

# RECALIBRATION **DUE DATE:**

February 18, 2021

# ertificate o

**Calibration Certification Information** 

Cal. Date: February 18, 2020 Rootsmeter S/N: 438320

Ta: 294

Operator: Jim Tisch

Pa: 753.1

mm Hg

Calibration Model #:

TE-5025A

Calibrator S/N: 0005

F	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	Qstd	$\sqrt{\Delta H \left(\frac{Pa}{Pstd}\right) \left(\frac{Tstd}{Ta}\right)}$		Qa	√∆H(Ta/Pa)						
(m3)	(x-axis)	(y-axis)	Va	(x-axis)	(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						
	m=	2.00927		m=	1.25817						
QSTD	b=	-0.03767	QA	b=	-0.02348						
	r=	0.99995		r=	0.99995						

	Calculations							
Vstd=	ΔVoI((Pa-ΔP)/Pstd)(Tstd/Ta)	Va=	ΔVol((Pa-ΔP)/Pa)					
Qstd=	Vstd/∆Time	Qa=	Va/ΔTime					
	For subsequent flow rate calculations:							
Qstd=	$1/m\left(\left(\sqrt{\Delta H\left(\frac{Pa}{Pstd}\right)\left(\frac{Tstd}{Ta}\right)}\right)-b\right)$	Qa=	$1/m\left(\left(\sqrt{\Delta H(Ta/Pa)}\right)-b\right)$					

	Standard Conditions	
Tstd:	298.15 °K	
Pstd:	760 mm Hg	
	Key	
ΔH: calibrato	r manometer reading (in H2O)	
ΔP: rootsmet	er manometer reading (mm Hg)	
	solute temperature (°K)	
Pa: actual bar	rometric pressure (mm Hg)	
b: intercept		
m· slone		

## RECALIBRATION

US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30

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# Lam Environmental Services Limited

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

				•		•	•	
Location :		CMA1b			Calbratio	on Date	:	17-Sep-20
Equipment no.	ŀ	HVS001			Calbratio	on Due Date	:	17-Nov-20
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER					
				Ambient Condition				
Temperature, T <sub>a</sub>		302	2	Kelvin Pressure, P	a	1	007	mmHg
			Orifice Tr	ansfer Standard Infor	mation			
Equipment No.		0005		<b>Slope</b> , m <sub>c</sub> 2.009		Intercept, bc	$\top$	-0.03767
Last Calibration Date		18-Feb-2				3.3 x 298 /	$T_{-}$ ) $^{1/2}$	
Next Calibration Date		17-Feb-2		=		$Q_{std} + b_c$	· a/	
				Oalthartian of TOD		3.0		
Calibration	Man	D		Calibration of TSP	Comtinu	.aa Flam		IC
Point	Calibration Manometer Reading Q std  Point H (inches of water) (m³ / min					ious Flow	0M/D /40	
Point	,		•	(m <sup>3</sup> / min.) <b>X-axis</b>		rder, W	(W(P <sub>a</sub> /10°	13.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31) <b>Y-axis</b>
	(up)	(down)	(difference)			CFM)		
1	1.6	2.4	3.2	0.9004		27		26.7371
2	2.4		4.8	1.0985		36		35.6495
4	3.1	3.1	6.2	1.2459		42		41.5910
	3.8	3.8 4.6	7.6	1.3774		50		49.5131
5  By Linear Regression of	4.6	4.0	9.2	1.5136		58		57.4352
by Linear Regression of	Slope, m	_	49.69	070 Int	ercept, b =	10	9020	
Correlation Co	·	=	0.99		егсері, в =	-10	3.8029	
Calibration		=	Yes/P					
Calibration	Accepted	_	103/F					
* if Correlation Coefficier	nt < 0.990,	check and	I recalibration	again.				
** Delete as appropriate.								
5								
Remarks :								
	1 =	rones V	~		Charler	l have		James Chi
Calibrated by		rance Yun	<del></del>		Checked	i by	·	James Chu
Date	1.	7-Sep-20			Date		•	17-Sep-20



# Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

				•		•	•	
Location :		CMA1b			Calbratio	n Date	:	13-Nov-20
Equipment no.	ŀ	HVS001			Calbratio	n Due Date	:	14-Jan-21
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER					
				Ambient Condition				
Temperature, T <sub>a</sub>		296	3	Kelvin Pressure, P	a	1	017	mmHg
			Orifice Tr	ransfer Standard Infor	mation			
Equipment No.		0005		Slope, m <sub>c</sub> 2.009		Intercept, bc		-0.03767
Last Calibration Date		18-Feb-2				3.3 x 298 /	T ) 1/2	
Next Calibration Date		17-Feb-2		(11)		$Q_{std} + b_c$	'a/	
						- stu · - c		
				Calibration of TSP				
	Calibration Manometer Reading			Q <sub>std</sub>				IC
Point	,	inches of	•	(m <sup>3</sup> / min.)		der, W	(W(P <sub>a</sub> /10	13.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)
	(up)	(down)	(difference)		·	FM)		Y-axis
1	1.6	1.6	3.2	0.9137		24		24.1249
2	2.3	2.3	4.6	1.0917		32		32.1665
3	3.1	3.1	6.2	1.2644		10		40.2081
4	3.8	3.8	7.6	1.3979		18		48.2497
5	4.5	4.5	9.0	1.5196	5	55		55.2862
By Linear Regression of								
	Slope, m	=	51.36		ercept, b =	-23	5.5533	
Correlation Co		=	0.99					
Calibration	Accepted	=	Yes/4					
* if Correlation Coefficier	nt < 0.990,	check and	I recalibration	again.				
** Delete as appropriate.								
Doioto do appropriate.								
Remarks :								
Calibrated by	Lau	rance Yun	g		Checked	by	:	James Chu
Date :	1;	3-Nov-20			Date		:	13-Nov-20



Location	:	CMA2a	Calbration Date	:	10-Sep-20
Equipment no.	:	HVS002	Calbration 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, bc	-0.03767				
Last Calibration Date	18-Feb-20	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$							
Next Calibration Date	17-Feb-21	= <i>m</i> <sub>c</sub>	$x Q_{std} + b_c$						

	Calibration of TSP										
Calibration	Calibration Manometer Reading			Q <sub>std</sub>	Continuous Flow	IC					
Point	H (inches of water)		(m <sup>3</sup> / min.)	Recorder, W	(W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)						
	(up)	(down)	(difference)	X-axis	(CFM)	Y-axis					
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	<b>3</b> 4.1 4.1 8.2		8.2	1.4312	40	39.6433					
4	<b>4</b> 5.4 5.4 10.8		10.8	1.6398	46	45.5898					
5	<b>5</b> 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/Ne\*\*

Remarks :

 Calibrated by Date
 : Laurance Yung
 Checked by
 : James Chu

 Date
 : 10-Sep-20

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

<sup>\*\*</sup> Delete as appropriate.



# Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

				•		•	•	
Location :		CMA2a			Calbratio	n Date	:	13-Nov-20
Equipment no.	ŀ	HVS002			Calbratio	n Due Date	:	14-Jan-21
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER					
				Ambient Condition				
Temperature, T <sub>a</sub>		296	3	Kelvin Pressure, P	a	1	017	mmHg
			Orifice Tr	ansfer Standard Infor	mation			
Equipment No.		0005		Slope, m <sub>c</sub> 2.009		Intercept, bc		-0.03767
Last Calibration Date		18-Feb-2				3.3 x 298 /	T ) 1/2	
Next Calibration Date		17-Feb-2		(11)		$Q_{std} + b_c$	'a/	
						- siu · - c		
				Calibration of TSP				
	Calibration Manometer Reading			Q <sub>std</sub>		ous Flow		IC
Point	,	inches of	•	(m <sup>3</sup> / min.)		der, W	(W(P <sub>a</sub> /10 <sup>2</sup>	13.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)
	(up)	(down)	(difference)		· ·	FM)		Y-axis
1	1.8	1.8	3.6	0.9680		22		22.1145
2	2.5	2.5	5.0	1.1374		29		29.1509
3	3.2	3.2	6.4	1.2844		37		37.1925
4	4.1	4.1	8.2	1.4513		13		43.2237
5	4.9	4.9	9.8	1.5849	4	19		49.2549
By Linear Regression of								
	Slope, m	=	44.13		ercept, b =	-20	).5406	
Correlation Co		=	0.99					
Calibration	Accepted	=	Yes/4	<del>\0**</del>				
* if Correlation Coefficien	nt < 0.990,	check and	I recalibration	again.				
** Delete as appropriate.								
Delete as appropriate.								
Remarks :								
Calibrated by	Lau	rance Yun	g 		Checked	by	:	James Chu
Date :	1;	3-Nov-20			Date		:	13-Nov-20

Location	:	CMA3a	Calbration Date	:	17-Sep-20
Equipment no.	:	HVS012	Calbration 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, bc -0.03767								
Last Calibration Date	18-Feb-20		(H x P <sub>a</sub> / 1	013.3 x 298 / T	a) <sup>1/2</sup>			
Next Calibration Date	17-Feb-21		= <i>m</i> <sub>c</sub>	$x Q_{std} + b_c$				

	Calibration of TSP								
Calibration	Mar	nometer R	eading	Q <sub>std</sub>	Continuous Flow	IC			
Point	H (inches of water)		(m <sup>3</sup> / min.)	Recorder, W	(W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)				
	(up)	(down)	(difference)	X-axis	(CFM)	Y-axis			
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/Ne\*\*

Remarks :

 Calibrated by Date
 :
 Laurance Yung
 Checked by
 :
 James Chu

 Date
 :
 17-Sep-20

 $<sup>^{\</sup>star}$  if Correlation Coefficient < 0.990, check and recalibration again.

<sup>\*\*</sup> Delete as appropriate.



# Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

				•		•	•	
Location :		CMA3a			Calbratio	n Date	:	13-Nov-20
Equipment no.	ŀ	HVS012			Calbratio	n Due Date	:	14-Jan-21
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER					
				Ambient Condition				
Temperature, T <sub>a</sub>		296	3	Kelvin Pressure, P	a	1	017	mmHg
			Orifice Tr	ransfer Standard Infor	mation			
Equipment No.		0005		<b>Slope</b> , m <sub>c</sub> 2.009		Intercept, bc		-0.03767
Last Calibration Date		18-Feb-2				3.3 x 298 /	T ) 1/2	
Next Calibration Date		17-Feb-2		=		$Q_{std} + b_c$	'a/	
						- sia · - c		
				Calibration of TSP				
Calibration		nometer R		Q <sub>std</sub>		ous Flow		IC
Point		inches of	·	(m <sup>3</sup> / min.)		rder, W	(W(P <sub>a</sub> /101	3.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)
	(up)	(down)	(difference)			FM)	_	Y-axis
1	2.1	2.1	4.2	1.0440		24	_	24.1249
2	2.8	2.8	5.6	1.2026		31	<u> </u>	31.1613
3	3.5	3.5	7.0	1.3424		37	<del>                                     </del>	37.1925
4	4.0	4.0	8.0	1.4338		14		44.2289
5	4.8	4.8	9.6	1.5688		51		51.2653
By Linear Regression of								
	Slope, m	=	52.18		ercept, b =	-31	1.1597	
Correlation Co		=	0.99					
Calibration	Accepted	=	Yes/4	<del></del>				
* if Correlation Coefficier	nt < 0.990,	check and	I recalibration	again.				
** Delete as appropriate.								
Doioto do appropriate.								
Remarks :								
Calibrated by	Lau	rance Yun	g		Checked	by	:	James Chu
Date :	1;	3-Nov-20			Date		:	13-Nov-20

Location	:	CMA4a	Calbration Date	:	17-Sep-20
Equipment no.	: _	HVS004	Calbration 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, bc         -0.03767								
Last Calibration Date	18-Feb-20		(HxP <sub>a</sub> /1	013.3 x 298 / T	a) <sup>1/2</sup>			
Next Calibration Date	Next Calibration Date 17-Feb-21 = $m_c \times Q_{std} + b_c$							

	Calibration of TSP								
Calibration	Manometer Reading		Q <sub>std</sub>	Continuous Flow	IC				
Point	H (inches of water)		(m <sup>3</sup> / min.)	Recorder, W	(W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)				
	(up)	(down)	(difference)	X-axis	(CFM)	Y-axis			
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/Ne\*\*

Date

Remarks :

 Calibrated by
 :
 Laurance Yung
 Checked by
 :
 James Chu

 Bate
 :
 17-Sep-20
 Date
 :
 17-Sep-20

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

<sup>\*\*</sup> Delete as appropriate.

Location	:	CMA4a	Calbration Date	:	13-Nov-20
Equipment no.	:	HVS004	Calbration Due Date	:	14-Jan-21

#### CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition						
Temperature, T <sub>a</sub>	293	Kelvin	Pressure, P <sub>a</sub>	1019	mmHg	

Orifice Transfer Standard Information								
Equipment No.         0005         Slope, m <sub>c</sub> 2.00927         Intercept, bc         -0.03767								
Last Calibration Date	18-Feb-20		(H x P <sub>a</sub> / 1	013.3 x 298 / T	a) <sup>1/2</sup>			
Next Calibration Date	Next Calibration Date 17-Feb-21 = $m_c \times Q_{std} + b_c$							

	Calibration of TSP								
Calibration	Manometer Reading		Q <sub>std</sub>	Continuous Flow	IC				
Point	H (inches of water)		(m <sup>3</sup> / min.)	Recorder, W	(W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)				
	(up)	(down)	(difference)	X-axis	(CFM)	Y-axis			
1	2.5	2.5	5.0	1.1442	27	27.3059			
2	2.9	2.9	5.8	1.2309	33	33.3739			
3	3.5	3.5	7.0	1.3504	38	38.4305			
4	4.2	4.2	8.4	1.4775	43	43.4871			
5	4.9	4.9	9.8	1.5944	49	49.5551			

By Linear Regression of Y on X

Slope, m = 47.3609 Intercept, b = -25.9573

Correlation Coefficient\* = 0.9960

Calibration Accepted = Yes/No\*\*

Remarks :

 Calibrated by Date
 :
 Laurance Yung
 Checked by
 :
 James Chu

 Date
 :
 13-Nov-20

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

<sup>\*\*</sup> Delete as appropriate.



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

#### CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition						
Temperature, T <sub>a</sub>	301.5	Kelvin <b>Pres</b>	ssure, P <sub>a</sub>	1007	mmHg	

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

	Calibration of TSP									
Calibration	Mar	nometer R	eading	Q <sub>std</sub>	Continuous Flow	IC				
Point	Н (	inches of	water)	(m <sup>3</sup> / min.)	Recorder, W	(W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)				
	(up)	(down)	(difference)	X-axis	(CFM)	Y-axis				
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				
Pullinear Degression of	V									

By Linear Regression of Y on X

Slope, m = 32.8437 Intercept, b = 7.9136

Correlation Coefficient\* = 0.9999

Calibration Accepted = Yes/Ne\*\*

Remarks :

 Calibrated by Date
 :
 Laurance Yung
 Checked by
 :
 James Chu

 Date
 :
 10-Sep-20

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

<sup>\*\*</sup> Delete as appropriate.



# Lam Environmental Services Limited

# Calibration Data for High Volume Sampler (TSP Sampler)

				•		•	•	
Location :		MA1b			Calbration	n Date	:	13-Nov-20
Equipment no.	ŀ	HVS014			Calbration	n Due Date	:	14-Jan-21
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER					
				Ambient Condition				
Temperature, T <sub>a</sub>		296	<u> </u>	Kelvin Pressure, P	a	1	017	mmHg
			Orifice Tr	ransfer Standard Infor	mation			
Equipment No.		0005		<b>Slope</b> , <b>m</b> <sub>c</sub> 2.009		ntercept, bc	T	-0.03767
Last Calibration Date		18-Feb-2	20	(Hx	P <sub>a</sub> / 1013	3.3 x 298 /	$T_{2}$ ) 1/2	
Next Calibration Date		17-Feb-2	<u>?</u> 1	, =		$Q_{std} + b_c$	u,	
				Calibration of TSP				
Calibration	Man	nometer R	eading	Q <sub>std</sub>	Continuo	ous Flow		IC
Point		inches of		(m <sup>3</sup> / min.)	Recor		(W(P <sub>2</sub> /1013	.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)
	(up)	(down)	(difference)			FM)		Y-axis
1	2.6	2.6	5.2	1.1596	2	1	2	21.1093
2	3.2	3.2	6.4	1.2844	2	9	2	29.1509
3	3.6	3.6	7.2	1.3611	3	4	3	34.1769
4	4.3	4.3	8.6	1.4859	4	1	2	11.2133
5	4.8	4.8	9.6	1.5688	4	7	2	17.2445
By Linear Regression of	Y on X				·			
	Slope, m	=	62.98	829 Int	ercept, b =	-51	.8307	
Correlation Co	pefficient*	=	0.99	95	_			
Calibration	Accepted	=	Yes/P	<del>10</del> **				
* if Correlation Coefficien	nt ~ 0 000	chack and	l recalibration	aggin				
ii Correlation Coefficier	ii < 0.550,	CHECK AND	recalibration	ragam.				
** Delete as appropriate.								
Remarks :								
Calibrated by	Lau	rance Yun	g		Checked I	by	:	James Chu
Date	1;	3-Nov-20	·		Date		:	13-Nov-20



香港黄竹坑道37號利達中心12樓 12/F., Leader Centre, 37 Wong Chuk Hang Road, Aberdeen, Hong Kong. E-mail: smec@cigismec.com Website: www.cigismec.com Tel: (852) 2873 6860 Fax: (852) 2555 7533



# CERTIFICATE OF CALIBRATION

Certificate No.:

20CA0612 02-02

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Item tested

Description:

Sound Level Meter (Type 1) Larson Davis Microphone PCB

Preamp PCB

of

Manufacturer: Type/Model No.:

Larson Davis LxT1 377B02

PCB PRMLxT1L

Serial/Equipment No.: Adaptors used:

0005062

173734

042836

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 Signal generator B&K 4226 DS 360 2288444 61227 23-Aug-2020 24-Dec-2020 CIGISMEC CEPREI

Ambient conditions

Temperature:

Air pressure:

22 ± 1 °C

Relative humidity:

55 ± 10 % 1005 ± 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 ±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.

Jungi

Actual Measurement data are documented on worksheets.

Approved Signatory:

Date:

17-Jun-2020

Company Chop:

\$105 \* 011E

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.

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Form No.CARP152-1/Issue 1/Rev.C/01/02/2007



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# CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.:

20CA0612 02-02

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of

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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 Uncertanity (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	
	С	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	A	Pass	0.3	
	С	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 <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 Uncertanity (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.

Calibrated by:

Date:

Fung Chi Yip 17-Jun-2020 Checked by:

Shek Kwong Tat 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.

End

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Form No.CARP152-2/Issue 1/Rev.C/01/02/2007



香港 黄 竹 坑 道 3 7 號 利 達 中 心 1 2 樓 12/F., Leader Centre, 37 Wong Chuk Hang Road, Aberdeen, Hong Kong. E-mail: smec@cigismec.com Website: www.cigismec.com Tel: (852) 2873 6860 Fax: (852) 2555 7533 **SMECLab** 

Test Data for Sound Level Meter

Page 1 of 5

Sound level meter type:

LxT1

Serial No.

0005062

Date 17-

17-Jun-2020

Microphone Preamp type: type: 377B02 PRMLxT1L Serial No. Serial No. 173734 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

dΒ

Noise level in C weighting Noise level in Lin

11.521.9

dB 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	Devia	Deviation		
rtelefence/Expected level	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		



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Test Data for Sound Level Meter

Page 2 of 5

Sound level me	eter type:	LxT1		Serial No.	0005062	Date	e 17-Jun-	2020
Microphone Preamp	type: type:	377B02 PRMLxT1L		Serial No. Serial No.	173734 042836	Rep	ort: 20CA06	12 02-02
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
20-120	118.0	118.0	0.7	0.0

## FREQUENCY WEIGHTING TEST

The frequency response of the weighting netwoks 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	Tolerar	nce(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	Tolerar	nce(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



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Test Data for Sound Level Meter

Page 3 of 5

Sound level me	eter type:	LxT1	Serial No.	000	5062	Date	17-Jun-2020
Microphone Preamp	type: type:	377B02 PRMLxT1L	Serial No. Serial No.		734 836	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	Ref. level	Expected level	Actual level	Tolerar	nce(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	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	Expected level	Actual level	Tolera	nce(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	Tolera	nce(dB)	Deviation
dB	dB	dB	+	-	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. s	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

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Test Data for Sound Level Meter

Page 4 of 5

Sound level meter type:

LxT1

Serial No.

0005062

Date

17-Jun-2020

Microphone Preamp type: type: 377B02 PRMLxT1L Serial No. Serial No. 173734 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 wighting	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 burs	t 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 bu	ırst 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	Expected	Actual	Tolerance	Deviation	Remarks
	tone burst	Leq	Leq			
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 rar

Test frequency:

4000 Hz

Integration time:

10 sec

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Test Data for Sound Level Meter

Page 5 of 5

Sound level meter type:

LxT1

Serial No.

0005062

Date

17-Jun-2020

Microphone Preamp type:

377B02 PRMLxT1L Serial No. Serial No. 173734 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 rar

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
Hz	dB	Measured (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-----



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香港新界葵涌水基路22-24號好爸爸創科大廈 Good Ba Ba Hitech Building, Nos. 22-24 Wing Kei Road, Kwai Chung, New Territories, Hong Kong Tel: (852) 2873 6860 Fax: (852) 2555 7533 E-mail: smec@cigismec.com Website: www.cigismec.com





# CERTIFICATE OF CALIBRATION

Certificate No.:

20CA0907 03

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Item tested

Description: Manufacturer: Sound Level Meter (Type 1)

Microphone B & K Preamp B & K

Type/Model No.:

B & K 2250-L

4950 2827240 ZC0032 21213

Serial/Equipment No.: Adaptors used:

3006790

\_\_\_\_\_

-

Item submitted by

Customer Name:

Lam Geotechnics Limited

Address of Customer:

-

Request No.:

07-Sep-2020

Date of test:

10-Sep-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-2021

CIGISMEC

Signal generator

DS 360

61227

24-Dec-2020

**CEPREI** 

**Ambient conditions** 

Temperature:

22 ± 1 °C

Relative humidity: Air pressure:

55 ± 10 % 1005 ± 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 ±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.

Feng Junqi

Approved Signatory:

Date:

11-Sep-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. The results apply to the item as received.

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Form No.CARP152-1/Issue 1/Rev.C/01/02/2007



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# **CERTIFICATE OF CALIBRATION**

(Continuation Page)

Certificate No.:

20CA0907 03

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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.

			Expanded	Coverage
Test:	Subtest:	Status:	Uncertanity (dB)	Factor
Self-generated noise	A	Pass	0.3	
con generated notes	Č	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leg	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	Α	Pass	0.3	
, , , , ,	С	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 <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.

			Expanded	Coverage
Test:	Subtest	Status	Uncertanity (dB)	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:

End

Checked by

Date:

Fung Chi Yip 10-Sep-2020

Date:

11-Sep-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.

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Test Data for Sound Level Meter

Page 1 of 5

Sound level meter type:

2250-L

Serial No.

3006790

Date 10-Sep-2020

Microphone Preamp

type: type: 4950 ZC0032 Serial No. 2827240 Serial No. 21213

Report: 20CA0907 03

#### 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

17.2

dB

Noise level in C weighting

16.6

dB

Noise level in Lin

24.6 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	vel Actual level Tolerance		Tolerance	Devia	ation
Treference/Expected level	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	44.0	44.0	0.7	0.0	0.0
39.0	39.0	39.0	0.7	0.0	0.0

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Test Data for Sound Level Meter

Page 2 of 5

Sound level meter	type:	2250-L		Serial No.	3006790	Date	e 10-Sep	-2020
	ype: type:	4950 ZC0032		Serial No. Serial No.	2827240 21213	Rep	ort: 20CA09	07 03
34.0		34.1	34.1	0.7		0.1	0.1	
33.0		33.1	33.1	0.7		0.1	0.1	
32.0		32.1	32.1	0.7		0.1	0.1	
31.0		31.1	31.1	0.7		0.1	0.1	
30.0		30.2	30.2	0.7		0.2	0.2	

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	30.2	0.7	0.2
20-140	138.0	138.0	0.7	0.0

#### FREQUENCY WEIGHTING TEST

The frequency response of the weighting netwoks 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	Tolera	nce(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	0.0	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	85.3	1.0	1.0	-0.1
501.2	94.0	90.8	0.0	90.8	1.0	1.0	0.0
1995.0	94.0	95.2	0.0	95.1	1.0	1.0	-0.1
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	Tolerar	nce(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	0.0	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

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Test Data for Sound Level Meter

Page 3 of 5

Sound level me	ter type:	2250-L		Serial No.	300	6790	Date 10-	Sep-2020
Microphone Preamp	type: type:	4950 ZC0032		Serial No. Serial No.	282 212	7240 13	Report: 200	A0907 03
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:

r requericy weigi			0 " (		<b>-</b> .	( 10)	
Frequency	Ref. level	Expected level	electrical response	Actual level	l olerar	nce(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	0.0	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	93.9	1.0	1.0	-0.1
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

<sup>\*</sup>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. lev	rel Expecte	ed level Actual le	vel Tolera	nce(dB)	Deviation	
dB	dl	B 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

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# **SMECLab**

Test Data for Sound Level Meter

Page 4 of 5

Sound level meter type:

2250-L

Serial No.

3006790

Date 10-Sep-2020

Microphone Preamp

type: type: 4950 ZC0032 Serial No. Serial No. 2827240 21213

Report: 20CA0907 03

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, LLPeak)

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)

	Ref. Level	Expected level	Tone burst signal	Tolerance	Deviation
Time wighting	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 burs	Single burst indication		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 bu	Repeated burst indication		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	Expected	Actual	Tolerance	Deviation	Remarks
	tone burst	Leq	Leq			
msec	dB	dB	dB	+/- dB	dB	
1000	110.0	110.0	109.9	1.0	-0.1	60s integ.
10000	100.0	100.0	99.8	1.0	-0.2	6min. integ.

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Test Data for Sound Level Meter

Page 5 of 5

Sound level meter type:

2250-L

Serial No.

3006790

Date 10-Sep-2020

Microphone Preamp type: type: 4950 ZC0032 Serial No. Serial No.

2827240 21213

Report: 20CA0907 03

# 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 SFL:

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
135.9	134.9	131.9	3.0	1.0	0.0

For integrating SLM, with the instrument indicating Leg.

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
142.7	141.7	101.7	101.7	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	Tolera	nce (dB)	Deviation
Hz	dB	Measured (dB)	+	-	dB
1000	94.0	94.0	0.0	0.0	0.0
125	77.9	78.2	1.0	1.0	0.3
8000	92.9	92.8	1.5	3.0	-0.1

-----END-----

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Tel: (852) 2873 6860 Fax: (852) 2555 7533



# CERTIFICATE OF CALIBRATION

Certificate No.:

20CA0225 02

Page

of

2

Item tested

Description: Manufacturer: Sound Level Meter (Type 1)

**B&K** 

2250 2701778

B & K 4950 2755097

Microphone

Preamp **B&K** ZC0032 19223

Adaptors used:

Type/Model No.:

Customer Name:

Lam Geotechnics Limited.

Address of Customer:

Serial/Equipment No.:

Item submitted by

Request No .:

Date of receipt:

25-Feb-2020

Date of test:

26-Feb-2020

Reference equipment used in the calibration

Description:

Multi function sound calibrator

Model: B&K 4226 Serial No.

**Expiry Date:** 

Traceable to:

Signal generator

DS 360

2288444 33873

23-Aug-2020

CIGISMEC

10-May-2020 CEPREI

**Ambient conditions** 

Temperature:

21 ± 1 °C 55 ± 10 %

Relative humidity: 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 2, replaced by an equivalent capacitance within a tolerance of +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 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.

Feng

Actual Measurement data are documented on worksheets.

Approved Signatory:

Date:

26-Feb-2020

Company Chop:

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.

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# CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.:

20CA0225 02

Page

2

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.

			Expanded	Coverage
Test:	Subtest:	Status:	Uncertanity (dB)	Factor
		_		
Self-generated noise	A	Pass	0.3	
	С	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	A	Pass	0.3	
	С	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 <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 Uncertanity (dB)	Coverage Factor
Acoustic response	Weighting A at 125 Hz	Pass	0.3	
I .	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:

1

Fung Chi Yip 26-Feb-2020 End

Checked by:

Date:

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.

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Test Data for Sound Level Meter

Page 1 of 5

Sound level meter type:

2250

Serial No.

2701778

Date

26-Feb-2020

Microphone Preamp type: type: 4950 ZC0032 Serial No. Serial No. 2755097 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	Actua	al level	Tolerance	Devia	ation
Neierence/Expedied level	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



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Test Data for Sound Level Meter

Page 2 of 5

Sound level met	ter type:	2250		Serial No.	2701778	Date	26-Feb-2020
Microphone Preamp	type: type:	4950 ZC0032		Serial No. Serial No.	2755097 19223	Repo	ort: 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
20-140	138.0	138.0	0.7	0.0

## FREQUENCY WEIGHTING TEST

The frequency response of the weighting netwoks 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	Tolera	nce(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:

r requeries weig	nung O.						
Frequency	Ref. level	Expected level	Correction of electrical response	Actual level	Tolera	nce(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



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Test Data for Sound Level Meter

Page 3 of 5

Sound level me	eter type:	2250		Serial No.	270	1778	Date 26-Feb-2020
Microphone Preamp	type: type:	4950 ZC0032		Serial No. Serial No.	275 192	5097 23	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	Tolera	nce(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

<sup>\*</sup>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	Tolera	nce(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

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Test Data for Sound Level Meter

Page 4 of 5

Sound level meter type:

2250

Serial No.

2701778

Date

26-Feb-2020

Microphone Preamp type: type: 4950 ZC0032 Serial No. Serial No. 2755097 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)

1 0110 10 110 1 013					12 1111
	Ref. Level	Expected level	Tone burst signal	Tolerance	Deviation
Time wighting	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	dB
120.0	111.2	111.1	2.0	-0.1

#### Repeated at 100 Hz

Ref. Level	Repeated bu	Repeated burst indication		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	Expected	Actual	Tolerance	Deviation	Remarks
	tone burst	Leq	Leq			
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



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Test Data for Sound Level Meter

Page 5 of 5

Sound level meter type:

2250

Serial No.

2701778

Date 26-Feb-2020

Microphone Preamp type: type: 4950 ZC0032 Serial No. Serial No. 2755097 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 Leg.

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: Single burst duration: 10 sec 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	Tolera	Tolerance (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-----



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# CERTIFICATE OF CALIBRATION

Certificate No.:

20CA0505 01

Page

of

Item tested

Description:
Manufacturer:
Type/Model No.:

Adaptors used:

Sound Level Meter (Type 1) B & K

2250-L 2722311 Microphone B & K 4950

2698703

Preamp B & K ZC0032 13321

Item submitted by

Serial/Equipment No.:

Customer Name: Address of Customer:

Request No.:

Date of receipt:

Lam Geotechnics Ltd.

05-May-2020

Date of test:

06-May-2020

Reference equipment used in the calibration

Description:

Multi function sound calibrator

Model: B&K 4226 Serial No. 2288444

Expiry Date: 23-Aug-2020

Traceable to: CIGISMEC

Signal generator

DS 360

61227

24-Dec-2020

CEPREI

**Ambient conditions** 

Temperature:

22 ± 1 °C 55 ± 10 %

Relative humidity: Air pressure:

1005 ± 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 ±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 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.

Feng Junqi

Approved Signatory:

Date:

06-May-2020

Company Chop:

WAR CHIEF COMPANY OF THE COMPANY O

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.

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Form No.CARP152-1/Issue 1/Rev.C/01/02/2007



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# CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.:

20CA0505 01

Page

of

2

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 Uncertanity (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	
	С	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	A	Pass	0.3	
	С	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 <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 Uncertanity (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 06-May-2020 End

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.

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Form No.CARP152-2/Issue 1/Rev.C/01/02/2007



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Test Data for Sound Level Meter

Page 1 of 5

Sound level meter type:

2250-L

Serial No.

2722311

Date

06-May-2020

Microphone Preamp

type: type: 4950 ZC0032 Serial No. Serial No.

2698703 13321

Tel: (852) 2873 6860

Fax: (852) 2555 7533

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	Actua	Actual level		Deviation		
1.5.6161166/Expedica 16461	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	



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Test Data for Sound Level Meter

Page 2 of 5

Sound level me	ter type:	2250-L		Serial No.	2722311	Date	e 06-May-	-2020
Microphone Preamp	type: type:	4950 ZC0032		Serial No. Serial No.	2698703 13321	Rep	ort: 20CA050	05 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	Expected level Actual level		Deviation	
dB	dB	dB	+/- dB	dB	
20-140	30.0	30.0	0.7	0.0	
20-140	138.0	138.0	0.7	0.0	

## FREQUENCY WEIGHTING TEST

The frequency response of the weighting netwoks 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	Tolerar	nce(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



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Test Data for Sound Level Meter

Page 3 of 5

Sound level me	ter type:	2250-L		Serial No.	272	2311	Date 06	-May-2020
Microphone Preamp	type: type:	4950 ZC0032		Serial No. Serial No.	269 133	8703 21	Report: 20	CA0505 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	Tolera	nce(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

<sup>\*</sup>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)

William and digital to domainadas.	( Trongine ) i, maxim	, a, , , , , , , , , , , , , , , , , ,			
Ref. level	Expected level	Actual level	Tolera	nce(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	Tolera	nce(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

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Test Data for Sound Level Meter

Page 4 of 5

Sound level meter type:

2250-L

Serial No.

2722311

Date

06-May-2020

Microphone Preamp type: type: 4950 ZC0032 Serial No. Serial No. 2698703 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:

Tone burst signal:

2000 Hz

Amplitude:

2 dB below the upper limit of the primary indicator range.

Burst repetition frequency:

40 Hz

11 cycles of a sine wave of frequency 2000 Hz. (Set to INT)

	Ref. Level	Expected level	Tone burst signal	Tolerance	Deviation
Time wighting	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 burs	Single burst indication		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 bu	ırst 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

Daration of tone barst.	1 1115					
Repetition Time	Level of	Expected	Actual	Tolerance	Deviation	Remarks
	tone burst	Leq	Leq			
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.

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Tel: (852) 2873 6860 Fax: (852) 2555 7533 **SMECLab** 

Test Data for Sound Level Meter

Page 5 of 5

Sound level meter type:

2250-L

Serial No.

2722311

Date

06-May-2020

Microphone Preamp

type: type: 4950 ZC0032 Serial No. Serial No. 2698703 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 Leg:

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: Single burst duration: 10 sec 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	Tolerar	Tolerance (dB)		
Hz	dB	Measured (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-----



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# CERTIFICATE OF CALIBRATION

Certificate No.:

20CA0922 01

Page

of

2

Item tested

Description:

Manufacturer:

B&K Type/Model No.: Serial/Equipment No.:

2250-L 2722310

Microphone **B&K** 4950 2698702

Preamp B & K ZC0032 13318

Item submitted by

Customer Name:

Lam Geotechnics Ltd.

Sound Level Meter (Type 1)

Address of Customer:

Adaptors used:

Request No.:

Date of receipt:

22-Sep-2020

Date of test:

23-Sep-2020

Reference equipment used in the calibration

Description:

Multi function sound calibrator

Model: B&K 4226 Serial No. 2288444

**Expiry Date:** 23-Aug-2021

Traceable to: CIGISMEC

Signal generator

DS 360

61227

24-Dec-2020

CEPREI

Ambient conditions

Temperature: Relative humidity:

Air pressure:

22 ± 1 °C 55 ± 10 % 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 1, 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 2, replaced by an equivalent capacitance within a tolerance of ±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 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:

Date:

24-Sep-2020

Company Chop:

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. The results apply to the item as received.

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Form No.CARP152-1/Issue 1/Rev.C/01/02/2007



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# CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.:

20CA0922 01

Page

2

#### **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.

		Expanded	Coverage
Subtest:	Status:	Uncertanity (dB)	Factor
	Dass	0.3	
	20 20 20 20 20		
	(1) (A)(A)(A)		
dB above lower limit of each range	Pass	0.3	
at reference range , Step 5 dB at 4 kHz	Pass	0.3	
1	Pass	0.3	
	Pass	0.3	
in	Pass	0.3	
Single Burst Fast	Pass	0.3	
Single Burst Slow	Pass	0.3	
Single 100µs rectangular pulse	Pass	0.3	
Crest factor of 3	Pass	0.3	
Single burst 5 ms at 2000 Hz	Pass	0.3	
Repeated at frequency of 100 Hz	Pass	0.3	
ms burst duty factor 1/10 <sup>3</sup> at 4kHz	Pass	0.3	
ms burst duty factor 1/10 <sup>4</sup> at 4kHz	Pass	0.3	
Single burst 10 ms at 4 kHz	Pass	0.4	
Single burst 10 ms at 4 kHz	Pass	0.4	
SPL	Pass	0.3	
eq	Pass	0.4	
AC AR SHACE SECOND	in Single Burst Fast Single Burst Slow Single Burst Slow Single 100µs rectangular pulse Crest factor of 3 Single burst 5 ms at 2000 Hz Repeated at frequency of 100 Hz ms burst duty factor 1/10³ at 4kHz ms burst duty factor 1/10⁴ at 4kHz Single burst 10 ms at 4 kHz Single burst 10 ms at 4 kHz	Pass Pass In Pass Pass In Pass It reference range , Step 5 dB at 4 kHz Reference SPL on all other ranges It dB below upper limit of each range It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass In Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It reference range , Step 5 dB at 4 kHz Pass It referen	Status:         Uncertanity (dB)           A         Pass         0.3           B         Pass         0.8           B         Pass         1.6           B         B         1.6           B         B         1.6           B         B         1.6           B         B         0.3           B         B         0.3 <tr< td=""></tr<>

#### 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.

		Expanded	Coverage
Subtest	Status	Uncertanity (dB)	Factor
Weighting A at 125 Hz	Pass	0.3	
Weighting A at 8000 Hz	Pass	0.5	
	Weighting A at 125 Hz	Weighting A at 125 Hz Pass	SubtestStatusUncertanity (dB)Weighting A at 125 HzPass0.3

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:

Fung Chi Yip 23-Sep-2020 Checked by

Date:

ınai 24-Sep-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.

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Form No.CARP152-2/Issue 1/Rev.C/01/02/2007



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Test Data for Sound Level Meter

Page 1 of 5

Sound level meter type:

2250-L

Serial No.

2722310

Date 23-Sep-2020

Microphone Preamp

type: type:

4950 ZC0032

Serial No. Serial No.

2698702 13318

Report: 20CA0922 01

Form No.: CAWS 152/Issue 1/Rev. B/01/02/2007

#### 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

12.8

dB

Noise level in C weighting

14.4

Noise level in Lin

dΒ

21.0 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	Actua	l level	Tolerance	Devia	ation
Neierenee/Expected level	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	135.1	135.1	0.7	0.1	0.1
136.0	136.1	136.1	0.7	0.1	0.1
137.0	137.1	137.1	0.7	0.1	0.1
138.0	138.1	138.1	0.7	0.1	0.1
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	44.0	44.0	0.7	0.0	0.0
39.0	39.0	39.0	0.7	0.0	0.0

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Test Data for Sound Level Meter

Page 2 of 5

Sound level me	ter type:	2250-L		Serial No.	2722310	Date	e 23-Sep-	2020
Microphone Preamp	type: type:	4950 ZC0032		Serial No. Serial No.	2698702 13318	Rep	ort: 20CA092	22 01
34.0		34.0	34.0	0.7		0.0	0.0	
33.0		33.1	33.1	0.7		0.1	0.1	
32.0		32.1	32.1	0.7		0.1	0.1	
31.0		31.1	31.1	0.7		0.1	0.1	
30.0		30.1	30.1	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
20-140	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	30.1	0.7	0.1
20-140	138.0	138.1	0.7	0.1

#### FREQUENCY WEIGHTING TEST

The frequency response of the weighting netwoks 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	Tolerar	nce(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	54.4	1.5	1.5	-0.2
63.1	94.0	67.8	0.0	67.7	1.5	1.5	-0.1
125.9	94.0	77.9	0.0	77.9	1.0	1.0	0.0
251.2	94.0	85.4	0.0	85.3	1.0	1.0	-0.1
501.2	94.0	90.8	0.0	90.7	1.0	1.0	-0.1
1995.0	94.0	95.2	0.0	95.1	1.0	1.0	-0.1
3981.0	94.0	95.0	-0.1	94.8	1.0	1.0	-0.1
7943.0	94.0	92.9	-0.3	92.5	1.5	3.0	-0.1
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	Tolerar	nce(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	93.1	1.5	1.5	-0.1
125.9	94.0	93.8	0.0	93.8	1.0	1.0	0.0

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Test Data for Sound Level Meter

Page 3 of 5

Sound level meter type: Microphone type: Preamp type:		2250-L		Serial No.	272	2310	Date	23-Sep-2020	)	
		4950 ZC0032	Serial No. 2 Serial No.		2698702 13318		Report: 20CA0922 01			
	251.2	94.0	94.0	0.0	93.9	1.0	1.0	-0.1		
	501.2	94.0	94.0	0.0	94.0	1.0	1.0	0.0		
	1995.0	94.0	93.8	0.0	93.7	1.0	1.0	-0.1		
	3981.0	94.0	93.2	-0.1	93.0	1.0	1.0	-0.1		
	7943.0	94.0	91.0	-0.3	90.6	1.5	3.0	-0.1		
	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	Tolerar	nce(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	94.0	1.5	1.5	0.0
63.1	94.0	94.0	0.0	94.0	1.5	1.5	0.0
125.9	94.0	94.0	0.0	93.9	1.0	1.0	-0.1
251.2	94.0	94.0	0.0	93.9	1.0	1.0	-0.1
501.2	94.0	94.0	0.0	93.9	1.0	1.0	-0.1
1995.0	94.0	94.0	0.0	93.9	1.0	1.0	-0.1
3981.0	94.0	94.0	-0.1	93.9	1.0	1.0	0.0
7943.0	94.0	94.0	-0.3	93.6	1.5	3.0	-0.1
12590.0	94.0	94.0	-0.3	93.6	3.0	6.0	-0.1

<sup>\*</sup>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)

9	, , ,	, , ,					
Ref. level	Expected level	Actual level	Tolera	nce(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)

9	(	,			
Ref. level	Expected level	Actual level	Tolera	nce(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

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Test Data for Sound Level Meter

Page 4 of 5

Sound level meter type:

2250-L

Serial No.

2722310

Date 23-Sep-2020

Microphone Preamp

type: type: 4950 ZC0032 Serial No. Serial No. 2698702 13318

Report: 20CA0922 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	119.4	2.0	0.4

Negative polarities:

Ref. level	Response to 10 ms	Response to 100 us	Tolerance	Deviation
dB	dB	dB	+/- dB	dB
119.0	119.0	119.4	2.0	0.4

#### **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 wighting	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 burs	Single burst indication		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 bu	Repeated burst indication		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	Expected	Actual	Tolerance	Deviation	Remarks
	tone burst	Leq	Leq			
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.

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Test Data for Sound Level Meter

Page 5 of 5

Sound level meter type:

2250-L

Serial No. 2722310

Date 23-Sep-2020

Microphone Preamp

type: type: 4950 ZC0032 Serial No. Serial No. 2698702 13318

Report: 20CA0922 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	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
135.2	134.2	131.2	3.0	1.0	0.0

For integrating SLM, with the instrument indicating Leg.

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: Single burst duration: 10 sec 1 msec

Rms level	Level reduced by	Expected level	Actual level	Tolerance	Deviation
at overload (dB)	1 dB	dB	dB	dB	dB
142.2	141.2	101.2	101.2	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	Tolerar	nce (dB)	Deviation
Hz	dB	Measured (dB)	+	-	dB
1000	94.0	94.0	0.0	0.0	0.0
125	77.9	77.9	1.0	1.0	0.0
8000	92.9	93.5	1.5	3.0	0.6

-----END-----

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# CERTIFICATE OF CALIBRATION

Certificate No.:

20CA0107 02

Page:

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Item tested

Description:

Acoustical Calibrator (Class 1)

Manufacturer: Type/Model No.: Larson Davis

Serial/Equipment No.:

13128

Adaptors used:

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Item submitted by

Curstomer:

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	CEPRE
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 ± 1 °C

Relative humidity:

55 ± 10 %

Air pressure:

1000 ± 5 hPa

# Test specifications

- 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.

Feng Junqi

**Approved Signatory:** 

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.

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Form No CARP156-1/Issue 1/Rev.D/01/03/2007



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# CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.:

20CA0107 02

Page:

of

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#### 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
1000	94.00	93.76	0.10

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

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

#### **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.

Calibrated by:

Date:

End

Checked by:

Date:

Shek Kwong Tai

08-Jan-2020

Fung Chi Yip 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.

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Form No.CARP156-2/Issue 1/Rev.C/01/05/2005