



Certificate of Calibration

Calibration Certification Information			
Cal. Date: October 17, 2018	Rootsmeter S/N: 438320	Ta: 294	°K
Operator: Jim Tisch		Pa: 755.7	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: 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)	$\sqrt{\Delta H \left(Ta/Pa \right)}$ (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
QSTD	m=	2.13015	QA	m=	1.33386
	b=	-0.04186		b=	-0.02601
	r=	0.99996		r=	0.99996

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/ΔTime	Qa=	Va/ΔTime
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=	$1/m \left(\left(\sqrt{\Delta H \left(Ta/Pa \right)} \right) - b \right)$

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



Certificate of Calibration

Calibration Certification Information			
Cal. Date: November 20, 2017	Rootsmeter S/N: 438320	Ta: 294	°K
Operator: Jim Tisch		Pa: 756.9	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: 2456		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4440	3.2	2.00
2	3	4	1	1.0260	6.4	4.00
3	5	6	1	0.9130	7.8	5.00
4	7	8	1	0.8680	8.8	5.50
5	9	10	1	0.7190	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)	
1.0052	0.6961	1.4209	0.9958	0.6896	0.8814	
1.0010	0.9756	2.0095	0.9915	0.9664	1.2465	
0.9991	1.0943	2.2467	0.9897	1.0840	1.3936	
0.9978	1.1495	2.3563	0.9884	1.1387	1.4616	
0.9926	1.3805	2.8418	0.9832	1.3675	1.7628	
QSTD	m=	2.07133	QA	m=	1.29703	
	b=	-0.01892		b=	-0.01173	
	r=	0.99995		r=	0.99995	

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/ΔTime	Qa=	Va/ΔTime
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

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TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Project : Environmental Monitoring Works For Contract No. KLN/2015/07			Date of Calibration: 2-Oct-18
Location : KER1b			Next Calibration Date: 1-Jan-19
Brand:	Tisch		Technician: Toby Wan
Model:	TE-5170	S/N: 3482	

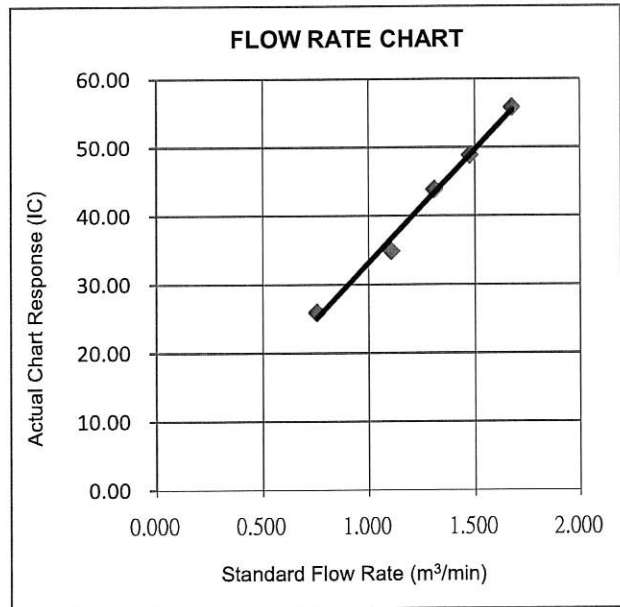
CONDITIONS			
Sea Level Pressure (hPa):	1014.9	Corrected Pressure (mm Hg):	761
Temperature (°C):	27	Temperature (K):	300

CALIBRATION ORIFICE			
Make:	Tisch	Qstd Slope:	2.07013
Model:	TE-5025A	Qstd Intercept:	-0.01892
Calibration Date:	20-Nov-17	Expiry Date:	20-Nov-18
S/N:	2456		

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	12.00	0.00	12.000	1.678	56.00	55.85	Slope = 32.9848
13	10.60	1.30	9.300	1.478	49.00	48.87	Intercept = 0.1261
10	9.40	2.10	7.300	1.311	44.00	43.88	Corr. coeff.: 0.9961
7	8.70	3.50	5.200	1.108	35.00	34.91	
5	7.60	5.20	2.400	0.755	26.00	25.93	

Calculations:

$Q_{std} = 1/m[\sqrt{H_2O(P_a/P_{std})(T_{std}/T_a)}] - b$
 $IC = I[\sqrt{P_a/P_{std}}(T_{std}/T_a)]$
 Qstd = standard flow rate
 IC = corrected chart response
 I = actual chart response
 m = calibrator Qstd slope
 b = calibrator Qstd intercept
 T_a = actual temperature during calibration (deg K)
 P_a = actual pressure during calibration (mm Hg)
 T_{std} = 298 deg K
 P_{std} = 760 mm Hg
For subsequent calculation of sampler flow:
 $1/m((I)[\sqrt{298/T_{av}}](P_{av}/760)] - b$
 m = sampler slope
 b = sampler intercept
 I = chart response
 T_{av} = daily average temperature
 P_{av} = daily average pressure



CHOI KAM HO
Project Consultant

Report Date: 2nd October, 2018

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TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

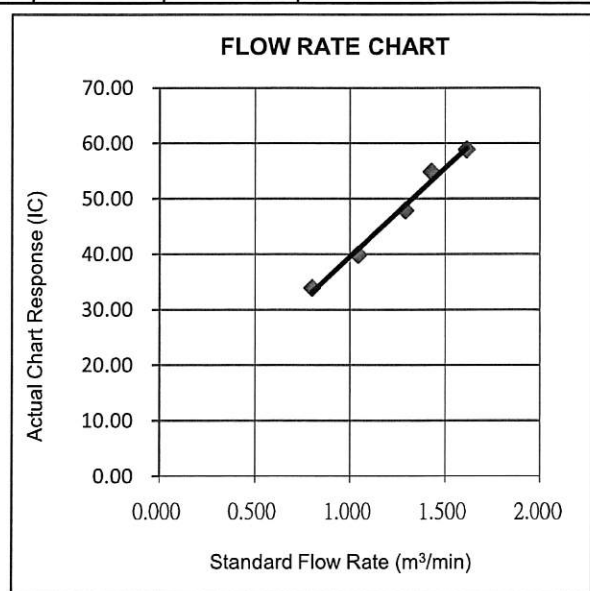
Project : Environmental Monitoring Works For Contract No. KLN/2015/07			Date of Calibration: 2-Oct-18		
Location : KTD1a			Next Calibration Date: 1-Jan-19		
Brand:	Tisch		Technician: Toby Wan		
Model:	TE-5170	S/N:	4037		

CONDITIONS					
Sea Level Pressure (hPa):	1014.9	Corrected Pressure (mm Hg):	761		
Temperature (°C):	27	Temperature (K):	300		

CALIBRATION ORIFICE					
Make:	Tisch	Qstd Slope:	2.07013		
Model:	TE-5025A	Qstd Intercept:	-0.01892		
Calibration Date:	20-Nov-17	Expiry Date:	20-Nov-18		
S/N:	2456				

CALIBRATIONS							
Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m³/min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	11.50	0.40	11.100	1.614	59.00	58.84	Slope = 31.9470 Intercept = 7.5845 Corr. coeff.: 0.9939
13	10.30	1.60	8.700	1.430	55.00	54.85	
10	9.40	2.30	7.100	1.293	48.00	47.87	
7	8.30	3.70	4.600	1.042	40.00	39.89	
5	7.30	4.60	2.700	0.801	34.00	33.91	

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




CHOI KAM HO
 Project Consultant

Report Date: 2nd October, 2018

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TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Project : Environmental Monitoring Works For Contract No. KLN/2015/07			Date of Calibration: 6-Nov-18		
Location : KTD2b			Next Calibration Date: 5-Feb-19		
Brand:	Tisch		Technician: Ting Chan		
Model:	TE-5170	S/N:	3838		

CONDITIONS					
Sea Level Pressure (hPa):	1017.5	Corrected Pressure (mm Hg):	763		
Temperature (°C):	27	Temperature (K):	300		

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 ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	5.40	-6.10	11.500	1.609	49.00	48.93	Slope = 24.9721 Intercept = 8.1265 Corr. coeff.: 0.9962
13	4.00	-4.80	8.800	1.410	43.00	42.94	
10	2.70	-3.20	5.900	1.158	37.00	36.95	
7	1.80	-2.50	4.300	0.992	32.00	31.95	
5	0.90	-1.60	2.500	0.761	28.00	27.96	

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:

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

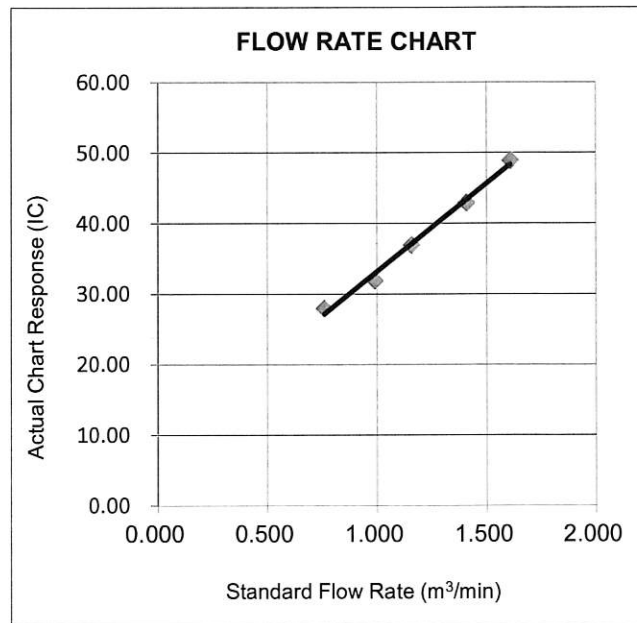
m = sampler slope

b = sampler intercept

I = chart response

Tav = daily average temperature

Pav = daily average pressure



CHOI KAM HO
Project Consultant

Report Date: 8th November, 2018

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MaterialLab

Report no.: 172379CA180329A

Page 1 of 1

CALIBRATION CERTIFICATE OF SOUND LEVEL METER

Client Supplied Information

Client : MaterialLab Consultants Ltd.

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

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Sound Level Meter

Manufacturer : Casella

	Meter	Microphone	Preamplifier
Model No.	CEL-63X	CE-251	CEL-495
Serial No.	1057055	00995	002317

Next Calibration Date : 12-Feb-2019

Specification Limit : EN 61672: 2003 Type 1

Laboratory Information

Description : B & K Acoustic Multifunction Calibrator 4226 (Traditional free field setting)

Equipment ID. : R-108-1

Date of Calibration : 13-Feb-2018 Ambient Temperature : 22 °C

Calibration Location : Calibration Laboratory of FTS

Method Used : By direct comparison

Calibration Results :

Parameters	Mean Value (dB)	Specification Limit(dB)
A-weighting frequency response	4000Hz	0.4 2.6 to -0.6
	2000Hz	1.0 2.8 to -0.4
	1000Hz	0.2 1.1 to -1.1
	500Hz	-3.0 -1.8 to -4.6
	250Hz	-8.3 -7.2 to -10.0
	125Hz	-15.7 -14.6 to -17.6
	63Hz	-25.7 -24.7 to -27.7
	31.5Hz	-38.7 -37.4 to -41.4
Differential level linearity	94dB-104dB	± 0.6
	104dB-114dB	± 0.6

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. For calibration: Reference SPL are 94, 104 & 114dB, range setting is 20-140dB & time weighing is fast
4. The equipment does comply with EN 61672: 2003 Type 1 sound level meter for the above measurement.
5. This is to supersede the previous report no. 172379CA180329.

Checked by : CONF Date : 5-7-2018 Certified by : K.T. Leung Date : 7-7-2018

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

Leung Kwok Tai (Assistant Manager)

** End of Report **

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MaterialLab

Report no.: 172379CA185194

Page 1 of 1

CALIBRATION CERTIFICATE OF SOUND LEVEL METER

Client Supplied Information

Client : MaterialLab Consultants Ltd.

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

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Sound Level Meter
Manufacturer : Casella

	Meter	Microphone	Preamplifier
Model No.	CL63X	CE-251	CEL-495
Serial No.	3756072	2403	002109

Equipment ID : N/A
Next Calibration Date : 11-Jun-2019
Specification Limit : EN 61672: 2003 Type 1

Laboratory Information

Description : B & K Acoustic Multifunction Calibrator 4226 (Traditional free field setting)
Equipment ID. : R-108-1
Date of Calibration : 12-Jun-2018 Ambient Temperature : 22 °C
Calibration Location : Calibration Laboratory of FTS
Method Used : By direct comparison

Calibration Results :

Parameters		Mean Value (dB)	Specification Limit(dB)
A-weighting frequency response	4000Hz	0.4	2.6 to -0.6
	2000Hz	1.0	2.8 to -0.4
	1000Hz	-0.1	1.1 to -1.1
	500Hz	-3.4	-1.8 to -4.6
	250Hz	-9.6	-7.2 to -10.0
	125Hz	-16.2	-14.6 to -17.6
	63Hz	-26.3	-24.7 to -27.7
	31.5Hz	-39.2	-37.4 to -41.4
Differential level linearity	94dB-104dB	0.0	± 0.6
	104dB-114dB	0.0	± 0.6

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. For calibration: Reference range is 30-130dB, reference SPL is 94,104 & 114dB, frequency weighing is A,
4. The equipment does comply with EN 61672: 2003 Type 1 sound level meter for the above measurement.

Checked by : William Date : 22-6-2018 Certified by : K. T. Leung Date : 23-6-2018
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

** End of Report **

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MateriaLab

Report no.: 172379CA180336

Page 1 of 1

CALIBRATION CERTIFICATE OF SOUND LEVEL METER

Client Supplied Information

Client : MateriaLab Consultants Ltd.

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

Project : Calibration Services

Details of Unit Under Test, UUT

Description : Sound Level Meter

Manufacturer : Rion

	Meter	Microphone	Preamplifier
Model No.	NL-52	NH-59	NH-25
Serial No.	00943295	10452	43311

Next Calibration Date : 13-Feb-2019

Specification Limit : EN 61672: 2003 Type 1

Laboratory Information

Description : B & K Acoustic Multifunction Calibrator 4226

Equipment ID. : R-108-1

Date of Calibration : 14-Feb-2018 Ambient Temperature : 22 °C

Calibration Location : Calibration Laboratory of FTS



Method Used : By direct comparison

Calibration Results :

Parameters	Mean Value (dB)	Specification Limit(dB)
A-weighting frequency response	4000Hz	1.1
	2000Hz	1.5
	1000Hz	0.4
	500Hz	-2.8
	250Hz	-8.1
	125Hz	-15.5
	63Hz	-25.6
	31.5Hz	-38.6
C-weighting frequency response	4000Hz	-0.7
	2000Hz	0.1
	1000Hz	0.4
	500Hz	0.5
	250Hz	0.5
	125Hz	0.4
	63Hz	-0.2
	31.5Hz	-2.5
Differential level linearity	94dB-104dB	0.0
	104dB-114dB	0.0

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. Setting for calibration: Reference SPL is 94, 104 & 114dB, reference range is automatic & time weighing is fast
4. The equipment does comply with EN 61672: 2003 Type 1 sound level meter for the above measurement.

Checked by :  Date : 15-2-2018 Certified by :  Date : 26.2.2018

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

Chan Chun Wai (Manager)

** End of Report **

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Report no.: 183057CA185294

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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 no. CEL-120/1)
Serial No. : 5230736
Equipment ID : FY-SLC-01
Next Calibration Date : 18-Jul-2019
Specification Limit : EN 60942: 2003 Type 1

Laboratory Information

Description : Reference Sound level meter
Equipment ID. : R-119-1
Date of Calibration : 19-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	-0.2 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 : 20-7-2018 Certified by : Chan Date : 23.7.2018

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

Chan Chun Wai (Manager)

** End of Report **

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Report no.: 172379CA180517(1)

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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 no. CEL-120/1)
Serial No. : 5230758
Equipment ID : FY-SLC-01
Next Calibration Date : 11-Mar-2019
Specification Limit : EN 60942: 2003 Type 1

Laboratory Information



Description : Reference Sound level meter
Equipment ID. : R-119-1
Date of Calibration : 12-Mar-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	-0.4 dB	±0.4dB
114dB	-0.3 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 :  Date : 13.3.2018 Certified by :  Date : 13.3.2018
CA-R-297 (22/07/2009) Chan Chun Wai (Manager)

**** End of Report ****

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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)

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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 ****