditions:-** 31 °C  
 51 %RH  
 1000 mBar

**Test Engineer:-** Chris Taylor  
**Date of Issue:-** September 7, 2018



**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:-**

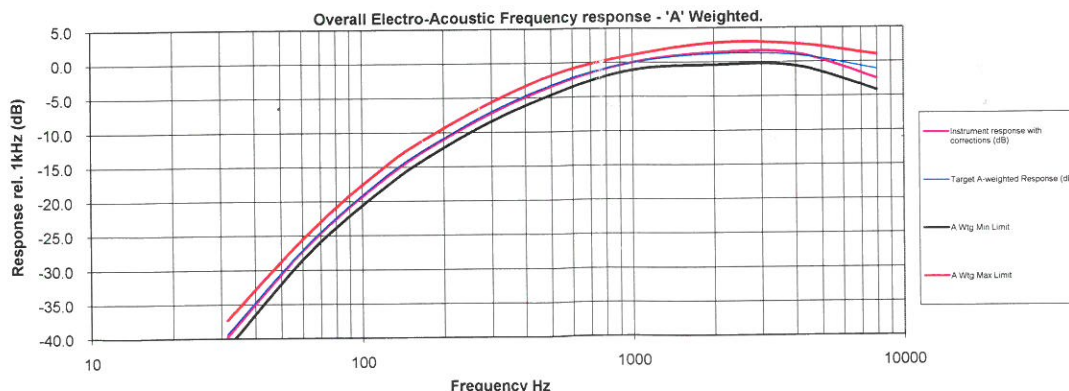
- Self Generated Noise Test
- Electrical Signal Test Of Frequency Weightings
- Frequency & Time Weightings At 1 kHz
- Level Linearity On The Reference Level Range
- Toneburst Response Test
- C-peak Sound Levels
- Overload Indication
- Acoustic Tests

**All Tests Pass**  
**All Tests Pass**  
**All Tests Pass**  
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**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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# MaterialLab

Report no.: 183057CA185248

Page 1 of 1

## CALIBRATION CERTIFICATE OF SOUND CALIBRATOR

### Client Supplied Information

Client : MaterialLab Consultants Ltd.

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Sound Calibrator  
Manufacturer : Casella (Model CEL-120/1)  
Serial No. : 4358250  
Equipment ID : N/A  
Next Calibration Date : 02-Jul-2019  
Specification Limit : EN 60942: 2003 Type 1

### Laboratory Information

Description : Reference Sound level meter  
Equipment ID. : R-119-1  
Date of Calibration : 03-Jul-2018 Ambient Temperature : 22 °C  
Calibration Location : Calibration Laboratory of FTS  
Method Used : By direct comparison

### Calibration Results :

Parameters (Setting of UUT)	Mean Value (error of measurement)	Specification Limit(dB)
94dB	0.0 dB	±0.4dB
114dB	0.1 dB	

### Remarks :

1. The equipment used in this calibration is traceable to recognized National Standards.
2. The mean value is the average of four measurements.
3. The equipment does comply with the specification limit.

Checked by : William Date : 10-7-2018 Certified by : Chan Chun Wai Date : 16.7.2018

CA-R-297 (22/07/2009)

Chan Chun Wai (Manager)

**\*\* End of Report \*\***



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# MaterialLab

Report no.: 183057CA185228(1)

Page 1 of 1

## CALIBRATION CERTIFICATE OF SOUND CALIBRATOR

### Client Supplied Information

Client : MaterialLab Consultants Ltd.

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Sound Calibrator  
Manufacturer : Casella (Model CEL-120/1)  
Serial No. : 4358251  
Equipment ID : N/A  
Next Calibration Date : 25-Jun-2019  
Specification Limit : EN 60942: 2003 Type 1

### Laboratory Information

Description : Reference Sound level meter  
Equipment ID. : R-119-1  
Date of Calibration : 26-Jun-2018 Ambient Temperature : 22 °C  
Calibration Location : Calibration Laboratory of MaterialLab  
Method Used : By direct comparison

### Calibration Results :

Parameters (Setting of UUT)	Mean Value (error of measurement)	Specification Limit(dB)
94dB	-0.1 dB	±0.4dB
114dB	-0.1 dB	

### Remarks :

1. The equipment used in this calibration is traceable to recognized National Standards.
2. The mean value is the average of four measurements.
3. The equipment does comply with the specification limit.

Checked by : William Date : 28-6-2018 Certified by : Chan Date : 4.7.2018

CA-R-297 (22/07/2009)

Chan Chun Wai (Manager)

\*\* End of Report \*\*



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# MaterialLab

Report No. : 183057CA185180(1)

Page 1 of 1

## CALIBRATION CERTIFICATE OF ANEMOMETER

### Client Supplied Information

Client : MaterialLab Consultants Ltd.

Project : Calibration Services

### Details of Unit Under Test, UUT

Description : Anemometer

Manufacturer : Benetech

Model No. : GM816

Serial No. : 13372555

Equipment ID. : N/A

Next Calibration Date : 08-Jun-2019

### Laboratory Information

Details of Reference Equipment –

Description : Reference Anemometer

Equipment ID. : R-101-4

Date of Calibration : 09-Jun-2018 Ambient Temperature : 22 °C

Calibration Location : Calibration Laboratory of FTS

Method Used : By direct Comparison

### Calibration Results :

Reference Reading (m/s)	UUT Reading (m/s)	Error (m/s)
1.96	2.2	0.2
4.04	4.1	0.1
6.05	6.2	0.2
8.02	7.9	-0.1
10.06	9.7	-0.4

### Remark :

1. The equipment being used in this calibration is traceable to recognized National Standards.

Checked by : William Date : 12-6-2018 Certified by : Chan Chun Wai Date : 13.6.2018

CA-R-297 (22/07/2009)

Chan Chun Wai (Manager)

\*\* End of Report \*\*

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# Materialab

Report No. : 182933CA185214(2)

Page 1 of 1

## CALIBRATION CERTIFICATE OF ANEMOMETER

### Client Supplied Information

Client : Materialab Consultants Ltd.

Address: Room 723 & 725, 7F., Block B Profit Industrial Building, 1-15 Kwai Fung Crescent, Kwai Chung, N.T.

Project : Calibration Services

### Details of Unit Under Test, UUT

Description : Comfort Level Probe

Manufacturer : Testo

Model No. :

Serial No. :

Equipment ID :

Next Calibration Due Date :

Meter	Probe
480	409
61003846	03216409

N/A

22-Aug-2019

### Laboratory Information

Details of Reference Equipment –

Description : Reference Anemometer

Equipment ID. : R-101-4

Date of Calibration : 23-Aug-2018

Ambient Temperature : 20± 2 °C

Calibration Location : Calibration Laboratory of FTS

Method Used : By direct Comparison

### Calibration Results :

Reference Reading (m/s)	UUT Reading (m/s)	Error (m/s)
1.05	1.06	0.01
3.02	3.06	0.04
5.04	5.07	0.03

### Remarks :

1. The equipment being used in this calibration is traceable to recognized National Standards.
2. The reported readings in this calibration are an average from 10 trials.

Checked by : William Date : 31-8-2018 Certified by : K. T. Leung Date : 31-8-2018  
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

**\*\* End of Report \*\***