



Certificate of Calibration

Calibration Certification Information			
Cal. Date: January 24, 2018	Rootsmeter S/N: 438320	Ta: 293	°K
Operator: Jim Tisch		Pa: 756.9	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: 3166		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4430	3.2	2.00
2	3	4	1	1.0270	6.4	4.00
3	5	6	1	0.9220	7.9	5.00
4	7	8	1	0.8780	8.7	5.50
5	9	10	1	0.7270	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)
1.0087	0.6990	1.4233	0.9958	0.6901	0.8799
1.0044	0.9780	2.0129	0.9915	0.9655	1.2443
1.0024	1.0872	2.2505	0.9896	1.0733	1.3912
1.0013	1.1404	2.3603	0.9885	1.1259	1.4591
0.9961	1.3701	2.8467	0.9834	1.3526	1.7598
QSTD	m=	2.12231	QA	m=	1.32895
	b=	-0.06016		b=	-0.03719
	r=	0.99999		r=	0.99999

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



Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA1b
 Equipment no. : HVS001
 Calibration Date : 19-Oct-18
 Calibration Due Date : 19-Dec-18

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition						
Temperature, T_a	297.2	Kelvin	Pressure, P_a	1017	mmHg	
Orifice Transfer Standard Information						
Equipment No.	Ori002	Slope, m_c	2.12231	Intercept, b_c	-0.06018	
Last Calibration Date	19-Jan-18	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $m_c \times Q_{std} + b_c$				
Next Calibration Date	19-Jan-19					
Calibration of TSP						
Calibration Point	Manometer Reading			Q_{std} ($m^3 / min.$) X-axis	Continuous Flow Recorder, W (CFM)	IC ($W(P_a/1013.3 \times 298/T_a)^{0.3531}$) Y-axis
	(up)	(down)	(difference)			
1	1.7	1.7	3.4	0.9000	27	27.0883
2	2.5	2.5	5.0	1.0854	33	33.1079
3	4.0	4.0	8.0	1.3654	43	43.1406
4	5.3	5.3	10.6	1.5674	49	49.1602
5	6.6	6.6	13.2	1.7458	55	55.1799
By Linear Regression of Y on X						
Slope, m		=	33.2775	Intercept, b =		-2.6174
Correlation Coefficient*		=	0.9997			
Calibration Accepted		=	Yes/No**			

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : As per client's provided information, the equipment reference no. of the calibrated High Volume Sampler has been re-assigned from EL452 to HVS001 with respect to the update in quality management system.

Calibrated by : Ray Lee
 Date : 19-Oct-18
 Checked by : Pui-lin Wong
 Date : 19-Oct-18



Lam Environmental Services Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA1b Calibration Date : 19-Dec-18
 Equipment no. : HVS001 Calibration Due Date : 18-Feb-19

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	293	Kelvin	Pressure, P _a
			1020 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori3166	Slope, m _c	2.12231	Intercept, b _c	-0.06016
Last Calibration Date	24-Jan-18	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	24-Jan-19				

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC $W(P_a/1013.3 \times 298/T_a)^{1/2}/35.3$ Y-axis
	(up)	(down)	(difference)			
1	1.6	1.6	3.2	0.8812	26	26.3074
2	2.7	2.7	5.4	1.1362	34	34.4020
3	4.0	4.0	8.0	1.3768	45	45.5321
4	5.2	5.2	10.4	1.5658	48	48.5676
5	6.3	6.3	12.6	1.7207	54	54.6385

By Linear Regression of Y on X

Slope, m = 33.7706 Intercept, b = -3.2329
 Correlation Coefficient* = 0.9933
 Calibration Accepted = Yes/No**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

Calibrated by : Henry Lau Checked by : Chan Ka Chun
 Date : 19-Dec-18 Date : 19-Dec-18



Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA2a
 Equipment no. : HVS002
 Calibration Date : 19-Oct-18
 Calibration Due Date : 19-Dec-18

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T_a	297.2	Kelvin	Pressure, P_a
			1017 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori002	Slope, m_c	2.12231	Intercept, b_c	-0.06016
Last Calibration Date	19-Jan-18	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $m_c \times Q_{std} + b_c$			
Next Calibration Date	19-Jan-19				

Calibration of TSP						
Calibration Point	Manometer Reading H (inches of water)			Q_{std} ($m^3 / min.$) X-axis	Continuous Flow Recorder, W (CFM)	IC ($(W/P_a) \times 1013.3 \times 298 / T_a)^{1/2} \times 35.31$) Y-axis
	(up)	(down)	(difference)			
1	1.6	1.6	3.2	0.8740	27	27.0883
2	2.6	2.6	5.2	1.1063	34	34.1112
3	4.0	4.0	8.0	1.3654	42	42.1373
4	5.2	5.2	10.4	1.5528	50	50.1635
5	6.5	6.5	13.0	1.7328	54	54.1766

By Linear Regression of Y on X

Slope, m = 32.4470 Intercept, b = -1.4980
 Correlation Coefficient* = 0.9975
 Calibration Accepted = Yes/No**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : As per client's provided information, the equipment reference no. of the calibrated High Volume Sampler has been re-assigned from EL449 to HVS002 with respect to the update in quality management system.

Calibrated by : Ray Lee Checked by : Pualine Wong
 Date : 19-Oct-18 Date : 19-Oct-18



Lam Environmental Services Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA2a Calibration Date : 19-Dec-18
 Equipment no. : HVS002 Calibration Due Date : 18-Feb-19

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	293	Kelvin	Pressure, P _a
			1020 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori3166	Slope, m _c	2.12231	Intercept, b _c	-0.06016
Last Calibration Date	24-Jan-18	$\left(H \times P_a / 1013.3 \times 298 / T_a \right)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	24-Jan-19				

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3x298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.5	1.5	3.0	0.8541	28	28.3311
2	2.2	2.2	4.4	1.0284	32	32.3784
3	3.7	3.7	7.4	1.3253	40	40.4730
4	4.5	4.5	9.0	1.4586	44	44.5203
5	6.0	6.0	12.0	1.6799	52	52.6149

By Linear Regression of Y on X

Slope, m = 29.0948 Intercept, b = 2.7348
 Correlation Coefficient* = 0.9963
 Calibration Accepted = Yes/No**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

Calibrated by : Henry Lau Checked by : Chan Ka Chun
 Date : 19-Dec-18 Date : 19-Dec-18



Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA3a
 Equipment no. : HVS012
 Calibration Date : 19-Oct-18
 Calibration Due Date : 19-Dec-18

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T_a	297.2	Kelvin	Pressure, P_a
			1017 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori002	Slope, m_c	2.12231	Intercept, b_c	-0.06016
Last Calibration Date	19-Jan-18	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $m_c \times Q_{std} + b_c$			
Next Calibration Date	19-Jan-19				

Calibration of TSP						
Calibration Point	Manometer Reading			Q_{std} ($m^3 / min.$) X-axis	Continuous Flow Recorder, W (CFM)	IC ($(W/P_a) \times 1013.3 \times 298 / T_a)^{1/2} / 35.31$) Y-axis
	(up)	(down)	(difference)			
1	1.4	1.4	2.8	0.8194	32	32.1046
2	2.2	2.2	4.4	1.0199	38	38.1243
3	3.4	3.4	6.8	1.2611	44	44.1439
4	4.3	4.3	8.6	1.4146	50	50.1635
5	5.4	5.4	10.8	1.5819	56	56.1831

By Linear Regression of Y on X

Slope, m = 31.1434 Intercept, b = 6.1682
 Correlation Coefficient* = 0.9966
 Calibration Accepted = Yes/No**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : As per client's provided information, the equipment reference no. of the calibrated High Volume Sampler has been re-assigned from EL333 to HVS012 with respect to the update in quality management system.

Calibrated by : Ray Lee Checked by : Pualine Wong
 Date : 19-Oct-18 Date : 19-Oct-18



Lam Environmental Services Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA3a
 Equipment no. : HVS012

Calibration Date : 19-Dec-18
 Calibration Due Date : 18-Feb-19

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	293	Kelvin	Pressure, P _a
			1020 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori3166	Slope, m _c	2.12231	Intercept, b _c	-0.06016
Last Calibration Date	24-Jan-18	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	24-Jan-19				

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3x298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.2	1.2	2.4	0.7669	20	20.2365
2	2.0	2.0	4.0	0.9819	28	28.3311
3	3.5	3.5	7.0	1.2897	37	37.4375
4	4.5	4.5	9.0	1.4586	41	41.4848
5	5.5	5.5	11.0	1.6096	50	50.5912

By Linear Regression of Y on X

Slope, m = 33.7811 Intercept, b = -5.6420
 Correlation Coefficient* = 0.9918
 Calibration Accepted = Yes/No**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

Calibrated by : Henry Lau
 Date : 19-Dec-18

Checked by : Chan Ka Chun
 Date : 19-Dec-18



Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA4a
 Equipment no. : HVS004
 Calibration Date : 19-Oct-18
 Calibration Due Date : 19-Dec-18

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T_a	297.2	Kelvin	Pressure, P_a
			1017 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori002	Slope, m_c	2.12231	Intercept, b_c	-0.06016
Last Calibration Date	19-Jan-18	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $m_c \times Q_{std} + b_c$			
Next Calibration Date	19-Jan-19				

Calibration of TSP						
Calibration Point	Manometer Reading H (inches of water)			Q_{std} ($m^3 / min.$) X-axis	Continuous Flow Recorder, W (CFM)	IC ($W(P_a/1013.3 \times 298/T_a)^{1/2} / 35.31$) Y-axis
	(up)	(down)	(difference)			
1	1.5	1.5	3.0	0.8471	22	22.0719
2	2.2	2.2	4.4	1.0199	31	31.1014
3	3.4	3.4	6.8	1.2611	41	41.1341
4	4.7	4.7	9.4	1.4777	50	50.1635
5	6.0	6.0	12.0	1.6659	56	56.1631

By Linear Regression of Y on X

Slope, m = 41.6384 Intercept, b = -12.0983
 Correlation Coefficient* = 0.9974
 Calibration Accepted = Yes/No**

* If Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : As per client's provided information, the equipment reference no. of the calibrated High Volume Sampler has been re-assigned from EL390 to HVS004 with respect to the update in quality management system.

Calibrated by : Ray Lee Checked by : Pusline Wong
 Date : 19-Oct-18 Date : 19-Oct-18



Lam Environmental Services Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA4a Calibration Date : 19-Dec-18
 Equipment no. : HVS004 Calibration Due Date : 18-Feb-19

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	293	Kelvin	Pressure, P _a
			1020 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori3166	Slope, m _c	2.12231	Intercept, b _c	-0.06016
Last Calibration Date	24-Jan-18	$\left(\frac{H \times P_a}{1013.3 \times 298 / T_a} \right)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	24-Jan-19				

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3x298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.5	1.5	3.0	0.8541	24	24.2838
2	2.0	2.0	4.0	0.9819	31	31.3666
3	3.6	3.6	7.2	1.3076	40	40.4730
4	4.2	4.2	8.4	1.4101	47	47.5558
5	5.7	5.7	11.4	1.6381	56	56.6622

By Linear Regression of Y on X

Slope, m = 39.8624 Intercept, b = -9.2955
 Correlation Coefficient* = 0.9932
 Calibration Accepted = Yes/No**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

Calibrated by : Henry Lau Checked by : Chan Ka Chun
 Date : 19-Dec-18 Date : 19-Dec-18



Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA5b
 Equipment no. : HVS010
 Calibration Date : 19-Oct-18
 Calibration Due Date : 19-Dec-18

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T_a	297.2	Kelvin	Pressure, P_a
			1017 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori002	Slope, m_c	2.12231	Intercept, b_c	-0.06016
Last Calibration Date	19-Jan-18	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $m_c \times Q_{std} + b_c$			
Next Calibration Date	19-Jan-19				

Calibration of TSP						
Calibration Point	Manometer Reading H (inches of water)			Q_{std} ($m^3 / min.$) X-axis	Continuous Flow Recorder, W (CFM)	IC ($W(P_a/1013.3 \times 298/T_a)^{1/2} / 35.31$) Y-axis
	(up)	(down)	(difference)			
1	1.3	1.3	2.6	0.7906	33	33.1079
2	2.0	2.0	4.0	0.9738	38	38.1243
3	3.2	3.2	6.4	1.2243	45	45.1472
4	4.2	4.2	8.4	1.3984	50	50.1635
5	5.3	5.3	10.6	1.5674	55	55.1799

By Linear Regression of Y on X

Slope, m = 28.3797 Intercept, b = 10.5471
 Correlation Coefficient* = 0.9999
 Calibration Accepted = Yes/No**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : As per client's provided information, the equipment reference no. of the calibrated High Volume Sampler has been re-assigned from EL222 to HVS010 with respect to the update in quality management system.

Calibrated by : Ray Lee Checked by : Pualine Wong
 Date : 19-Oct-18 Date : 19-Oct-18



Lam Environmental Services Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA5b Calibration Date : 19-Dec-18
 Equipment no. : HVS010 Calibration Due Date : 18-Feb-19

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	293	Kelvin	Pressure, P _a
			1020 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori3166	Slope, m _c	2.12231	Intercept, b _c	-0.06016
Last Calibration Date	24-Jan-18	$\left(\frac{H \times P_a}{1013.3 \times 298 / T_a} \right)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	24-Jan-19				

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$ Y-axis
	(up)	(down)	difference			
1	1.5	1.5	3.0	0.8541	25	25.2956
2	2.8	2.8	5.6	1.1566	34	34.4020
3	3.6	3.6	7.2	1.3076	38	38.4493
4	4.8	4.8	9.6	1.5055	46	46.5439
5	6.0	6.0	12.0	1.6799	54	54.6385

By Linear Regression of Y on X

Slope, m = 35.1088 Intercept, b = -5.8015
 Correlation Coefficient* = 0.9935
 Calibration Accepted = Yes/No**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

Calibrated by : Henry Lau Checked by : Chan Ka Chun
 Date : 19-Dec-18 Date : 19-Dec-18



Calibration Data for High Volume Sampler (TSP Sampler)

Location : MA1a
 Equipment no. : HVS007
 Calibration Date : 19-Oct-18
 Calibration Due Date : 19-Dec-18

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition						
Temperature, T_a	297.2	Kelvin	Pressure, P_a	1017	mmHg	
Orifice Transfer Standard Information						
Equipment No.	Orif002	Slope, m_c	2.12231	Intercept, b_c	-0.06018	
Last Calibration Date	19-Jan-18	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $m_c \times Q_{std} + b_c$				
Next Calibration Date	19-Jan-19					
Calibration of TSP						
Calibration Point	Manometer Reading			Q_{std} ($m^3 / min.$) X-axis	Continuous Flow Recorder, W (CFM)	IC ($W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31$) Y-axis
	(up)	(down)	(difference)			
1	1.5	1.5	3.0	0.8471	26	28.0850
2	2.4	2.4	4.8	1.0640	35	38.1145
3	3.9	3.9	7.8	1.3486	48	48.1570
4	4.9	4.9	9.8	1.5082	54	54.1766
5	6.2	6.2	12.4	1.6930	61	61.1995
By Linear Regression of Y on X						
Slope, m	=	41.9586	Intercept, b	=	-9.2721	
Correlation Coefficient*	=	0.9993				
Calibration Accepted	=	Yes/No**				

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : As per client's provided information, the equipment reference no. of the calibrated High Volume Sampler has been re-assigned from EL455 to HVS007 with respect to the update in quality management system.

Calibrated by : Ray Lee
 Date : 19-Oct-18
 Checked by : Pualine Wong
 Date : 19-Oct-18



Lam Environmental Services Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : MA1e
 Equipment no. : HVS007

Calibration Date : 19-Dec-18
 Calibration Due Date : 18-Feb-19

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	293	Kelvin	Pressure, P _a
			1020 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori3166	Slope, m _c	2.12231	Intercept, b _c	-0.06016
Last Calibration Date	24-Jan-18	$\left(H \times P_a / 1013.3 \times 298 / T_a \right)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	24-Jan-19				

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3x298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.8	1.8	3.6	0.9329	24	24.2838
2	2.5	2.5	5.0	1.0944	33	33.3902
3	4.0	4.0	8.0	1.3768	43	43.5085
4	5.2	5.2	10.4	1.5658	50	50.5912
5	6.5	6.5	13.0	1.7473	57	57.6740

By Linear Regression of Y on X

Slope, m = 39.8628 Intercept, b = -11.6647
 Correlation Coefficient* = 0.9973
 Calibration Accepted = Yes/No**

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

Calibrated by : Henry Lau
 Date : 19-Dec-18

Checked by : Chan Ka Chun
 Date : 19-Dec-18



Calibration Data for High Volume Sampler (TSP Sampler)

Location : MA1w
 Equipment no. : HV5008
 Calibration Date : 19-Oct-18
 Calibration Due Date : 19-Dec-18

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition						
Temperature, T_a	297.2	Kelvin	Pressure, P_a	1017	mmHg	
Orifice Transfer Standard Information						
Equipment No.	Ori002	Slope, m_s	2.12231	Intercept, b_c	-0.06016	
Last Calibration Date	19-Jan-18	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $m_c \times Q_{std} + b_c$				
Next Calibration Date	19-Jan-19					
Calibration of TSP						
Calibration Point	Manometer Reading			Q_{std} ($m^3 / min.$) X-axis	Continuous Flow Recorder, W (CFM)	IC ($(W/P_a) \times 1013.3 \times 298 / T_a)^{1/2} \times 35.31$) Y-axis
	(up)	(down)	(difference)			
1	1.5	1.5	3.0	0.8471	20	20.0654
2	2.4	2.4	4.8	1.0640	26	26.0850
3	3.8	3.8	7.6	1.3316	36	36.1177
4	4.9	4.9	9.8	1.5082	43	43.1406
5	6.3	6.3	12.6	1.7064	49	49.1602
By Linear Regression of Y on X						
Slope, m	=	34.7914	Intercept, b	=	-10.0178	
Correlation Coefficient*	=	0.9985				
Calibration Accepted	=	Yes/No**				

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : As per client's provided information, the equipment reference no. of the calibrated High Volume Sampler has been re-assigned from EL080 to HV5008 with respect to the update in quality management system.

Calibrated by : Ray Lee
 Date : 19-Oct-18
 Checked by : Pualine Wong
 Date : 19-Oct-18



Lam Environmental Services Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : MA1w Calibration Date : 19-Dec-18
 Equipment no. : HVS008 Calibration Due Date : 18-Feb-19

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition						
Temperature, T _a	293	Kelvin	Pressure, P _a	1020	mmHg	
Orifice Transfer Standard Information						
Equipment No.	Ori3166	Slope, m _c	2.12231	Intercept, b _c	-0.06016	
Last Calibration Date	24-Jan-18	$\left(H \times P_a / 1013.3 \times 298 / T_a \right)^{1/2}$ $= m_c \times Q_{std} + b_c$				
Next Calibration Date	24-Jan-19					
Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3x298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.7	1.7	3.4	0.9074	24	24.2838
2	2.6	2.6	5.2	1.1155	33	33.3902
3	4.2	4.2	8.4	1.4101	43	43.5085
4	5.3	5.3	10.6	1.5806	50	50.5912
5	6.6	6.6	13.2	1.7605	57	57.6740
By Linear Regression of Y on X						
Slope, m		=	38.5875	Intercept, b		= -10.3897
Correlation Coefficient*		=	0.9993			
Calibration Accepted		=	Yes/No**			

* if Correlation Coefficient < 0.990, check and recalibration again.

** Delete as appropriate.

Remarks : _____

Calibrated by : Henry Lau Checked by : Chan Ka Chun
 Date : 19-Dec-18 Date : 19-Dec-18



CERTIFICATE OF CALIBRATION

Certificate No.: 18CA0213 02 Page 1 of 2

Item tested

Description:	Sound Level Meter (Type 1)	Microphone	Preamp
Manufacturer:	B & K	B & K	B & K
Type/Model No.:	2250	4950	ZC0032
Serial/Equipment No.:	2701778	2755097	19223
Adaptors used:	-	-	-

Item submitted by

Customer Name: Lam Geotechnics Limited.
Address of Customer: -
Request No.: -
Date of receipt: 13-Feb-2018

Date of test: 21-Feb-2018

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2268444	08-Sep-2018	CIGISMEC
Signal generator	DS 360	33873	25-Apr-2018	CEPREI
Signal generator	DS 360	61227	01-Apr-2018	CEPREI

Ambient conditions

Temperature: 20 ± 1 °C
Relative humidity: 50 ± 10 %
Air pressure: 1000 ± 5 hPa

Test specifications

- The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of +20%.
- The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure response of the Sound Level Meter.

Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:



Feng Jun Qi

Date: 21-Feb-2018

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 18CA0213 02 Page 2 of 2

1. Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	A	Pass	0.3	
	C	Pass	0.3	
Frequency weightings	Lin	Pass	0.3	
	Single Burst Fast	Pass	0.3	
	Single Burst Slow	Pass	0.3	
Peak response	Single 100µs rectangular pulse	Pass	0.3	
	Crest factor of 3	Pass	0.3	
R.M.S. accuracy	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time weighting I	1 ms burst duty factor 1/10 ³ at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 ⁴ at 4kHz	Pass	0.3	
Time averaging	Single burst 10 ms at 4 kHz	Pass	0.4	
	Single burst 10 ms at 4 kHz	Pass	0.4	
Pulse range	SPL	Pass	0.3	
	Leq	Pass	0.4	
Sound exposure level				
Overload indication				

2. Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Expanded Uncertainty (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

3. Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

Calibrated by:

Date:

Fung Chi Yip
21-Feb-2018

Checked by:

Date:

Lam Tze Wai
21-Feb-2018

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



CERTIFICATE OF CALIBRATION

Certificate No.: 18CA0309 01 Page 1 of 2

Item tested

Description:	Sound Level Meter (Type 1)	Microphone	Preamp
Manufacturer:	B & K	B & K	B & K
Type/Model No.:	2250-L	4950	ZC0032
Serial/Equipment No.:	2722310	2698702	13318
Adaptors used:	-	-	-

Item submitted by

Customer Name: Lam Geotechnics Ltd.
Address of Customer: -
Request No.: -
Date of receipt: 09-Mar-2018

Date of test: 10-Mar-2018

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	08-Sep-2018	CIGISMEC
Signal generator	DS 360	33873	25-Apr-2018	CEPREI
Signal generator	DS 360	61227	01-Apr-2018	CEPREI

Ambient conditions

Temperature: 21 ± 1 °C
Relative humidity: 50 ± 10 %
Air pressure: 1000 ± 5 hPa

Test specifications

- The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
- The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsiveness of the Sound Level Meter.

Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:

Feng Jun Q

Date: 12-Mar-2018

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 18CA0309 01 Page 2 of 2

1. Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	A	Pass	0.3	
Frequency weightings	C	Pass	0.3	
	Lin	Pass	0.3	
	Time weightings	Single Burst Fast	Pass	0.3
Peak response	Single Burst Slow	Pass	0.3	
	Single 100µs rectangular pulse	Pass	0.3	
R.M.S. accuracy	Crest factor of 3	Pass	0.3	
	Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3
Time averaging	Repeated at frequency of 100 Hz	Pass	0.3	
	1 ms burst duty factor 1/10 ³ at 4kHz	Pass	0.3	
Pulse range	1 ms burst duty factor 1/10 ⁴ at 4kHz	Pass	0.3	
	Single burst 10 ms at 4 kHz	Pass	0.4	
Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4	
	Overload indication	SPL	Pass	0.3
	Leq	Pass	0.4	

2. Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Expanded Uncertainty (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

3. Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

Calibrated by:

Date: 10-Mar-2018

Fung Chi Yip

- End -

Checked by:

Date: 12-Mar-2018

Lam Tze Wai

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



CERTIFICATE OF CALIBRATION

Certificate No.: 18CA0413 02 Page 1 of 2

Item tested

Description:	Sound Level Meter (Type 1)	Microphone	Preamp
Manufacturer:	B & K	B & K	B & K
Type/Model No.:	2250-L	4950	ZC0032
Serial/Equipment No.:	2722311	2698703	13321
Adaptors used:	-	-	-

Item submitted by

Customer Name: Lam Geotechnics Ltd.
Address of Customer: -
Request No.: -
Date of receipt: 13-Apr-2018

Date of test: 18-Apr-2018

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	08-Sep-2018	CIGISMEC
Signal generator	DS 360	33873	25-Apr-2018	CEPREI

Ambient conditions

Temperature: 20 ± 1 °C
Relative humidity: 50 ± 10 %
Air pressure: 1000 ± 5 hPa

Test specifications


- The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
- The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsiveness of the Sound Level Meter.

Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:  Date: 18-Apr-2018 Company Chop:

Feng Junqi



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 18CA0413 02 Page 2 of 2

1. Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Frequency weightings			
Time weightings	A	Pass	0.3	
	C	Pass	0.3	
	Lin	Pass	0.3	
Peak response	Single Burst Fast	Pass	0.3	
	Single Burst Slow	Pass	0.3	
R.M.S. accuracy	Single 100µs rectangular pulse	Pass	0.3	
	Crest factor of 3	Pass	0.3	
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time averaging	1 ms burst duty factor 1/10 ³ at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 ⁴ at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
	Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

2. Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Expanded Uncertainty (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

3. Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Date:

Fung Chi Yip
18-Apr-2018

Checked by:

Date:

Lam Tze Wai
18-Apr-2018

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



CERTIFICATE OF CALIBRATION

Certificate No.: 18CA0116 01 Page 1 of 2

Item tested

Description:	Sound Level Meter (Type 1)	Microphone	Preamp
Manufacturer:	B & K	B & K	B & K
Type/Model No.:	2250L	4950	ZC0032
Serial/Equipment No.:	3002695	2940839	18582
Adaptors used:	-	-	-

Item submitted by

Customer Name: Lam Geotechnics Ltd.
Address of Customer: -
Request No.: -
Date of receipt: 16-Jan-2018

Date of test: 18-Jan-2018

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	08-Sep-2018	CIGISMEC
Signal generator	DS 360	33873	25-Apr-2018	CEPREI
Signal generator	DS 360	61227	01-Apr-2018	CEPREI

Ambient conditions

Temperature: 21 ± 1 °C
Relative humidity: 50 ± 10 %
Air pressure: 1005 ± 5 hPa

Test specifications

- The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
- The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsess of the Sound Level Meter.

Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:



Feng Jun Qi

Date: 18-Jan-2018

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 18CA0116 01 Page 2 of 2

1, Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	A	Pass	0.3	
	C	Pass	0.3	
Frequency weightings	Lin	Pass	0.3	
	Time weightings	Single Burst Fast	Pass	0.3
	Single Burst Slow	Pass	0.3	
Peak response	Single 100µs rectangular pulse	Pass	0.3	
	R.M.S. accuracy	Crest factor of 3	Pass	0.3
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time averaging	1 ms burst duty factor 1/10 ³ at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 ⁴ at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4	
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

2, Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Expanded Uncertainty (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

3, Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Fung Chi Yip

Date: 18-Jan-2018

Checked by:

Lam Tze Wai

Date: 18-Jan-2018

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



CERTIFICATE OF CALIBRATION

Certificate No.: 18CA0907 02 Page 1 of 2

Item tested

Description:	Sound Level Meter (Type 1)	Microphone	Preamp
Manufacturer:	B & K	B & K	B & K
Type/Model No.:	2250-L	4950	ZC0032
Serial/Equipment No.:	3006790	2827240	21213
Adaptors used:	-	-	-

Item submitted by

Customer Name: Lam Geotechnics Limited
 Address of Customer: -
 Request No.: -
 Date of receipt: 07-Sep-2018

Date of test: 10-Sep-2018

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2019	CIGISMEC
Signal generator	DS 360	33873	24-Apr-2019	CEPREI
Signal generator	DS 360	61227	23-Apr-2019	CEPREI

Ambient conditions

Temperature: 21 ± 1 °C
 Relative humidity: 50 ± 10 %
 Air pressure: 1005 ± 5 hPa

Test specifications

- The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
- The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure response of the Sound Level Meter.

Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:


 Feng Junq

Date: 10-Sep-2018

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 18CA0907 02 Page 2 of 2

1. Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	A	Pass	0.3	
	C	Pass	0.3	
Frequency weightings	Lin	Pass	0.3	
	Time weightings	Single Burst Fast	Pass	0.3
	Single Burst Slow	Pass	0.3	
Peak response	Single 100µs rectangular pulse	Pass	0.3	
	R.M.S. accuracy	Crest factor of 3	Pass	0.3
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
	Time averaging	1 ms burst duty factor 1/10 ³ at 4kHz	Pass	0.3
Pulse range	1 ms burst duty factor 1/10 ⁴ at 4kHz	Pass	0.3	
	Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4
Overload indication	Single burst 10 ms at 4 kHz	Pass	0.4	
	SPL	Pass	0.3	
	Leq	Pass	0.4	

2. Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Expanded Uncertainty (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

3. Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Date: 10-Sep-2018

Fung Chi Yip

Checked by:

Date: 10-Sep-2018

Shek Kwong Tat

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



CERTIFICATE OF CALIBRATION

Certificate No.: 18CA0322 01 Page 1 of 2

Item tested

Description:	Sound Level Meter (Type 1)	Microphone
Manufacturer:	Larson Davis	PCB
Type/Model No.:	LxT1	377B02
Serial/Equipment No.:	0003737	171529
Adaptors used:	-	-

Item submitted by

Customer Name: Lam Geotechnics Ltd.
Address of Customer: -
Request No.: -
Date of receipt: 22-Mar-2018

Date of test: 28-Mar-2018

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	08-Sep-2018	CIGISMEC
Signal generator	DS 360	61227	01-Apr-2018	CEPREI

Ambient conditions

Temperature: 21 ± 1 °C
Relative humidity: 50 ± 10 %
Air pressure: 1005 ± 5 hPa

Test specifications

- The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of $\pm 20\%$.
- The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsiveness of the Sound Level Meter.

Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:



Feng Jun Qi

Date: 06-Apr-2018

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 18CA0322 01 Page 2 of 2

1. Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	2.1
	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	2.2
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
Linearity range for SPL	A	Pass	0.3	
	C	Pass	0.3	
	Lin	Pass	0.3	
Time weightings	Single Burst Fast	Pass	0.3	
	Single Burst Slow	Pass	0.3	
Peak response	Single 100µs rectangular pulse	N/A	N/A	
	R.M.S. accuracy	Crest factor of 3	Pass	
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time averaging	1 ms burst duty factor 1/10 ³ at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 ⁴ at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
	Sound exposure level	Single burst 10 ms at 4 kHz	Pass	
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

2. Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Expanded Uncertainty (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

3. Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Date:

Fung Chi Yip
28-Mar-2018

Checked by:

Date:

Lam Tze Wai
06-Apr-2018

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.



CERTIFICATE OF CALIBRATION

Certificate No.: 18CA0510 04 Page 1 of 2

Item tested

Description:	Sound Level Meter (Type 1)	Microphone:	Preamp:
Manufacturer:	Larson Davis	PCB	PCB
Type/Model No.:	LxT1	377B02	PRMLxT1L
Serial/Equipment No.:	0004796	155507	042621
Adaptors used:	-	-	-

Item submitted by

Customer Name: Lam Geotechnics Ltd
Address of Customer: -
Request No.: -
Date of receipt: 10-May-2018

Date of test: 11-May-2018

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2268444	08-Sep-2018	CIGISMEC
Signal generator	DS 360	61227	23-Apr-2019	CEPREI

Ambient conditions

Temperature: 21 ± 1 °C
Relative humidity: 50 ± 10 %
Air pressure: 1005 ± 5 hPa

Test specifications

- The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.
- The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.
- The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure responsiveness of the Sound Level Meter.

Test results

This is to certify that the Sound Level Meter conforms to BS 7580: Part 1: 1997 for the conditions under which the test was performed.

Details of the performed measurements are presented on page 2 of this certificate.

Actual Measurement data are documented on worksheets.

Approved Signatory:



Feng Junqi

Date: 11-May-2018

Company Chop:



Comments: The results reported in this certificate refer to the condition of the instrument on the date of calibration and carry no implication regarding the long-term stability of the instrument.



CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 18CA0510 04

Page 2 of 2

1. Electrical Tests

The electrical tests were performed using an equivalent capacitance substituted for the microphone. The results are given in below with test status and the estimated uncertainties. The "Pass" means the result of the test is inside the tolerances stated in the test specifications. The "-" means the result of test is outside these tolerances.

Test:	Subtest:	Status:	Expanded Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	2.1
	C	Pass	0.8	
	Lin	Pass	1.6	2.2
Linearity range for Leq	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
	At reference range, Step 5 dB at 4 kHz	Pass	0.3	
Linearity range for SPL	A	Pass	0.3	
	C	Pass	0.3	
	Lin	Pass	0.3	
Time weightings	Single Burst Fast	Pass	0.3	
	Single Burst Slow	Pass	0.3	
Peak response	Single 100µs rectangular pulse	Pass	0.3	
R.M.S. accuracy	Crest factor of 3	Pass	0.3	
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time averaging	1 ms burst duty factor 1/10 ³ at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 ⁴ at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4	
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

2. Acoustic tests

The complete sound level meter was calibrated on the reference range using a B&K 4226 acoustic calibrator with 1000Hz and SPL 94 dB. The sensitivity of the sound level meter was adjusted. The test result at 125 Hz and 8000 Hz are given in below with test status and the estimated uncertainties.

Test:	Subtest	Status	Expanded Uncertainty (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
	Weighting A at 8000 Hz	Pass	0.5	

3. Response to associated sound calibrator

N/A

The expanded uncertainties have been calculated in accordance with the ISO Publication "Guide to the expression of uncertainty in measurement", and gives an interval estimated to have a level of confidence of 95%. A coverage factor of 2 is assumed unless explicitly stated.

- End -

Calibrated by:

Date: 11-May-2018

Fung Chi Yip

Checked by:

Date: 11-May-2018

Shek Kwong Tai

The standard(s) and equipment used in the calibration are traceable to national or international recognised standards and are calibrated on a schedule to maintain the required accuracy level.

Calibration Certificate

Certificate Number 2018010851

Customer:

LAM Environmental Services Ltd
11/F Centre Point
181-185 Gloucester Road
Wanchai, , Hong Kong

Model Number CAL200
Serial Number 13098
Test Results Pass

Initial Condition Inoperable

Description Larson Davis CAL200 Acoustic Calibrator

Procedure Number D0001.8386
Technician Scott Montgomery
Calibration Date 29 Oct 2018
Calibration Due
Temperature 23 °C ± 0.3 °C
Humidity 34 %RH ± 3 %RH
Static Pressure 101.2 kPa ± 1 kPa

Evaluation Method The data is acquired by the insert voltage calibration method using the reference microphone's open circuit sensitivity. Data reported in dB re 20 µPa.

Compliance Standards Compliant to Manufacturer Specifications per D0001.8190 and the following standards:
IEC 60942:2017 ANSI S1.40-2006

Issuing lab certifies that the instrument described above meets or exceeds all specifications as stated in the referenced procedure (unless otherwise noted). It has been calibrated using measurement standards traceable to the SI through the National Institute of Standards and Technology (NIST), or other national measurement institutes, and meets the requirements of ISO/IEC 17025:2005. **Test points marked with a ‡ in the uncertainties column do not fall within this laboratory's scope of accreditation.**

The quality system is registered to ISO 9001:2008.

This calibration is a direct comparison of the unit under test to the listed reference standards and did not involve any sampling plans to complete. No allowance has been made for the instability of the test device due to use, time, etc. Such allowances would be made by the customer as needed.

The uncertainties were computed in accordance with the ISO Guide to the Expression of Uncertainty in Measurement (GUM). A coverage factor of approximately 2 sigma (k=2) has been applied to the standard uncertainty to express the expanded uncertainty at approximately 95% confidence level.

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Standards Used

Description	Cal Date	Cal Due	Cal Standard
Agilent 34401A DMM	09/06/2018	09/06/2019	001021
Larson Davis Model 2900 Real Time Analyzer	04/10/2018	04/10/2019	001051
Microphone Calibration System	03/07/2018	03/07/2019	005446
1/2" Preamplifier	09/20/2018	09/20/2019	006506
Larson Davis 1/2" Preamplifier 7-pin LEMO	08/07/2018	08/07/2019	006507
1/2 inch Microphone - RI - 200V	05/10/2018	05/10/2019	006510
Pressure Transducer	07/18/2018	07/18/2019	007368

Larson Davis, a division of PCB Piezotronics, Inc
1681 West 820 North
Provo, UT 84601, United States
716-684-0001



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A PCB PIEZOTRONICS DIV.