



<b>RECALIBRATION DUE DATE:</b>
<b>February 18, 2021</b>

# Certificate of Calibration

Calibration Certification Information			
Cal. Date: February 18, 2020	Rootsmeter S/N: 438320	Ta: 294	°K
Operator: Jim Tisch		Pa: 753.1	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: 0005		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.3790	3.2	2.00
2	3	4	1	0.9840	6.4	4.00
3	5	6	1	0.8740	7.9	5.00
4	7	8	1	0.8350	8.8	5.50
5	9	10	1	0.6910	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)	$\sqrt{\Delta H (Ta/Pa)}$ (y-axis)
1.0001	0.7253	1.4173	0.9958	0.7221	0.8836
0.9959	1.0121	2.0044	0.9915	1.0076	1.2496
0.9939	1.1372	2.2410	0.9895	1.1322	1.3971
0.9927	1.1888	2.3504	0.9883	1.1836	1.4653
0.9876	1.4293	2.8347	0.9833	1.4230	1.7672
<b>QSTD</b>	m=	<b>2.00927</b>	<b>QA</b>	m=	<b>1.25817</b>
	b=	<b>-0.03767</b>		b=	<b>-0.02348</b>
	r=	<b>0.99995</b>		r=	<b>0.99995</b>

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

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



Lam Environmental Services Limited

### Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA1b  
 Equipment no. : HVS001  
 Calibration Date : 24-Jul-20  
 Calibration Due Date : 23-Sep-20

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

Ambient Condition			
Temperature, T <sub>a</sub>	304	Kelvin	Pressure, P <sub>a</sub>
			1006 mmHg

Orifice Transfer Standard Information					
Equipment No.	0005	Slope, m <sub>c</sub>	2.00927	Intercept, b <sub>c</sub>	-0.03767
Last Calibration Date	18-Feb-20	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	17-Feb-21				

Calibration of TSP						
Calibration Point	Manometer Reading			Q <sub>std</sub> (m <sup>3</sup> / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.4	1.4	2.8	0.8405	29	28.6145
2	2.0	2.0	4.0	1.0009	34	33.5480
3	2.6	2.6	5.2	1.1386	41	40.4549
4	3.2	3.2	6.4	1.2611	48	47.3619
5	3.8	3.8	7.6	1.3726	55	54.2688

By Linear Regression of Y on X

Slope, m = 48.7207      Intercept, b = -13.8500

Correlation Coefficient\* = 0.9916

Calibration Accepted = Yes/No\*\*

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

\*\* Delete as appropriate.

Remarks : \_\_\_\_\_

Calibrated by : Laurance Yung      Checked by : James Chu  
 Date : 24-Jul-20      Date : 24-Jul-20



Lam Environmental Services Limited

**Calibration Data for High Volume Sampler (TSP Sampler)**

Location : CMA1b  
 Equipment no. : HVS001

Calibration Date : 17-Sep-20  
 Calibration Due Date : 17-Nov-20

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

Ambient Condition			
Temperature, T <sub>a</sub>	302	Kelvin	Pressure, P <sub>a</sub>
			1007 mmHg

Orifice Transfer Standard Information					
Equipment No.	0005	Slope, m <sub>c</sub>	2.00927	Intercept, b <sub>c</sub>	-0.03767
Last Calibration Date	18-Feb-21	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	18-Feb-22				

Calibration of TSP						
Calibration Point	Manometer Reading			Q <sub>std</sub> (m <sup>3</sup> / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.6	1.6	3.2	0.9004	27	26.7371
2	2.4	2.4	4.8	1.0985	36	35.6495
3	3.1	3.1	6.2	1.2459	42	41.5910
4	3.8	3.8	7.6	1.3774	50	49.5131
5	4.6	4.6	9.2	1.5136	58	57.4352

By Linear Regression of Y on X

Slope, m = 49.6979      Intercept, b = -18.8029  
 Correlation Coefficient\* = 0.9964  
 Calibration Accepted = Yes/No\*\*

\* if Correlation Coefficient &lt; 0.990, check and recalibration again.

\*\* Delete as appropriate.

Remarks : \_\_\_\_\_

Calibrated by : Laurance Yung  
 Date : 17-Sep-20

Checked by : James Chu  
 Date : 17-Sep-20



Lam Environmental Services Limited

**Calibration Data for High Volume Sampler (TSP Sampler)**

Location : CMA2a  
 Equipment no. : HVS002

Calibration Date : 24-Jul-20  
 Calibration Due Date : 23-Sep-20

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

Ambient Condition			
Temperature, T <sub>a</sub>	304	Kelvin	Pressure, P <sub>a</sub>
			1006 mmHg

Orifice Transfer Standard Information					
Equipment No.	0005	Slope, m <sub>c</sub>	2.00927	Intercept, b <sub>c</sub>	-0.03767
Last Calibration Date	18-Feb-20	$\left( \frac{H \times P_a}{1013.3 \times 298 / T_a} \right)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	17-Feb-21				

Calibration of TSP						
Calibration Point	Manometer Reading			Q <sub>std</sub> (m <sup>3</sup> / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) Y-axis
	(up)	(down)	(difference)			
1	2.1	2.1	4.2	1.0252	25	24.6676
2	2.8	2.8	5.6	1.1808	31	30.5879
3	3.7	3.7	7.4	1.3546	37	36.5081
4	4.5	4.5	9.0	1.4920	43	42.4283
5	5.1	5.1	10.2	1.5871	49	48.3486

By Linear Regression of Y on X

Slope, m = 40.8241      Intercept, b = -17.7041  
 Correlation Coefficient\* = 0.9948  
 Calibration Accepted = Yes/No\*\*

\* if Correlation Coefficient &lt; 0.990, check and recalibration again.

\*\* Delete as appropriate.

Remarks : \_\_\_\_\_

Calibrated by : Laurance Yung  
 Date : 24-Jul-20

Checked by : James Chu  
 Date : 24-Jul-20



Lam Environmental Services Limited

### Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA2a  
 Equipment no. : HVS002

Calibration Date : 10-Sep-20  
 Calibration Due Date : 10-Nov-20

#### CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T <sub>a</sub>	301.5	Kelvin	Pressure, P <sub>a</sub>
			1007 mmHg

Orifice Transfer Standard Information					
Equipment No.	0005	Slope, m <sub>c</sub>	2.00927	Intercept, b <sub>c</sub>	-0.03767
Last Calibration Date	18-Feb-20	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	17-Feb-21				

Calibration of TSP						
Calibration Point	Manometer Reading			Q <sub>std</sub> (m <sup>3</sup> / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.8	1.8	3.6	0.9546	20	19.8217
2	2.8	2.8	5.6	1.1860	29	28.7414
3	4.1	4.1	8.2	1.4312	40	39.6433
4	5.4	5.4	10.8	1.6398	46	45.5898
5	6.6	6.6	13.2	1.8108	52	51.5363

By Linear Regression of Y on X

Slope, m = 37.1971      Intercept, b = -15.1764  
 Correlation Coefficient\* = 0.9975  
 Calibration Accepted = Yes/No\*\*

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

\*\* Delete as appropriate.

Remarks : \_\_\_\_\_

Calibrated by : Laurance Yung  
 Date : 10-Sep-20

Checked by : James Chu  
 Date : 10-Sep-20



Lam Environmental Services Limited

**Calibration Data for High Volume Sampler (TSP Sampler)**

Location : CMA3a  
 Equipment no. : HVS012

Calibration Date : 24-Jul-20  
 Calibration Due Date : 23-Sep-20

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

Ambient Condition			
Temperature, T <sub>a</sub>	304	Kelvin	Pressure, P <sub>a</sub>
			1006 mmHg

Orifice Transfer Standard Information					
Equipment No.	0005	Slope, m <sub>c</sub>	2.00927	Intercept, b <sub>c</sub>	-0.03767
Last Calibration Date	18-Feb-20	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	17-Feb-21				

Calibration of TSP						
Calibration Point	Manometer Reading			Q <sub>std</sub> (m <sup>3</sup> / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.8	1.8	3.6	0.9505	27	26.6411
2	2.2	2.2	4.4	1.0488	33	32.5613
3	2.7	2.7	5.4	1.1599	38	37.4948
4	3.5	3.5	7.0	1.3180	45	44.4018
5	4.1	4.1	8.2	1.4250	51	50.3220

By Linear Regression of Y on X

Slope, m = 48.4263      Intercept, b = -18.8805  
 Correlation Coefficient\* = 0.9985  
 Calibration Accepted = Yes/No\*\*

\* if Correlation Coefficient &lt; 0.990, check and recalibration again.

\*\* Delete as appropriate.

Remarks : \_\_\_\_\_  
 \_\_\_\_\_

Calibrated by : Laurance Yung  
 Date : 24-Jul-20

Checked by : James Chu  
 Date : 24-Jul-20



Lam Environmental Services Limited

**Calibration Data for High Volume Sampler (TSP Sampler)**

Location : CMA3a  
 Equipment no. : HVS012

Calibration Date : 17-Sep-20  
 Calibration Due Date : 17-Nov-20

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

Ambient Condition			
Temperature, T <sub>a</sub>	302	Kelvin	Pressure, P <sub>a</sub>
			1007 mmHg

Orifice Transfer Standard Information					
Equipment No.	0005	Slope, m <sub>c</sub>	2.00927	Intercept, b <sub>c</sub>	-0.03767
Last Calibration Date	18-Feb-20	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	17-Feb-21				

Calibration of TSP						
Calibration Point	Manometer Reading			Q <sub>std</sub> (m <sup>3</sup> / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.6	1.6	3.2	0.9004	28	27.7274
2	2.5	2.5	5.0	1.1208	34	33.6689
3	3.3	3.3	6.6	1.2849	41	40.6008
4	4.3	4.3	8.6	1.4641	48	47.5326
5	5.0	5.0	10.0	1.5773	53	52.4839

By Linear Regression of Y on X

Slope, m = 37.0517      Intercept, b = -6.6336  
 Correlation Coefficient\* = 0.9961  
 Calibration Accepted = Yes/No\*\*

\* if Correlation Coefficient &lt; 0.990, check and recalibration again.

\*\* Delete as appropriate.

Remarks : \_\_\_\_\_

Calibrated by : Laurance Yung  
 Date : 17-Sep-20

Checked by : James Chu  
 Date : 17-Sep-20



Lam Environmental Services Limited

**Calibration Data for High Volume Sampler (TSP Sampler)**

Location : CMA4a  
 Equipment no. : HVS004

Calibration Date : 24-Jul-20  
 Calibration Due Date : 23-Sep-20

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

Ambient Condition			
Temperature, T <sub>a</sub>	304	Kelvin	Pressure, P <sub>a</sub>
			1006 mmHg

Orifice Transfer Standard Information					
Equipment No.	0005	Slope, m <sub>c</sub>	2.00927	Intercept, b <sub>c</sub>	-0.03767
Last Calibration Date	18-Feb-20	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	17-Feb-21				

Calibration of TSP						
Calibration Point	Manometer Reading			Q <sub>std</sub> (m <sup>3</sup> / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) Y-axis
	(up)	(down)	(difference)			
1	2.2	2.2	4.4	1.0488	30	29.6012
2	2.7	2.7	5.4	1.1599	36	35.5214
3	3.5	3.5	7.0	1.3180	41	40.4549
4	4.2	4.2	8.4	1.4420	47	46.3752
5	5.0	5.0	10.0	1.5717	55	54.2688

By Linear Regression of Y on X

Slope, m = 45.1601      Intercept, b = -17.8292  
 Correlation Coefficient\* = 0.9937  
 Calibration Accepted = Yes/No\*\*

\* if Correlation Coefficient &lt; 0.990, check and recalibration again.

\*\* Delete as appropriate.

Remarks : \_\_\_\_\_

Calibrated by : Laurance Yung  
 Date : 24-Jul-20

Checked by : James Chu  
 Date : 24-Jul-20





Lam Environmental Services Limited

**Calibration Data for High Volume Sampler (TSP Sampler)**

Location : CMA4a  
 Equipment no. : HVS004

Calibration Date : 17-Sep-20  
 Calibration Due Date : 17-Nov-20

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

Ambient Condition			
Temperature, T <sub>a</sub>	302	Kelvin	Pressure, P <sub>a</sub>
			1007 mmHg

Orifice Transfer Standard Information					
Equipment No.	0005	Slope, m <sub>c</sub>	2.00927	Intercept, b <sub>c</sub>	-0.03767
Last Calibration Date	18-Feb-20	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	17-Feb-21				

Calibration of TSP						
Calibration Point	Manometer Reading			Q <sub>std</sub> (m <sup>3</sup> / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.7	1.7	3.4	0.9275	30	29.7079
2	2.5	2.5	5.0	1.1208	37	36.6397
3	3.4	3.4	6.8	1.3039	45	44.5618
4	4.2	4.2	8.4	1.4472	51	50.5034
5	5.1	5.1	10.2	1.5928	58	57.4352

By Linear Regression of Y on X

Slope, m = 41.7162      Intercept, b = -9.5618  
 Correlation Coefficient\* = 0.9988  
 Calibration Accepted = Yes/No\*\*

\* if Correlation Coefficient &lt; 0.990, check and recalibration again.

\*\* Delete as appropriate.

Remarks : \_\_\_\_\_

Calibrated by : Laurance Yung  
 Date : 17-Sep-20

Checked by : James Chu  
 Date : 17-Sep-20



Lam Environmental Services Limited

### Calibration Data for High Volume Sampler (TSP Sampler)

Location : MA1b Calibration Date : 13-Jul-20  
 Equipment no. : HVS014 Calibration Due Date : 12-Sep-20

**CALIBRATION OF CONTINUOUS FLOW RECORDER**

Ambient Condition			
Temperature, T <sub>a</sub>	304	Kelvin	Pressure, P <sub>a</sub>
			1008 mmHg

Orifice Transfer Standard Information					
Equipment No.	0005	Slope, m <sub>c</sub>	2.00927	Intercept, b <sub>c</sub>	-0.03767
Last Calibration Date	18-Feb-20	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	17-Feb-21				

Calibration of TSP						
Calibration Point	Manometer Reading			Q <sub>std</sub> (m <sup>3</sup> / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) Y-axis
	(up)	(down)	(difference)			
1	2.1	2.1	4.2	1.0260	22	21.7248
2	2.6	2.6	5.2	1.1395	26	25.6747
3	3.4	3.4	6.8	1.3003	32	31.5997
4	4.4	4.4	8.8	1.4767	38	37.5246
5	5.0	5.0	10.0	1.5729	45	44.4370

By Linear Regression of Y on X

Slope, m = 39.6987 Intercept, b = -19.5379

Correlation Coefficient\* = 0.9920

Calibration Accepted = Yes/No\*\*

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

\*\* Delete as appropriate.

Remarks : \_\_\_\_\_

Calibrated by : Laurance Yung Checked by : James Chu  
 Date : 13-Jul-20 Date : 13-Jul-20



Lam Environmental Services Limited

### Calibration Data for High Volume Sampler (TSP Sampler)

Location : MA1b Calibration Date : 10-Sep-20  
 Equipment no. : HVS014 Calibration Due Date : 10-Nov-20

#### CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T <sub>a</sub>	301.5	Kelvin	Pressure, P <sub>a</sub>
			1007 mmHg

Orifice Transfer Standard Information					
Equipment No.	0005	Slope, m <sub>c</sub>	2.00927	Intercept, b <sub>c</sub>	-0.03767
Last Calibration Date	18-Feb-20	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	17-Feb-21				

Calibration of TSP						
Calibration Point	Manometer Reading			Q <sub>std</sub> (m <sup>3</sup> / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) Y-axis
	(up)	(down)	(difference)			
1	1.4	1.4	2.8	0.8441	36	35.6790
2	2.2	2.2	4.4	1.0534	43	42.6166
3	3.4	3.4	6.8	1.3050	51	50.5453
4	4.4	4.4	8.8	1.4820	57	56.4918
5	5.5	5.5	11.0	1.6547	63	62.4383

By Linear Regression of Y on X

Slope, m = 32.8437 Intercept, b = 7.9136  
 Correlation Coefficient\* = 0.9999  
 Calibration Accepted = Yes/No\*\*

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

\*\* Delete as appropriate.

Remarks : \_\_\_\_\_

Calibrated by : Laurance Yung Checked by : James Chu  
 Date : 10-Sep-20 Date : 10-Sep-20



## CERTIFICATE OF CALIBRATION

Certificate No.: 20CA0612 02-02 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.:	0005062	173734	042836
Adaptors used:	-	-	-

### Item submitted by

Customer Name: Lam Environmental Services Limited  
Address of Customer: -  
Request No.: -  
Date of receipt: 12-Jun-2020

Date of test: 17-Jun-2020

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2020	CIGISMEC
Signal generator	DS 360	61227	24-Dec-2020	CEPREI

### Ambient conditions

Temperature:  $22 \pm 1$  °C  
Relative humidity:  $55 \pm 10$  %  
Air pressure:  $1005 \pm 5$  hPa

### Test specifications

- 1, 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.
- 2, 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  $\pm 20\%$ .
- 3, 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 responses of the Sound Level Meter.

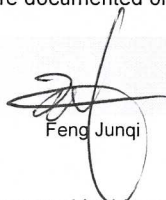
### Test results

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: 17-Jun-2020

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.: 20CA0612 02-02 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	2.1
	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	
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	
Time weighting I	Crest factor of 3	Pass	0.3	
	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 <sup>3</sup> at 4kHz	Pass	0.3	
Pulse range	1 ms burst duty factor 1/10 <sup>4</sup> 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.

This calibration certificate supersedes the last certificate 19CA0527 01.

- End -

Calibrated by:

Date:

Fung Chi Yip  
17-Jun-2020

Checked by:

Date:

Shek Kwong Fat  
17-Jun-2020

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.



Test Data for Sound Level Meter

Page 1 of 5

Sound level meter type:	LxT1	Serial No.	0005062	Date	17-Jun-2020
Microphone type:	377B02	Serial No.	173734		
Preamp type:	PRMLxT1L	Serial No.	042836	Report:	20CA0612 02-02

### SELF GENERATED NOISE TEST

The noise test is performed in the most sensitive range of the SLM with the microphone replaced by an equivalent impedance.

Noise level in A weighting	10.2	dB
Noise level in C weighting	11.5	dB
Noise level in Lin	21.9	dB

### LINEARITY TEST

The linearity is tested relative to the reference sound pressure level using a continuous sinusoidal signal of frequency 4 kHz. The measurement is made on the reference range for indications at 5 dB intervals starting from the 94 dB reference sound pressure level. And until within 5 dB of the upper and lower limits of the reference range, the measurements shall be made at 1 dB intervals. (SLM set to LEQ/SPL)

Reference/Expected level	Actual level		Tolerance	Deviation	
	non-integrated	integrated		non-integrated	integrated
dB	dB	dB	+/- dB	dB	dB
94.0	94.0	94.0	0.7	0.0	0.0
99.0	99.0	99.0	0.7	0.0	0.0
104.0	104.0	104.0	0.7	0.0	0.0
109.0	109.0	109.0	0.7	0.0	0.0
114.0	114.0	114.0	0.7	0.0	0.0
115.0	115.0	115.0	0.7	0.0	0.0
116.0	116.0	116.0	0.7	0.0	0.0
117.0	117.0	117.0	0.7	0.0	0.0
118.0	118.0	118.0	0.7	0.0	0.0
119.0	119.0	119.0	0.7	0.0	0.0
120.0	120.0	120.0	0.7	0.0	0.0
89.0	89.0	89.0	0.7	0.0	0.0
84.0	84.0	84.0	0.7	0.0	0.0
79.0	79.0	79.0	0.7	0.0	0.0
74.0	74.0	74.0	0.7	0.0	0.0
69.0	69.0	69.0	0.7	0.0	0.0
64.0	64.0	64.0	0.7	0.0	0.0
59.0	59.0	59.0	0.7	0.0	0.0
54.0	54.0	54.0	0.7	0.0	0.0
49.0	49.0	49.0	0.7	0.0	0.0
44.0	44.0	44.0	0.7	0.0	0.0
39.0	39.0	39.0	0.7	0.0	0.0
34.0	34.0	33.9	0.7	0.0	-0.1
33.0	32.9	32.9	0.7	-0.1	-0.1



Test Data for Sound Level Meter

Page 2 of 5

Sound level meter type:	LxT1	Serial No.	0005062	Date	17-Jun-2020
Microphone type:	377B02	Serial No.	173734	Report:	20CA0612 02-02
Preamp type:	PRMLxT1L	Serial No.	042836		
32.0	31.9	31.9	0.7	-0.1	-0.1
31.0	30.9	30.9	0.7	-0.1	-0.1
30.0	29.9	29.9	0.7	-0.1	-0.1

Measurements for an indication of the reference SPL on all other ranges which include it

Other ranges	Expected level	Actual level	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
20-120	94.0	94.0	0.7	0.0

Measurements on all level ranges for indications 2 dB below the upper limit and 2 dB above the lower limit

Ranges	Reference/Expected level	Actual level	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
20-120	30.0	29.9	0.7	-0.1
	118.0	118.0	0.7	0.0

## FREQUENCY WEIGHTING TEST

The frequency response of the weighting networks are tested at octave intervals over the frequency ranges 31.5 Hz to 12500 Hz. The signal level at 1000 Hz is set to give an indication of the reference SPL.

Frequency weighting A:

Frequency	Ref. level	Expected level	Actual level	Tolerance(dB)		Deviation
				+	-	
Hz	dB	dB	dB			dB
1000.0	94.0	94.0	94.0	0.0	0.0	0.0
31.6	94.0	54.6	54.6	1.5	1.5	0.0
63.1	94.0	67.8	67.8	1.5	1.5	0.0
125.9	94.0	77.9	77.9	1.0	1.0	0.0
251.2	94.0	85.4	85.4	1.0	1.0	0.0
501.2	94.0	90.8	90.7	1.0	1.0	-0.1
1995.0	94.0	95.2	95.2	1.0	1.0	0.0
3981.0	94.0	95.0	95.0	1.0	1.0	0.0
7943.0	94.0	92.9	92.9	1.5	3.0	0.0
12590.0	94.0	89.7	89.6	3.0	6.0	-0.1

Frequency weighting C:

Frequency	Ref. level	Expected level	Actual level	Tolerance(dB)		Deviation
				+	-	
Hz	dB	dB	dB			dB
1000.0	94.0	94.0	94.0	0.0	0.0	0.0
31.6	94.0	91.0	91.0	1.5	1.5	0.0
63.1	94.0	93.2	93.2	1.5	1.5	0.0
125.9	94.0	93.8	93.8	1.0	1.0	0.0
251.2	94.0	94.0	94.0	1.0	1.0	0.0
501.2	94.0	94.0	94.0	1.0	1.0	0.0



Test Data for Sound Level Meter

Page 3 of 5

Sound level meter type: LxT1 Serial No. 0005062 Date 17-Jun-2020  
Microphone type: 377B02 Serial No. 173734  
Preamp type: PRMLxT1L Serial No. 042836 Report: 20CA0612 02-02

1995.0	94.0	93.8	93.9	1.0	1.0	0.1
3981.0	94.0	93.2	93.2	1.0	1.0	0.0
7943.0	94.0	91.0	91.0	1.5	3.0	0.0
12590.0	94.0	87.8	87.7	3.0	6.0	-0.1

Frequency weighting Lin:

Frequency Hz	Ref. level dB	Expected level dB	Actual level dB	Tolerance(dB)		Deviation dB
				+	-	
1000.0	94.0	94.0	94.0	0.0	0.0	0.0
31.6	94.0	94.0	93.9	1.5	1.5	-0.1
63.1	94.0	94.0	93.9	1.5	1.5	-0.1
125.9	94.0	94.0	94.0	1.0	1.0	0.0
251.2	94.0	94.0	94.0	1.0	1.0	0.0
501.2	94.0	94.0	94.0	1.0	1.0	0.0
1995.0	94.0	94.0	94.0	1.0	1.0	0.0
3981.0	94.0	94.0	94.0	1.0	1.0	0.0
7943.0	94.0	94.0	94.0	1.5	3.0	0.0
12590.0	94.0	94.0	93.9	3.0	6.0	-0.1

#### TIME WEIGHTING FAST TEST

Time weighting F is tested on the reference range with a single sinusoidal burst of duration 200 ms at a frequency 2000 Hz and an amplitude which produces an indication 4 dB below the upper limit of the primary indicator range when the signal is continuous. (Weight A, Maximum hold)

Ref. level dB	Expected level dB	Actual level dB	Tolerance(dB)		Deviation dB
			+	-	
116.0	115.0	115.0	1.0	1.0	0.0

#### TIME WEIGHTING SLOW TEST

Time weighting S is tested on the reference range with a single sinusoidal burst of duration 500 ms at a frequency 2000 Hz and an amplitude which produces an indication 4 dB below the upper limit of the primary indicator range when the signal is continuous. (Weight A, Maximum hold)

Ref. level dB	Expected level dB	Actual level dB	Tolerance(dB)		Deviation dB
			+	-	
116.0	111.9	111.8	1.0	1.0	-0.1

#### PEAK RESPONSE TEST

The onset time of the peak detector is tested on the reference range by comparing the response to a 100 us rectangular test pulse with the response to a 10 ms reference pulse of the same amplitude. The amplitude of the 10 ms reference pulse is such as to produce an indication 1 dB below the upper limit of the primary indicator range. Positive polarities: (Weighting Z, set the generator signal to single, Lzpeak)

Ref. level dB	Response to 10 ms dB	Response to 100 us dB	Tolerance +/- dB	Deviation dB





Test Data for Sound Level Meter

Page 4 of 5

Sound level meter type: LxT1 Serial No. 0005062 Date 17-Jun-2020  
Microphone type: 377B02 Serial No. 173734  
Preamp type: PRMLxT1L Serial No. 042836 Report: 20CA0612 02-02

Negative polarities:

Ref. level	Response to 10 ms	Response to 100 us	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
119.0	119.0	119.5	2.0	0.5

RMS ACCURACY TEST

The RMS detector accuracy is tested on the reference range for a crest factor of 3.

Test frequency: 2000 Hz  
Amplitude: 2 dB below the upper limit of the primary indicator range.  
Burst repetition frequency: 40 Hz  
Tone burst signal: 11 cycles of a sine wave of frequency 2000 Hz. (Set to INT)

	Ref. Level	Expected level	Tone burst signal	Tolerance	Deviation
Time weighting	dB	dB	indication(dB)	+/- dB	dB
Slow	118.0+6.6	118.0	117.9	0.5	-0.1

TIME WEIGHTING IMPULSE TEST

Time weighting I is tested on the reference range (Set the SLM to LAImax)

Test frequency: 2000 Hz  
Amplitude: The upper limit of the primary indicator range.

Single sinusoidal burst of duration 5 ms:

Ref. Level	Single burst indication		Tolerance	Deviation
dB	Expected (dB)	Actual (dB)	+/- dB	dB
120.0	111.2	111.1	2.0	-0.1

Repeated at 100 Hz

Ref. Level	Repeated burst indication		Tolerance	Deviation
dB	Expected (dB)	Actual (dB)	+/- dB	dB
120.0	117.3	117.1	1.0	-0.2

TIME AVERAGING TEST

This test compares the SLM reading for continuous sine signals with readings obtained from a sine tone burst sequence having the same RMS level. The test level is 30 dB below the upper limit of the linearity range and repeated for Type 1 SLM with 40 dB below the upper limit of the linearity.

Frequency of tone burst: 4000 Hz

Duration of tone burst: 1 ms

Repetition Time	Level of tone burst	Expected Leq	Actual Leq	Tolerance	Deviation	Remarks
msec	dB	dB	dB	+/- dB	dB	
1000	90.0	90.0	89.9	1.0	-0.1	60s integ.
10000	80.0	80.0	79.9	1.0	-0.1	6min. integ.

PULSE RANGE AND SOUND EXPOSURE LEVEL TEST

The test tone burst signal is superimposed on a baseline signal corresponding to the lower limit of reference range

Test frequency: 4000 Hz

Integration time: 10 sec



Test Data for Sound Level Meter

Page 5 of 5

Sound level meter type: LxT1 Serial No. 0005062 Date 17-Jun-2020  
Microphone type: 377B02 Serial No. 173734  
Preamp type: PRMLxT1L Serial No. 042836 Report: 20CA0612 02-02

The integrating sound level meter set to Leq:

Duration	Rms level of	Expected	Actual	Tolerance	Deviation
msec	tone burst (dB)	dB	dB	+/- dB	dB
10	88.0	58.0	58.0	1.7	0.0

The integrating sound level meter set to SEL:

Duration	Rms level of	Expected	Actual	Tolerance	Deviation
msec	tone burst (dB)	dB	dB	+/- dB	dB
10.0	88.0	68.0	68.0	1.7	0.0

#### OVERLOAD INDICATION TEST

For SLM capable of operating in a non-integrating mode.

Test frequency: 2000 Hz  
Amplitude: 2 dB below the upper limit of the primary indicator range.  
Burst repetition frequency: 40 Hz  
Tone burst signal: 11 cycles of a sine wave of frequency 2000 Hz.

Level	Level reduced by	Further reduced	Difference	Tolerance	Deviation
at overload (dB)	1 dB	3 dB	dB	dB	dB
112.6	111.6	108.6	3.0	1.0	0.0

For integrating SLM, with the instrument indicating Leq.

For integrating SLM, with the instrument indicating Leq and set to the reference range. The test signal as follow  
The test tone burst signal is superimposed on a baseline signal corresponding to the lower limit of reference range

Test frequency: 4000 Hz  
Integration time: 10 sec  
Single burst duration: 1 msec

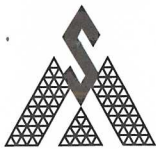
Rms level	Level reduced by	Expected level	Actual level	Tolerance	Deviation
at overload (dB)	1 dB	dB	dB	dB	dB
119.9	118.9	78.9	78.9	2.2	0.0

#### ACOUSTIC TEST

The acoustic test of the complete SLM is tested at the frequency 125 Hz and 8000 Hz using a B&K type 4226 Multifunction Acoustic Calibrator. The test is performed in A weighting.

Frequency	Expected level	Actual level		Tolerance (dB)		Deviation
		Measured (dB)		+	-	
Hz	dB					dB
1000	94.0	94.0		0.0	0.0	0.0
125	77.9	77.7		1.0	1.0	-0.2
8000	92.9	90.8		1.5	3.0	-2.1

-----END-----



## CERTIFICATE OF CALIBRATION

Certificate No.: 19CA0905 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: 05-Sep-2019

Date of test: 06-Sep-2019

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2020	CIGISMEC
Signal generator	DS 360	61227	26-Dec-2019	CEPREI

### Ambient conditions

Temperature:  $21 \pm 1$  °C  
Relative humidity:  $55 \pm 10$  %  
Air pressure:  $1000 \pm 5$  hPa

### Test specifications

- 1, 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.
- 2, 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  $\pm 20\%$ .
- 3, 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.

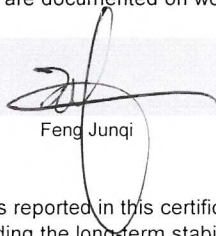
### Test results

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: 06-Sep-2019

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.: 19CA0905 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	
	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 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> 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  
06-Sep-2019

Checked by:

Date:

Shek Kwong Tat  
06-Sep-2019

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.: 20CA0225 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: 25-Feb-2020

Date of test: 26-Feb-2020

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2020	CIGISMEC
Signal generator	DS 360	33873	10-May-2020	CEPREI

### Ambient conditions

Temperature:  $21 \pm 1$  °C  
Relative humidity:  $55 \pm 10$  %  
Air pressure:  $1005 \pm 5$  hPa

### Test specifications

- 1, 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.
- 2, 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  $\pm 20\%$ .
- 3, 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.

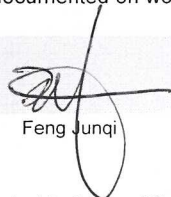
### Test results

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: 26-Feb-2020

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.: 20CA0225 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 <sup>3</sup> at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 <sup>4</sup> 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  
26-Feb-2020

Checked by:

Date:

Shek Kwong Tat  
26-Feb-2020

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.



Test Data for Sound Level Meter

Page 1 of 5

Sound level meter type:	2250	Serial No.	2701778	Date	26-Feb-2020
Microphone type:	4950	Serial No.	2755097		
Preamp type:	ZC0032	Serial No.	19223	Report:	20CA0225 02

**SELF GENERATED NOISE TEST**

The noise test is performed in the most sensitive range of the SLM with the microphone replaced by an equivalent impedance.

Noise level in A weighting	12.7	dB
Noise level in C weighting	14.2	dB
Noise level in Lin	20.3	dB

**LINEARITY TEST**

The linearity is tested relative to the reference sound pressure level using a continuous sinusoidal signal of frequency 4 kHz. The measurement is made on the reference range for indications at 5 dB intervals starting from the 94 dB reference sound pressure level. And until within 5 dB of the upper and lower limits of the reference range, the measurements shall be made at 1 dB intervals. (SLM set to LEQ/SPL)

Reference/Expected level	Actual level		Tolerance	Deviation	
	non-integrated	integrated		non-integrated	integrated
dB	dB	dB	+/- dB	dB	dB
94.0	94.0	94.0	0.7	0.0	0.0
99.0	99.0	99.0	0.7	0.0	0.0
104.0	104.0	104.0	0.7	0.0	0.0
109.0	109.0	109.0	0.7	0.0	0.0
114.0	114.0	114.0	0.7	0.0	0.0
119.0	119.0	119.0	0.7	0.0	0.0
124.0	124.0	124.0	0.7	0.0	0.0
129.0	129.0	129.0	0.7	0.0	0.0
134.0	134.0	134.0	0.7	0.0	0.0
135.0	135.0	135.0	0.7	0.0	0.0
136.0	136.0	136.0	0.7	0.0	0.0
137.0	137.0	137.0	0.7	0.0	0.0
138.0	138.0	138.0	0.7	0.0	0.0
139.0	139.0	139.0	0.7	0.0	0.0
140.0	140.0	140.0	0.7	0.0	0.0
89.0	89.0	89.0	0.7	0.0	0.0
84.0	84.0	84.0	0.7	0.0	0.0
79.0	79.0	79.0	0.7	0.0	0.0
74.0	74.0	74.0	0.7	0.0	0.0
69.0	69.0	69.0	0.7	0.0	0.0
64.0	64.0	64.0	0.7	0.0	0.0
59.0	59.0	59.0	0.7	0.0	0.0
54.0	54.0	54.0	0.7	0.0	0.0
49.0	49.0	49.0	0.7	0.0	0.0
44.0	43.9	43.9	0.7	-0.1	-0.1
39.0	39.0	39.0	0.7	0.0	0.0



Test Data for Sound Level Meter

Page 2 of 5

Sound level meter type: 2250 Serial No. 2701778 Date 26-Feb-2020  
Microphone type: 4950 Serial No. 2755097  
Preamp type: ZC0032 Serial No. 19223 Report: 20CA0225 02

34.0	33.9	33.9	0.7	-0.1	-0.1
33.0	32.9	32.9	0.7	-0.1	-0.1
32.0	32.0	32.0	0.7	0.0	0.0
31.0	31.0	31.0	0.7	0.0	0.0
30.0	30.0	30.0	0.7	0.0	0.0

Measurements for an indication of the reference SPL on all other ranges which include it

Other ranges	Expected level	Actual level	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
20-140	94.0	94.0	0.7	0.0

Measurements on all level ranges for indications 2 dB below the upper limit and 2 dB above the lower limit

Ranges	Reference/Expected level	Actual level	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
20-140	30.0	30.0	0.7	0.0
	138.0	138.0	0.7	0.0

### FREQUENCY WEIGHTING TEST

The frequency response of the weighting networks are tested at octave intervals over the frequency ranges 31.5 Hz to 12500 Hz. The signal level at 1000 Hz is set to give an indication of the reference SPL.

Frequency weighting A:

Frequency	Ref. level	Expected level	Correction of electrical response	Actual level	Tolerance(dB)		Deviation *
					+	-	
Hz	dB	dB	dB	dB	+	-	dB
1000.0	94.0	94.0	0.0	94.0	0.0	0.0	0.0
31.6	94.0	54.6	N/A	54.6	1.5	1.5	0.0
63.1	94.0	67.8	0.0	67.8	1.5	1.5	0.0
125.9	94.0	77.9	0.0	77.9	1.0	1.0	0.0
251.2	94.0	85.4	0.0	85.4	1.0	1.0	0.0
501.2	94.0	90.8	0.0	90.7	1.0	1.0	-0.1
1995.0	94.0	95.2	0.0	95.2	1.0	1.0	0.0
3981.0	94.0	95.0	-0.1	94.9	1.0	1.0	0.0
7943.0	94.0	92.9	-0.3	92.6	1.5	3.0	0.0
12590.0	94.0	89.7	-0.3	89.4	3.0	6.0	0.0

Frequency weighting C:

Frequency	Ref. level	Expected level	Correction of electrical response	Actual level	Tolerance(dB)		Deviation *
					+	-	
Hz	dB	dB	dB	dB	+	-	dB
1000.0	94.0	94.0	0.0	94.0	0.0	0.0	0.0
31.6	94.0	91.0	N/A	91.1	1.5	1.5	0.1
63.1	94.0	93.2	0.0	93.2	1.5	1.5	0.0
125.9	94.0	93.8	0.0	93.8	1.0	1.0	0.0





Test Data for Sound Level Meter

Sound level meter type: 2250 Serial No. 2701778 Date 26-Feb-2020  
Microphone type: 4950 Serial No. 2755097  
Preamp type: ZC0032 Serial No. 19223 Report: 20CA0225 02

251.2	94.0	94.0	0.0	94.0	1.0	1.0	0.0
501.2	94.0	94.0	0.0	94.0	1.0	1.0	0.0
1995.0	94.0	93.8	0.0	93.8	1.0	1.0	0.0
3981.0	94.0	93.2	-0.1	93.1	1.0	1.0	0.0
7943.0	94.0	91.0	-0.3	90.7	1.5	3.0	0.0
12590.0	94.0	87.8	-0.3	87.4	3.0	6.0	-0.1

Frequency weighting Lin:

Frequency	Ref. level	Expected level	Correction of electrical response	Actual level	Tolerance(dB)		Deviation *
					+	-	
Hz	dB	dB	dB	dB	+	-	dB
1000.0	94.0	94.0	0.0	94.0	0.0	0.0	0.0
31.6	94.0	94.0	N/A	94.1	1.5	1.5	0.1
63.1	94.0	94.0	0.0	94.0	1.5	1.5	0.0
125.9	94.0	94.0	0.0	94.0	1.0	1.0	0.0
251.2	94.0	94.0	0.0	94.0	1.0	1.0	0.0
501.2	94.0	94.0	0.0	94.0	1.0	1.0	0.0
1995.0	94.0	94.0	0.0	94.0	1.0	1.0	0.0
3981.0	94.0	94.0	-0.1	93.9	1.0	1.0	0.0
7943.0	94.0	94.0	-0.3	93.7	1.5	3.0	0.0
12590.0	94.0	94.0	-0.3	93.7	3.0	6.0	0.0

\*Deviation = Actual level - ( Expected level + Correction of electrical response)

The correction of electrical response is specified in the Table A.2 of technical documentation of BE 1712-21. The maximum expanded uncertainty of correction of electrical response is 0.29 dB.

TIME WEIGHTING FAST TEST

Time weighting F is tested on the reference range with a single sinusoidal burst of duration 200 ms at a frequency 2000 Hz and an amplitude which produces an indication 4 dB below the upper limit of the primary indicator range when the signal is continuous. (Weight A, Maximum hold)

Ref. level	Expected level	Actual level	Tolerance(dB)		Deviation
			+	-	
dB	dB	dB	+	-	dB
116.0	115.0	115.0	1.0	1.0	0.0

TIME WEIGHTING SLOW TEST

Time weighting S is tested on the reference range with a single sinusoidal burst of duration 500 ms at a frequency 2000 Hz and an amplitude which produces an indication 4 dB below the upper limit of the primary indicator range when the signal is continuous. (Weight A, Maximum hold)

Ref. level	Expected level	Actual level	Tolerance(dB)		Deviation
			+	-	
dB	dB	dB	+	-	dB
116.0	111.9	111.9	1.0	1.0	0.0

PEAK RESPONSE TEST

The onset time of the peak detector is tested on the reference range by comparing the response to a 100 us rectangular test pulse with the response to a 10 ms reference pulse of the same amplitude. The amplitude of the



## Test Data for Sound Level Meter

Page 4 of 5

Sound level meter type: 2250 Serial No. 2701778 Date 26-Feb-2020  
 Microphone type: 4950 Serial No. 2755097  
 Preamp type: ZC0032 Serial No. 19223 Report: 20CA0225 02

10 ms reference pulse is such as to produce an indication 1 dB below the upper limit of the primary indicator range.

Positive polarities: (Weighting Z, set the generator signal to single, Lzpeak)

Ref. level	Response to 10 ms	Response to 100 us	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
119.0	119.0	119.6	2.0	0.6

Negative polarities:

Ref. level	Response to 10 ms	Response to 100 us	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
119.0	119.0	119.6	2.0	0.6

**RMS ACCURACY TEST**

The RMS detector accuracy is tested on the reference range for a crest factor of 3.

Test frequency: 2000 Hz  
 Amplitude: 2 dB below the upper limit of the primary indicator range.  
 Burst repetition frequency: 40 Hz  
 Tone burst signal: 11 cycles of a sine wave of frequency 2000 Hz. (Set to INT)

Time weighting	Ref. Level	Expected level	Tone burst signal	Tolerance	Deviation
	dB	dB	indication(dB)	+/- dB	dB
Slow	118.0+6.6	118.0	118.0	0.5	0.0

**TIME WEIGHTING IMPULSE TEST**

Time weighting I is tested on the reference range (Set the SLM to LAImax)

Test frequency: 2000 Hz  
 Amplitude: The upper limit of the primary indicator range.

Single sinusoidal burst of duration 5 ms:

Ref. Level	Single burst indication	Tolerance	Deviation
dB	Expected (dB)	Actual (dB)	+/- dB
120.0	111.2	111.1	2.0

Repeated at 100 Hz

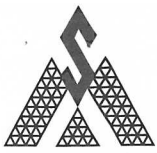
Ref. Level	Repeated burst indication	Tolerance	Deviation
dB	Expected (dB)	Actual (dB)	+/- dB
120.0	117.3	117.2	1.0

**TIME AVERAGING TEST**

This test compares the SLM reading for continuous sine signals with readings obtained from a sine tone burst sequence having the same RMS level. The test level is 30 dB below the upper limit of the linearity range and repeated for Type 1 SLM with 40 dB below the upper limit of the linearity.

Frequency of tone burst: 4000 Hz  
 Duration of tone burst: 1 ms

Repetition Time	Level of tone burst	Expected Leq	Actual Leq	Tolerance	Deviation	Remarks
msec	dB	dB	dB	+/- dB	dB	
1000	110.0	110.0	109.9	1.0	-0.1	60s integ.
10000	100.0	100.0	99.9	1.0	-0.1	6min. integ.



Test Data for Sound Level Meter

Page 5 of 5

Sound level meter type: 2250 Serial No. 2701778 Date 26-Feb-2020  
Microphone type: 4950 Serial No. 2755097  
Preamp type: ZC0032 Serial No. 19223 Report: 20CA0225 02

**PULSE RANGE AND SOUND EXPOSURE LEVEL TEST**

The test tone burst signal is superimposed on a baseline signal corresponding to the lower limit of reference range

Test frequency: 4000 Hz  
Integration time: 10 sec

The integrating sound level meter set to Leq:

Duration	Rms level of	Expected	Actual	Tolerance	Deviation
msec	tone burst (dB)	dB	dB	+/- dB	dB
10	88.0	58.0	58.0	1.7	0.0

The integrating sound level meter set to SEL:

Duration	Rms level of	Expected	Actual	Tolerance	Deviation
msec	tone burst (dB)	dB	dB	+/- dB	dB
10.0	88.0	68.0	68.0	1.7	0.0

**OVERLOAD INDICATION TEST**

For SLM capable of operating in a non-integrating mode.

Test frequency: 2000 Hz  
Amplitude: 2 dB below the upper limit of the primary indicator range.  
Burst repetition frequency: 40 Hz  
Tone burst signal: 11 cycles of a sine wave of frequency 2000 Hz.

Level	Level reduced by	Further reduced	Difference	Tolerance	Deviation
at overload (dB)	1 dB	3 dB	dB	dB	dB
135.3	134.3	131.3	3.0	1.0	0.0

For integrating SLM, with the instrument indicating Leq.

For integrating SLM, with the instrument indicating Leq and set to the reference range. The test signal as following:  
The test tone burst signal is superimposed on a baseline signal corresponding to the lower limit of reference range  
Test frequency: 4000 Hz  
Integration time: 10 sec  
Single burst duration: 1 msec

Rms level	Level reduced by	Expected level	Actual level	Tolerance	Deviation
at overload (dB)	1 dB	dB	dB	dB	dB
142.0	141.0	101.0	101.0	2.2	0.0

**ACOUSTIC TEST**

The acoustic test of the complete SLM is tested at the frequency 125 Hz and 8000 Hz using a B&K type 4226 Multifunction Acoustic Calibrator. The test is performed in A weighting.

Frequency	Expected level	Actual level		Tolerance (dB)		Deviation
		Measured (dB)		+	-	
Hz	dB	Measured (dB)		+	-	dB
1000	94.0	94.0		0.0	0.0	0.0
125	77.9	78.1		1.0	1.0	0.2
8000	92.9	92.2		1.5	3.0	-0.7

-----END-----



## CERTIFICATE OF CALIBRATION

Certificate No.: 20CA0505 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.:	2722311	2698703	13321
Adaptors used:	-	-	-

### Item submitted by

Customer Name: Lam Geotechnics Ltd.  
Address of Customer: -  
Request No.: -  
Date of receipt: 05-May-2020

Date of test: 06-May-2020

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	23-Aug-2020	CIGISMEC
Signal generator	DS 360	61227	24-Dec-2020	CEPREI

### Ambient conditions

Temperature:  $22 \pm 1$  °C  
Relative humidity:  $55 \pm 10$  %  
Air pressure:  $1005 \pm 5$  hPa

### Test specifications

- 1, 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.
- 2, 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  $\pm 20\%$ .
- 3, 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 responses 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: 06-May-2020

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.: 20CA0505 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	
Linearity range for SPL	2 dB above lower limit of each range	Pass	0.3	
	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	
Time weighting I	Crest factor of 3	Pass	0.3	
	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 <sup>3</sup> at 4kHz	Pass	0.3	
Pulse range	1 ms burst duty factor 1/10 <sup>4</sup> 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.

- End -

Calibrated by:

Date:

Fung Chi Yip

06-May-2020

Checked by:

Date:

Shek Kwong Tat

06-May-2020

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.



Test Data for Sound Level Meter

Sound level meter type:	2250-L	Serial No.	2722311	Date	06-May-2020
Microphone type:	4950	Serial No.	2698703		
Preamp type:	ZC0032	Serial No.	13321	Report:	20CA0505 01

**SELF GENERATED NOISE TEST**

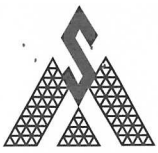
The noise test is performed in the most sensitive range of the SLM with the microphone replaced by an equivalent impedance.

Noise level in A weighting	13.2	dB
Noise level in C weighting	15.2	dB
Noise level in Lin	22.5	dB

**LINEARITY TEST**

The linearity is tested relative to the reference sound pressure level using a continuous sinusoidal signal of frequency 4 kHz. The measurement is made on the reference range for indications at 5 dB intervals starting from the 94 dB reference sound pressure level. And until within 5 dB of the upper and lower limits of the reference range, the measurements shall be made at 1 dB intervals. (SLM set to LEQ/SPL)

Reference/Expected level	Actual level		Tolerance	Deviation	
	non-integrated	integrated		non-integrated	integrated
dB	dB	dB	+/- dB	dB	dB
94.0	94.0	94.0	0.7	0.0	0.0
99.0	99.0	99.0	0.7	0.0	0.0
104.0	104.0	104.0	0.7	0.0	0.0
109.0	109.0	109.0	0.7	0.0	0.0
114.0	114.0	114.0	0.7	0.0	0.0
119.0	119.0	119.0	0.7	0.0	0.0
124.0	124.0	124.0	0.7	0.0	0.0
129.0	129.0	129.0	0.7	0.0	0.0
134.0	134.0	134.0	0.7	0.0	0.0
135.0	135.0	135.0	0.7	0.0	0.0
136.0	136.0	136.0	0.7	0.0	0.0
137.0	137.0	137.0	0.7	0.0	0.0
138.0	138.0	138.0	0.7	0.0	0.0
139.0	139.0	139.0	0.7	0.0	0.0
140.0	140.0	140.0	0.7	0.0	0.0
89.0	89.0	89.0	0.7	0.0	0.0
84.0	84.0	84.0	0.7	0.0	0.0
79.0	79.0	79.0	0.7	0.0	0.0
74.0	74.0	74.0	0.7	0.0	0.0
69.0	69.0	69.0	0.7	0.0	0.0
64.0	64.0	64.0	0.7	0.0	0.0
59.0	59.0	59.0	0.7	0.0	0.0
54.0	53.9	53.9	0.7	-0.1	-0.1
49.0	49.0	49.0	0.7	0.0	0.0
44.0	43.9	43.9	0.7	-0.1	-0.1
39.0	39.0	39.0	0.7	0.0	0.0



Test Data for Sound Level Meter

Page 2 of 5

Sound level meter type: 2250-L Serial No. 2722311 Date 06-May-2020  
Microphone type: 4950 Serial No. 2698703  
Preamp type: ZC0032 Serial No. 13321 Report: 20CA0505 01

34.0	34.0	34.0	0.7	0.0	0.0
33.0	33.0	33.0	0.7	0.0	0.0
32.0	32.0	32.0	0.7	0.0	0.0
31.0	31.0	31.0	0.7	0.0	0.0
30.0	30.0	30.0	0.7	0.0	0.0

Measurements for an indication of the reference SPL on all other ranges which include it

Other ranges	Expected level	Actual level	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
20-140	94.0	94.0	0.7	0.0

Measurements on all level ranges for indications 2 dB below the upper limit and 2 dB above the lower limit

Ranges	Reference/Expected level	Actual level	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
20-140	30.0	30.0	0.7	0.0
	138.0	138.0	0.7	0.0

### FREQUENCY WEIGHTING TEST

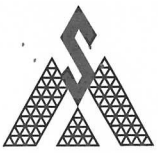
The frequency response of the weighting networks are tested at octave intervals over the frequency ranges 31.5 Hz to 12500 Hz. The signal level at 1000 Hz is set to give an indication of the reference SPL.

Frequency weighting A:

Frequency	Ref. level	Expected level	Correction of electrical response	Actual level	Tolerance(dB)		Deviation *
					+	-	
Hz	dB	dB	dB	dB	+	-	dB
1000.0	94.0	94.0	0.0	94.0	0.0	0.0	0.0
31.6	94.0	54.6	N/A	54.6	1.5	1.5	0.0
63.1	94.0	67.8	0.0	67.8	1.5	1.5	0.0
125.9	94.0	77.9	0.0	77.9	1.0	1.0	0.0
251.2	94.0	85.4	0.0	85.4	1.0	1.0	0.0
501.2	94.0	90.8	0.0	90.7	1.0	1.0	-0.1
1995.0	94.0	95.2	0.0	95.2	1.0	1.0	0.0
3981.0	94.0	95.0	-0.1	94.9	1.0	1.0	0.0
7943.0	94.0	92.9	-0.3	92.6	1.5	3.0	0.0
12590.0	94.0	89.7	-0.3	89.3	3.0	6.0	-0.1

Frequency weighting C:

Frequency	Ref. level	Expected level	Correction of electrical response	Actual level	Tolerance(dB)		Deviation *
					+	-	
Hz	dB	dB	dB	dB	+	-	dB
1000.0	94.0	94.0	0.0	94.0	0.0	0.0	0.0
31.6	94.0	91.0	N/A	91.0	1.5	1.5	0.0
63.1	94.0	93.2	0.0	93.2	1.5	1.5	0.0
125.9	94.0	93.8	0.0	93.8	1.0	1.0	0.0



Test Data for Sound Level Meter

Page 3 of 5

Sound level meter type: 2250-L Serial No. 2722311 Date 06-May-2020  
Microphone type: 4950 Serial No. 2698703  
Preamp type: ZC0032 Serial No. 13321 Report: 20CA0505 01

251.2	94.0	94.0	0.0	94.0	1.0	1.0	0.0
501.2	94.0	94.0	0.0	94.0	1.0	1.0	0.0
1995.0	94.0	93.8	0.0	93.8	1.0	1.0	0.0
3981.0	94.0	93.2	-0.1	93.1	1.0	1.0	0.0
7943.0	94.0	91.0	-0.3	90.7	1.5	3.0	0.0
12590.0	94.0	87.8	-0.3	87.4	3.0	6.0	-0.1

Frequency weighting Lin:

Frequency	Ref. level	Expected level	Correction of electrical response	Actual level	Tolerance(dB)		Deviation *
					+	-	
Hz	dB	dB	dB	dB	+	-	dB
1000.0	94.0	94.0	0.0	94.0	0.0	0.0	0.0
31.6	94.0	94.0	N/A	94.1	1.5	1.5	0.1
63.1	94.0	94.0	0.0	94.0	1.5	1.5	0.0
125.9	94.0	94.0	0.0	94.0	1.0	1.0	0.0
251.2	94.0	94.0	0.0	94.0	1.0	1.0	0.0
501.2	94.0	94.0	0.0	94.0	1.0	1.0	0.0
1995.0	94.0	94.0	0.0	94.0	1.0	1.0	0.0
3981.0	94.0	94.0	-0.1	93.9	1.0	1.0	0.0
7943.0	94.0	94.0	-0.3	93.7	1.5	3.0	0.0
12590.0	94.0	94.0	-0.3	93.7	3.0	6.0	0.0

\*Deviation = Actual level - ( Expected level + Correction of electrical response)

The correction of electrical response is specified in the Table A.2 of technical documentation of BE 1853-11. The maximum expanded uncertainty of correction of electrical response is 0.3 dB.

TIME WEIGHTING FAST TEST

Time weighting F is tested on the reference range with a single sinusoidal burst of duration 200 ms at a frequency 2000 Hz and an amplitude which produces an indication 4 dB below the upper limit of the primary indicator range when the signal is continuous. (Weight A, Maximum hold)

Ref. level	Expected level	Actual level	Tolerance(dB)		Deviation
			+	-	
dB	dB	dB	+	-	dB
116.0	115.0	114.9	1.0	1.0	-0.1

TIME WEIGHTING SLOW TEST

Time weighting S is tested on the reference range with a single sinusoidal burst of duration 500 ms at a frequency 2000 Hz and an amplitude which produces an indication 4 dB below the upper limit of the primary indicator range when the signal is continuous. (Weight A, Maximum hold)

Ref. level	Expected level	Actual level	Tolerance(dB)		Deviation
			+	-	
dB	dB	dB	+	-	dB
116.0	111.9	111.9	1.0	1.0	0.0

PEAK RESPONSE TEST

The onset time of the peak detector is tested on the reference range by comparing the response to a 100 us rectangular test pulse with the response to a 10 ms reference pulse of the same amplitude. The amplitude of the





Test Data for Sound Level Meter

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Sound level meter type: 2250-L Serial No. 2722311 Date 06-May-2020  
Microphone type: 4950 Serial No. 2698703  
Preamp type: ZC0032 Serial No. 13321 Report: 20CA0505 01

10 ms reference pulse is such as to produce an indication 1 dB below the upper limit of the primary indicator range.

Positive polarities: (Weighting L, set the generator signal to single, Lzpeak)

Ref. level	Response to 10 ms	Response to 100 us	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
119.0	119.0	119.5	2.0	0.5

Negative polarities:

Ref. level	Response to 10 ms	Response to 100 us	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
119.0	119.0	119.5	2.0	0.5

RMS ACCURACY TEST

The RMS detector accuracy is tested on the reference range for a crest factor of 3.

Test frequency: 2000 Hz  
Amplitude: 2 dB below the upper limit of the primary indicator range.  
Burst repetition frequency: 40 Hz  
Tone burst signal: 11 cycles of a sine wave of frequency 2000 Hz. (Set to INT)

Time weighting	Ref. Level	Expected level	Tone burst signal	Tolerance	Deviation
	dB	dB	indication(dB)	+/- dB	dB
Slow	118.0+6.6	118.0	117.9	0.5	-0.1

TIME WEIGHTING IMPULSE TEST

Time weighting I is tested on the reference range (Set the SLM to LAImax)

Test frequency: 2000 Hz  
Amplitude: The upper limit of the primary indicator range.

Single sinusoidal burst of duration 5 ms:

Ref. Level	Single burst indication		Tolerance	Deviation
dB	Expected (dB)	Actual (dB)	+/- dB	dB
120.0	111.2	111.1	2.0	-0.1

Repeated at 100 Hz

Ref. Level	Repeated burst indication		Tolerance	Deviation
dB	Expected (dB)	Actual (dB)	+/- dB	dB
120.0	117.3	117.2	1.0	-0.1

TIME AVERAGING TEST

This test compares the SLM reading for continuous sine signals with readings obtained from a sine tone burst sequence having the same RMS level. The test level is 30 dB below the upper limit of the linearity range and repeated for Type 1 SLM with 40 dB below the upper limit of the linearity.

Frequency of tone burst: 4000 Hz

Duration of tone burst: 1 ms

Repetition Time	Level of tone burst	Expected Leq	Actual Leq	Tolerance	Deviation	Remarks
msec	dB	dB	dB	+/- dB	dB	
1000	110.0	110.0	109.9	1.0	-0.1	60s integ.
10000	100.0	100.0	99.9	1.0	-0.1	6min. integ.



Test Data for Sound Level Meter

Sound level meter type: 2250-L Serial No. 2722311 Date 06-May-2020  
Microphone type: 4950 Serial No. 2698703  
Preamp type: ZC0032 Serial No. 13321 Report: 20CA0505 01

**PULSE RANGE AND SOUND EXPOSURE LEVEL TEST**

The test tone burst signal is superimposed on a baseline signal corresponding to the lower limit of reference range

Test frequency: 4000 Hz  
Integration time: 10 sec

The integrating sound level meter set to Leq:

Duration	Rms level of	Expected	Actual	Tolerance	Deviation
msec	tone burst (dB)	dB	dB	+/- dB	dB
10	88.0	58.0	57.9	1.7	-0.1

The integrating sound level meter set to SEL:

Duration	Rms level of	Expected	Actual	Tolerance	Deviation
msec	tone burst (dB)	dB	dB	+/- dB	dB
10.0	88.0	68.0	67.9	1.7	-0.1

**OVERLOAD INDICATION TEST**

For SLM capable of operating in a non-integrating mode.

Test frequency: 2000 Hz  
Amplitude: 2 dB below the upper limit of the primary indicator range.  
Burst repetition frequency: 40 Hz  
Tone burst signal: 11 cycles of a sine wave of frequency 2000 Hz.

Level	Level reduced by	Further reduced	Difference	Tolerance	Deviation
at overload (dB)	1 dB	3 dB	dB	dB	dB
135.7	134.7	131.7	3.0	1.0	0.0

For integrating SLM, with the instrument indicating Leq.

For integrating SLM, with the instrument indicating Leq and set to the reference range. The test signal as following:  
The test tone burst signal is superimposed on a baseline signal corresponding to the lower limit of reference range  
Test frequency: 4000 Hz  
Integration time: 10 sec  
Single burst duration: 1 msec

Rms level	Level reduced by	Expected level	Actual level	Tolerance	Deviation
at overload (dB)	1 dB	dB	dB	dB	dB
142.3	141.3	101.3	101.2	2.2	-0.1

**ACOUSTIC TEST**

The acoustic test of the complete SLM is tested at the frequency 125 Hz and 8000 Hz using a B&K type 4226 Multifunction Acoustic Calibrator. The test is performed in A weighting.

Frequency	Expected level	Actual level		Tolerance (dB)		Deviation
		Measured (dB)		+	-	
Hz	dB					dB
1000	94.0	94.0		0.0	0.0	0.0
125	77.9	78.0		1.0	1.0	0.1
8000	92.9	93.6		1.5	3.0	0.7

-----END-----



## CERTIFICATE OF CALIBRATION

Certificate No.: 20CA0107 02

Page: 1 of 2

### Item tested

Description: Acoustical Calibrator (Class 1)  
Manufacturer: Larson Davis  
Type/Model No.: CAL200  
Serial/Equipment No.: 13128  
Adaptors used: -

### Item submitted by

Customer: Lam Environmental Service Ltd.  
Address of Customer: -  
Request No.: -  
Date of receipt: 07-Jan-2020

Date of test: 08-Jan-2020

### Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2341427	03-May-2020	SCL
Preamplifier	B&K 2673	2239857	17-May-2020	CEPREI
Measuring amplifier	B&K 2610	2346941	05-Jun-2020	CEPREI
Signal generator	DS 360	33873	10-May-2020	CEPREI
Digital multi-meter	34401A	US36087050	08-May-2020	CEPREI
Audio analyzer	8903B	GB41300350	13-May-2020	CEPREI
Universal counter	53132A	MY40003662	10-May-2020	CEPREI

### Ambient conditions

Temperature:  $21 \pm 1$  °C  
Relative humidity:  $55 \pm 10$  %  
Air pressure:  $1000 \pm 5$  hPa

### Test specifications

- 1, The Sound Calibrator has been calibrated in accordance with the requirements as specified in IEC 60942 1997 Annex B and the lab calibration procedure SMTP004-CA-156.
- 2, The calibrator was tested with its axis vertical facing downwards at the specific frequency using insert voltage technique.
- 3, The results are rounded to the nearest 0.01 dB and 0.1 Hz and have not been corrected for variations from a reference pressure of 1013.25 hectoPascals as the maker's information indicates that the instrument is insensitive to pressure changes.

### Test results

This is to certify that the sound calibrator conforms to the requirements of annex B of IEC 60942: 1997 for the conditions under which the test was performed. This does not imply that the sound calibrator meets IEC 60942 under any other conditions.

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

Approved Signatory:

Feng Junqi

Date: 08-Jan-2020

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.: 20CA0107 02

Page: 2 of 2

### 1, Measured Sound Pressure Level

The output Sound Pressure Level in the calibrator head was measured at the setting and frequency shown using a calibrated laboratory standard microphone and insert voltage technique. The results are given in below with the estimated uncertainties.

(Output level in dB re 20 µPa)

Frequency Shown Hz	Output Sound Pressure Level Setting dB	Measured Output Sound Pressure Level dB	Estimated Expanded Uncertainty dB
1000	94.00	93.76	0.10

### 2, Sound Pressure Level Stability - Short Term Fluctuations

The Short Term Fluctuations was determined by measuring the maximum and minimum of the fast weighted DC output of the B&K 2610 measuring amplifier over a 20 second time interval as required in the standard. The Short Term Fluctuation was found to be:

At 1000 Hz **STF = 0.009 dB**  
Estimated expanded uncertainty 0.005 dB

### 3, Actual Output Frequency

The determination of actual output frequency was made using a B&K 4180 microphone together with a B&K 2673 preamplifier connected to a B&K 2610 measuring amplifier. The AC output of the B&K 2610 was taken to an universal counter which was used to determine the frequency averaged over 20 second of operation as required by the standard. The actual output frequency at 1 KHz was:

At 1000 Hz **Actual Frequency = 999.5 Hz**  
Estimated expanded uncertainty 0.1 Hz Coverage factor k = 2.2

### 4, Total Noise and Distortion


For the Total Noise and Distortion measurement, the unfiltered AC output of the B&K 2610 measuring amplifier was connected to an Agilent Type 8903 B distortion analyser. The TND result at 1 KHz was:

At 1000 Hz **TND = 0.4 %**  
Estimated expanded uncertainty 0.7 %

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: 08-Jan-2020

Checked by:   
Date: 08-Jan-2020

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.