

# 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

R	un	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 ra	te calculatio	ns:					
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

ch Environmental, Inc.

South Miami Avenue

age of Cleves, OH 45002

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TOLL FREE: (877)263-7610

FAX: (513)467-9009



RECALIBRATION
DUE DATE:

July 17, 2021

# Certificate of Calibration

**Calibration Certification Information** 

Cal. Date: July 17, 2020

Rootsmeter S/N: 438320

Ta: 296

°K

Operator: Jim Tisch

Pa: 753.4

mm Hg

Calibration Model #: TE-5025A

Α

Calibrator S/N: 3166

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4450	3.2	2.00
2	3	4	1	1.0230	6.4	4.00
3	5	6	1	0.9140	7.9	5.00
4	7	8	1	0.8720	8.7	5.50
5	9	10	1	0.7190	12.8	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)						
0.9937	0.6877	1.4128	0.9958	0.6891	0.8865						
0.9895	0.9672	1.9980	0.9915	0.9692	1.2536						
0.9875	1.0804	2.2338	0.9895	1.0826	1.4016						
0.9864	1.1312	2.3428	0.9885	1.1335	1.4700						
0.9810	1.3644	2.8255	0.9830	1.3672	1.7729						
	m=	2.08877		m=	1.30796						
<b>QSTD</b>	b=	-0.02270	QA	b=	-0.01424						
	r=	0.99999		r=	0.99999						

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

	Standard Conditions
Tstd:	298.15 °K
Pstd:	760 mm Hg
	Key
	or manometer reading (in H2O)
	ter manometer reading (mm Hg)
	solute temperature (°K)
Pa: actual ba	rometric pressure (mm Hg)
b: intercept	
m: slope	

# RECALIBRATION

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

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5 South Miami Avenue

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FAX: (513)467-9009



Location :		CMA1b				Calbratio	on Date	:	09-Mar-21
Equipment no.	ŀ	HVS001				Calbratio	on Due Date	:	09-May-21
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER						
				Ambient C	Condition				
Temperature, T <sub>a</sub>		293	3	Kelvin	Pressure, P	a	1	020	mmHg
			Orifice Tr	ansfer Sta	ndard Inforr	nation			
Equipment No.		3166		Slope, m <sub>c</sub>	2.088	77	Intercept, bc		-0.02270
Last Calibration Date		17-Jul-2	0		(Hx	P <sub>a</sub> / 101	3.3 x 298 /	$T_a$ ) 1/2	
Next Calibration Date		17-Jul-2	1		. =		$Q_{std} + b_c$	α,	
				Calibratio	n of TSP				
Calibration	Man	ometer R	eading		std	Continu	ious Flow		IC
Point		inches of	•		n <sup>3</sup> / min.) Recorder, W		(W/P /101	13.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)	
	(up)	(down)	(difference)		axis	(CFM)		((. 2	Y-axis
1	1.7	1.7	3.4		9041	24			24.2838
2	2.8	2.8	5.6		1572		33		33.3902
3	4.1	4.1	8.2		3980	,	42		42.4966
4	5.0	5.0	10.0	1.5	5427	,	48		48.5676
5	6.2	6.2	12.4	1.7	7167		54		54.6385
By Linear Regression of	Y on X								
,	Slope, m	=	37.6	907	Into	ercept, b =	-9.	9708	
Correlation Co	oefficient*	=	0.99	97		·			
Calibration	Accepted	=	Yes/	lo**					
	·								
* if Correlation Coefficier	nt < 0.990,	check and	I recalibration	again.					
** Delete as appropriate.									
Remarks :									
Calibrated by:	Lau	rance Yun	g			Checked	by	:	James Chu
Calibrated by		9-Mar-21				Date	-	:	09-Mar-21



Location :		CMA1b				Calbratio	on Date	:	11-Jan-21
Equipment no.	ŀ	HVS001				Calbratio	on Due Date	:	11-Mar-21
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER						
				Ambient C	Condition				
Temperature, T <sub>a</sub>		284	ļ	Kelvin	Pressure, P	a	1	026	mmHg
			Orifice Tr	ansfer Sta	ndard Inform	mation			
Equipment No.		0005		Slope, m <sub>c</sub>	2.009	27	Intercept, bc		-0.03767
Last Calibration Date		18-Feb-2	0		(Hx	P <sub>a</sub> / 101	3.3 x 298 /	T <sub>a</sub> )	1/2
Next Calibration Date		17-Feb-2	:1		=	m <sub>c</sub> x	$Q_{std} + b_c$		
				Calibratio	n of TSP				
Calibration	Mar	ometer R	eading	C	std	Continu	ous Flow		IC
Point	<b>H</b> (i	inches of	water)	(m <sup>3</sup>	(m <sup>3</sup> / min.)		Recorder, W		013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)
	(up)	(down)	(difference)	X-	axis	(CFM)			Y-axis
1	1.5	1.5	3.0	0.9	9072	25			25.7663
2	2.4	2.4	4.8	1.	1426	31			31.9502
3	3.9	3.9	7.8	1.4	<del>1</del> 513	39			40.1954
4	5.2	5.2	10.4	1.6	6730	48			49.4712
5	6.4	6.4	12.8	1.8	3539		53		54.6245
By Linear Regression of	Y on X								
	Slope, m	=	30.9	194	Int	ercept, b =	-3	.0586	
Correlation Co	pefficient*	=	0.99	64					
Calibration	Accepted	=	Yes/A	<del>10</del> **					
* if Correlation Coefficien	nt < 0.990,	check and	recalibration	again.					
				_					
** Delete as appropriate.									
Remarks :									
Calibrated by	Lau	rance Yun	9			Checked	by	:	James Chu
Date :	1	1-Jan-21				Date		:	11-Jan-21



				•	• `	•	•	
Location :		CMA2a			Calbration	Date	:	11-Jan-21
Equipment no.	ı	HVS002			Calbration	Due Date	:	11-Mar-21
CALIBRATION OF CON	ITINUOUS	S FLOW R	ECORDER					
				Ambient Condition				
Temperature, T <sub>a</sub>		284		Kelvin Pressure, P	a	10	026	mmHg
			Orifice Tr	ransfer Standard Infor	mation			
Equipment No.		0005	0111100 11	Slope, m <sub>c</sub> 2.009		ntercept, bc	Т	-0.03767
Last Calibration Date		18-Feb-2	20		c P <sub>a</sub> / 1013		T ) 1/2	0.00707
Next Calibration Date		17-Feb-2		=		$Q_{std} + b_c$	'a <i>)</i>	
						stu · ~ c		
	ı			Calibration of TSP		T		
Calibration		nometer R	-		Q <sub>std</sub> Continuous Flow			IC
Point	H (	inches of	•	(m <sup>3</sup> / min.)	<sup>3</sup> / min.) Recorde		(W(P <sub>a</sub> /1013	3.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)
	(up)	(down)	(difference)	X-axis	(CF			Y-axis
1	1.6	1.6	3.2	0.9363	26	6		26.7969
2	2.6	2.6	5.2	1.1884	36	6	;	37.1034
3	4.1	4.1	8.2	1.4876	43	3		44.3180
4	5.4	5.4	10.8	1.7045	50	)	51.5325	
5	6.9	6.9	13.8	1.9243	54	1		55.6551
By Linear Regression of	Y on X							
	Slope, m	=	29.0	189 Int	ercept, b = _	1.0	0552	
Correlation Co	oefficient*	=	0.99	933				
Calibration	Accepted	=	Yes/	<del>\0</del> **				
* if Correlation Coefficier	nt < 0.990,	check and	I recalibration	ı again.				
				_				
** Delete as appropriate.								
Remarks :								
Calibrated by	Lau	rance Yun	g		Checked b	ру	:	James Chu
Date : 11-Jan-21				Date :			11-Jan-21	



				•	• •	•	,	
Location :	: CMA2a					n Date	:	09-Mar-21
Equipment no.	ŀ	HVS002			Calbratio	n Due Date	:	09-May-21
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER					
				Ambient Condition				
Temperature, T <sub>a</sub>		293	3	Kelvin Pressure, P	a	1	020	mmHg
			Orifice Tr	ansfer Standard Infor	mation			
Equipment No.		3166		<b>Slope</b> , m <sub>c</sub> 2.088		Intercept, bc		-0.02270
Last Calibration Date		17-Jul-2		- 1		3.3 x 298 /	$T_{-}$ ) $^{1/2}$	
Next Calibration Date		17-Jul-2		=		$Q_{std} + b_c$	· a/	
				Calibratian of TCD		old 0		
Calibration	Mon	ometer B	anding	Calibration of TSP	Continu	eus Flow		IC
Point		nometer R inches of		Q std			(W(P <sub>a</sub> /1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)	
Foint	(up)	(down)	(difference)	(m <sup>3</sup> / min.) <b>X-axis</b>			(W(F <sub>a</sub> /101)	Y-axis
1	1.3	1.3	2.6	0.7920	(CFM) 20		20.2365	
2	2.2	2.2	4.4	1.0270	27			27.3193
3	3.1	3.1	6.2	1.2170	37			37.4375
4	4.5	4.5	9.0	1.4641		14		44.5203
5	6.1	6.1	12.2	1.7028		51		51.6031
By Linear Regression of		···	12.2	1.1020		<u> </u>		
, ,	Slope, m	=	35.23	372 Int	ercept, b =	-7.	.4914	
Correlation Co	·	=	0.99		• •			<del></del>
Calibration		=	Yes/P					
* if Correlation Coefficier	nt < 0.990,	check and	I recalibration	again.				
** Delete as appropriate.								
Remarks :								
	Lau	rance Yun	g		Checked	by	:	James Chu
Calibrated by		9-Mar-21	<del>-</del>		Date	-	:	09-Mar-21
Date								



				•	• `	•	,	
Location :		CMA3a			Calbration	n Date	:	11-Jan-21
Equipment no.	ŀ	HVS012			Calbration	Due Date	:	11-Mar-21
CALIBRATION OF CON	ITINUOUS	S FLOW R	ECORDER					
				Ambient Condition				
Temperature, T <sub>a</sub>		284	ļ	Kelvin Pressure, P	a	1	026	mmHg
			Orifico Tr	ransfer Standard Infor	mation			
Equipment No.		0005		Slope, m <sub>c</sub> 2.009		ntercept, bc		-0.03767
Last Calibration Date		18-Feb-2			c P <sub>a</sub> / 1013		T 1/2	
Next Calibration Date		17-Feb-2		(		$Q_{std} + b_c$	<i>l<sub>a</sub>)</i>	
Next Campration Date		17-1 60-2	- 1	-	III c X G	std + D <sub>C</sub>		
				Calibration of TSP	ı			
Calibration	Mar	nometer R	eading	Q <sub>std</sub>	Continuo	ous Flow		IC
Point	H (i	inches of	water)	(m <sup>3</sup> / min.)	Record	der, W	(W(P <sub>a</sub> /10	13.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)
	(up)	(down)	(difference)	X-axis	(CF	·M)		Y-axis
1	1.7	1.7	3.4	0.9646	28	8		28.8582
2	2.6	2.6	5.2	1.1884	34	4		35.0421
3	3.4	3.4	6.8	1.3564	4	1		42.2567
4	4.4	4.4	8.8	1.5404	48	8		49.4712
5	5.1	5.1	10.2	1.6570	50	0		51.5325
By Linear Regression of	Y on X							
	Slope, m	=	34.49	981 Int	ercept, b =	-4.	.8419	
Correlation Co	pefficient*	=	0.99	52				
Calibration	Accepted	=	Yes/4	<del>\0</del> **				
* if Correlation Coefficien	nt < 0.990.	check and	l recalibration	ı aqain.				
				C				
** Delete as appropriate.								
Remarks :								
Calibrated by	Lau	rance Yun	g		Checked b	ру	:	James Chu
Date	1	1-Jan-21			Date		:	11-Jan-21



				•		•	,	
Location :		CMA3a			Calbratio	on Date	:	09-Mar-21
Equipment no.	ŀ	HVS012			Calbratio	on Due Date	:	09-May-21
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER					
				Ambient Condition				
Temperature, T <sub>a</sub>		293	3	Kelvin Pressure, P	a	1	020	mmHg
			Orifice Tr	ansfer Standard Infor	mation			
Equipment No.		3166		<b>Slope</b> , m <sub>c</sub> 2.088		Intercept, bc	$\top$	-0.02270
Last Calibration Date		17-Jul-2				3.3 x 298 /	$T_{-}$ ) $^{1/2}$	
Next Calibration Date		17-Jul-2		=		$Q_{std} + b_c$	· a/	
				Oalthartian of TOD		0.0		
Calibration	Man			Calibration of TSP	Comtinu	- Flam		IC
Calibration Point		nometer R inches of		Q <sub>std</sub>		ious Flow	0M/D /404	13.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)
Point	,		•	(m <sup>3</sup> / min.) <b>X-axis</b>		rder, W	(W(P <sub>a</sub> /101	Y-axis
1	(up)	(down)	(difference)		· ·	FM)		
	1.7	1.7	3.4	0.9041		32		32.3784
2	2.5	2.5	5.0	1.0940		39		39.4612
4	3.5	3.5	7.0	1.2925		47		47.5558
	4.5	4.5	9.0	1.4641		52		52.6149
5  By Linear Regression of	5.6	5.6	11.2	1.6320	;	57		57.6740
by Linear Regression of	Slope, m	_	24.00	055 Int	ercept, b =	1 :	2254	
Correlation Co		=	0.99		егсері, в =		2354	
Calibration		=	Yes/P					
Calibration	Accepted	_	103/F					
* if Correlation Coefficier	nt < 0.990,	check and	I recalibration	again.				
** Delete as appropriate.								
Damada								
Remarks :								
	1 0	range Vivo	~		Chaakad	hv		James Chir
Calibrated by		rance Yun 9-Mar-21	<del></del>		Checked Date	ыу		James Chu 09-Mar-21
Date	U:	o-ivial=2 l			Date		•	UB-IVIAI -Z I



Location :		MA1b				Calbratio	n Date	:	09-Mar-21
Equipment no.	ŀ	HVS014				Calbratio	n Due Date	:	09-May-21
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER						
				Ambient (	Condition				
Temperature, T <sub>a</sub>		293	3	Kelvin	Pressure, P	1	1	1020	mmHg
	Orifice	Transfer \$	Standard Inf	ormation					
Equipment No.		3166		Slope, m <sub>c</sub>	2.08877	Intercep	t, bc		-0.02270
Last Calibration Date		17-Jul-2	0		(Нх	P <sub>a</sub> / 101	3.3 x 298 /	′T <sub>a</sub> )	1/2
Next Calibration Date		17-Jul-2	1		=	m <sub>c</sub> x	$Q_{std} + b_c$		
				Calibratio	n of TSP				
Calibration	Mar	ometer R	eading	C	Q <sub>std</sub>	Continu	ous Flow		IC
Point	H (i	inches of	water)	(m <sup>3</sup>	/ min.)	Reco	rder, W	(W(P <sub>a</sub> /	(1013.3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)
	(up)	(down)	(difference)	X-	axis	(C	FM)		Y-axis
1	2.1	2.1	4.2	1.	0036	;	33		33.3902
2	2.8	2.8	5.6	1.	1572	;	38		38.4493
3	3.8	3.8	7.6	1.3	3463		<b>1</b> 5		45.5321
4	4.7	4.7	9.4	1.4	4960	;	50		50.5912
5	5.5	5.5	11.0	1.	6175	!	55		55.6504
By Linear Regression of	Y on X								
	Slope, m	=	36.1	250	Inte	ercept, b =	-3	3.1114	
Correlation Co	pefficient*	=	0.99	95					
Calibration	Accepted	=	Yes/	<del>\0</del> **					
* if Correlation Coefficier	nt < 0.990.	check and	I recalibration	again.					
				3.					
** Delete as appropriate.									
Remarks :									
Calibrated by	Lau	rance Yun	g			Checked	by	:	James Chu
Date :	0:	9-Mar-21				Date		:	09-Mar-21



				•	• `	•	,	
Location :		MA1b			Calbratio	n Date	: 1:	2-Jan-21
Equipment no.	ŀ	HVS014			Calbratio	n Due Date	: 1	2-Mar-21
CALIBRATION OF CON	ITINUOUS	FLOW R	ECORDER					
				Ambient Condition				
Temperature, T <sub>a</sub>		284		Kelvin Pressure, P	a	1	026	mmHg
			Orifico Tr	ransfer Standard Infor	mation			
Equipment No.		0005	Office II	Slope, m <sub>c</sub> 2.009		Intercept, bc		0.03767
Last Calibration Date		18-Feb-2	20			3.3 x 298 /		0.03767
Next Calibration Date		17-Feb-2		(		$Q_{std} + b_c$	' a)	
Next Gambration Date		17-1 60-2	.1	_	III <sub>C</sub> X	Std + D c		
				Calibration of TSP				
Calibration	Mar	nometer R	eading	Q <sub>std</sub>	Continu	ous Flow		IC
Point	H (i	inches of	water)	(m <sup>3</sup> / min.)	Recor	der, W	(W(P <sub>a</sub> /1013.3	3x298/T <sub>a</sub> ) <sup>1/2</sup> /35.31)
	(up)	(down)	(difference)	X-axis	(CI	FM)	Y	-axis
1	1.5	1.5	3.0	0.9072	3	34	35	5.0421
2	2.2	2.2	4.4	1.0947	4	11	42	2.2567
3	3.5	3.5	7.0	1.3759	4	19	50	).5019
4	4.4	4.4	8.8	1.5404	5	55	56	5.6858
5	5.4	5.4	10.8	1.7045	5	59	60	).8084
By Linear Regression of	Y on X							
	Slope, m	=	32.33	312 Int	ercept, b =	6.2	2352	
Correlation Co	pefficient*	=	0.99	984				
Calibration	Accepted	=	Yes/	<del>\•</del> **				
* if Correlation Coefficier	nt < 0 990	check and	l recalibration	again				
ii Contolation Coomolor	0.000,	orioon and	rodanbration	agam.				
** Delete as appropriate.								
Remarks :								
Calibrated by	Lau	rance Yun	g		Checked	by	: Ja	ames Chu
Date	1:	2-Jan-21			Date		: 1	2-Jan-21



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# CERTIFICATE OF CALIBRATION

Certificate No.:

20CA0612 02-02

Page

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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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2

# 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	Actua	ıl level	Tolerance	Devia	Deviation		
rtelefelice/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.	o. 0005062		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	Tolerance(dB)		Deviation
dB	dB	dB	+	-	dB
116.0	115.0	115.0	1.0	1.0	0.0

#### TIME WEIGHTING SLOW TEST

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

Ref. level	Expected level	Actual level	Tolerance(dB)		Deviation
dB	dB	dB	+	-	dB
116.0	111.9	111.8	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 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	117.1	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	Tolerar	nce (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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of

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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

Page

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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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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.

3006790

Date 10-Sep-2020

Microphone

type:

4950

Serial No.

2827240

Preamp

type:

ZC0032

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	Actua	al level	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 t	type: 2250-L		Serial No.	3006790	Date	e 10-Sep-	-2020
	ype: 4950 ype: ZC0032		Serial No. Serial No.	2827240 21213	Rep	ort: 20CA090	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	I 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	Tolerar	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. leve	el Expected le	vel 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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# **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	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	ed burst indication Tolerance		Deviation
dB	Expected (dB)	Actual (dB)	+/- dB	dB
120.0	117.3	117.1	1.0	-0.2

#### TIME AVERAGING TEST

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

Frequency of tone burst:

4000 Hz

Duration of tone burst:

1 ms

Repetition Time	Level of	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	pected level Actual level		Tolerance (dB)		
Hz	Hz dB Measured (		+	-	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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# CERTIFICATE OF CALIBRATION

Certificate No.:

21CA0120 04-01

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of

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Item tested

Description: Manufacturer:

Adaptors used:

Sound Level Meter (Type 1) B & K

Type/Model No.: Serial/Equipment No.:

2250L 3002695 Microphone

B & K 4950 2940839 Preamp B & K ZC0032 18582

Item submitted by

Customer Name:

Lam Geotechnics Limited.

Address of Customer:

Request No.:

- -

Date of receipt:

20-Jan-2021

Date of test:

24-Jan-2021

Reference equipment used in the calibration

Description:

Multi function sound calibrator

Model: B&K 4226 Serial No.

Expiry Date: 23-Aug-2021

Traceable to: CIGISMEC

Signal generator

DS 360

2288444 33873

19-May-2021

CEPREI

Ambient conditions

Temperature:

21 ± 1 °C 55 ± 10 %

Relative humidity: Air pressure:

1000 ± 5 hPa

## Test specifications

 The Sound Level Meter has been calibrated in accordance with the requirements as specified in BS 7580: Part 1: 1997 and the lab calibration procedure SMTP004-CA-152.

 The electrical tests were performed using an electrical signal substituted for the microphone which was removed and replaced by an equivalent capacitance within a tolerance of ±20%.

 The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference between the free-field and pressure 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.

Date:

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

Actual Measurement data are documented on worksheets.

Approved Signatory:

Feng Jungi

25-Jan-2021

Company Chop:

SENGIMEGRIUS COMPANY OF ROLL STORY OF ROLL

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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# CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.:

21CA0120 04-01

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of

2

1, Electrical Tests

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

	COL SERVICE COST		Expanded	Coverage
Test:	Subtest:	Status:	Uncertanity (dB)	Factor
Self-generated noise	Α	Pass	0.3	
Sell-generated hoise	Ĉ	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leq	At reference range , Step 5 dB at 4 kHz	Pass	0.3	
Ellicanty range for Eoq	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	
roqueries meighninge	C	Pass	0.3	
	Lin	Pass	0.3	
Time weightings	Single Burst Fast	Pass	0.3	
0 0	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 1/103 at 4kHz	Pass	0.3	
** ·=	1 ms burst duty factor 1/104 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	
The state of the s	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 24-Jan-2021 Checked by

Date:

Fend Junqi 25-Jan-2021

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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Test Data for Sound Level Meter

Page 1 of 5

Sound level meter type:

2250L

Serial No.

3002695

Date 24-Jan-2021

Microphone Preamp type: type: 4950 ZC0032 Serial No. Serial No. 2940839 18582

Report: 21CA0120 04-01

#### 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

14.3

dB

Noise level in C weighting

15.6

dB dB

Noise level in Lin

21.4

#### 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	Deviation		
Neierence/Expected lever	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	38.9	38.9	0.7	-0.1	-0.1	

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Test Data for Sound Level Meter

Page 2 of 5

Sound level met	er type:	2250L	Se	rial No.	3002695	Date	e 24-Jan-	2021
Microphone Preamp	type: type:	4950 ZC0032	7.7	rial No. rial No.	2940839 18582		ort: 21CA012	20 04-01
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	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	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	85.4	1.0	1.0	0.0
501.2	94.0	90.8	0.0	90.8	1.0	1.0	0.0
1995.0	94.0	95.2	0.0	95.2	1.0	1.0	0.0
3981.0	94.0	95.0	-0.1	94.9	1.0	1.0	0.0
7943.0	94.0	92.9	-0.3	92.6	1.5	3.0	0.0
12590.0	94.0	89.7	-0.3	89.4	3.0	6.0	0.0

Frequency weighting C:

Frequency	Ref. level	Expected level	Correction of electrical response	Actual level	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	91.1	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:	2250L		Serial No.	3002695		Date	24-Jan-2021
Microphone Preamp	type: type:	4950 ZC0032		Serial No. 2940839 Serial No. 18582		Report:	21CA0120 04-01	
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:

requeitly weighting Lin.								
Frequency	Ref. level	Expected level	correction of 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	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)

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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	111.9	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:

2250L

Serial No.

3002695

Date 24-Jan-2021

Microphone Preamp type: type: 4950 ZC0032 Serial No. Serial No. 2940839 18582

Report: 21CA0120 04-01

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 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	119.5	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 l

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

#### TIME AVERAGING TEST

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

Frequency of tone burst:

4000 Hz

Duration of tone burst:

1 ms

Daration of tone barst.	1 1110					
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:

2250L

Serial No.

3002695

Date 24-Jan-2021

Microphone Preamp type: type: 4950 ZC0032 Serial No. Serial No. 2940839 18582

Report: 21CA0120 04-01

#### 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	110.0	80.0	79.9	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	110.0	90.0	90.0	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
136.3	135.3	132.3	3.0	1.0	0.0

For integrating SLM, with the instrument indicating Leq.

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

Test frequency:

4000 Hz

Integration time:

10 sec

Single burst duration:

1 msec

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Rms level	Level reduced by	Expected level	Actual level	Tolerance	Deviation
at overload (dB)	1 dB	dB	dB	dB	dB
143.5	142.5	102.5	102.4	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) Devia	
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	93.1	1.5	3.0	0.2

----END-----



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



# 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:

Signal generator

Multi function sound calibrator

Model: B&K 4226 DS 360

Serial No. 2288444 61227

**Expiry Date:** 23-Aug-2020 24-Dec-2020

Traceable to: CIGISMEC CEPREI

**Ambient conditions** 

Temperature:

22 ± 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%.

The acoustic calibration was performed using an B&K 4226 sound calibrator and corrections was applied for the difference 3, 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 Jungi

Approved Signatory:

Date:

06-May-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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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	l level	Tolerance	Devia	ation
Neierence/Expedica 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	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 met	er 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	

Tel: (852) 2873 6860

Fax: (852) 2555 7533

## 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	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	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	93.2	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.	2722311		Date 06	-May-2020
Microphone Preamp	type: type:	4950 ZC0032		Serial No. 2698703 Serial No. 13321 Report: 20C		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	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-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.

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

#### TIME AVERAGING TEST

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

Frequency of tone burst:

4000 Hz

Duration of tone burst:

1 ms

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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	Deviation	
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

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Item tested

Description:

Manufacturer:

Type/Model No.: Serial/Equipment No.:

Adaptors used:

Sound Level Meter (Type 1) B&K

2250-L 2722310 **B&K** 4950 2698702

Microphone

Preamp B & K ZC0032 13318

Item submitted by

Customer Name:

Lam Geotechnics Ltd.

Address of Customer:

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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# **CERTIFICATE OF CALIBRATION**

(Continuation Page)

Certificate No.:

20CA0922 01

Page

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	Α	Pass	0.3	
Self-generated noise	C	Pass	0.8	
	Lin	Pass	1.6	
Linearity range for Leg	At reference range , Step 5 dB at 4 kHz	Pass	0.3	
Ellicanty range for Ecq	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	
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:

- End

Fung Chi Yip 23-Sep-2020 Checked by

Date: 24-Sep-2020

ınai

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.

2722310

Date 23-Sep-2020

Microphone Preamp

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

Report: 20CA0922 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

12.8

dB

Noise level in C weighting

14.4

dB

Noise level in Lin

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	al level	Tolerance	Deviation		
Melerence/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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# **SMECLab**

Test Data for Sound Level Meter

Page 2 of 5

Sound level met	er type:	2250-L	Se	erial No.	2722310	Date	e 23-Sep-	2020
Microphone Preamp	type: type:	4950 ZC0032		erial No. erial No.	2698702 13318		ort: 20CA092	2 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 me	ter type:	2250-L		Serial No.	272	2310	Date 23-	Sep-2020
Microphone Preamp	type: type:	4950 ZC0032		Serial No. Serial No.	269 133	8702 18	Report: 200	CA0922 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)

Ref. level	Expected level	Actual level	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	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-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.

40 Hz

Burst repetition frequency: 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

enigie seriet	aran arronn	1 111000			
Rms level	Level reduced by	Expected level	Actual level	Tolerance	Deviation
at overload (dB)	1 dB	dB	dB	dB	dB
142 2	1/11 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	Expected level Actual level Tolerance (dB)		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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2



# CERTIFICATE OF CALIBRATION

Certificate No.:

20CA1119 02-01

Page:

of

Item tested

Description:

Acoustical Calibrator (Class 1)

Manufacturer: Type/Model No.: Larson Davis CAL200

Serial/Equipment No.: Adaptors used:

13437

Item submitted by

Curstomer:

Lam Environmental Services Limited.

Address of Customer:

Request No.: Date of receipt:

19-Nov-2020

Date of test:

20-Nov-2020

#### Reference equipment used in the calibration

odel:	Serial No.	Expiry Date:	Traceable to:
kK 4180	2341427	11-May-2021	SCL
kK 2673	2743150	03-Jun-2021	CEPREI
kK 2610	2346941	03-Jun-2021	CEPREI
S 360	33873	19-May-2021	CEPREI
401A	US36087050	19-May-2021	CEPREI
03B	GB41300350	18-May-2021	CEPREI
132A	MY40003662	18-May-2021	CEPREI
333	uK 4180 uK 2673 uK 2610 3 360 401A 03B	LK 4180 2341427 LK 2673 2743150 LK 2610 2346941 S 360 33873 401A US36087050 03B GB41300350	48 4180     2341427     11-May-2021       48 2673     2743150     03-Jun-2021       48 2610     2346941     03-Jun-2021       401A     US36087050     19-May-2021       03B     GB41300350     18-May-2021

# Ambient conditions

Temperature:

22 ± 1 °C

Relative humidity:

55 ± 10 % 1005 ± 5 hPa

Air pressure:

#### 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

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

Approved Signatory:

Date: 21-Nov-2020

Company Chop:

op: \$705 \* '011

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.CARP156-1/Issue 1/Rev.D/01/03/2007



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# CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.:

20CA1119 02-01

Page:

#### 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)		
Estimated Expanded		
Uncertainty		

Frequency Shown	Output Sound Pressure Level Setting	Measured Output Sound Pressure Level	Estimated Expanded Uncertainty
Hz	dB	dB	dB
1000	94.00	93.66	0.10

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

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

At 1000 Hz

STF = 0.013 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 = 1000.1 Hz

Estimated expanded uncertainty

0.1 Hz

Coverage factor k = 2.2

#### **Total Noise and Distortion** 4,

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 = 0.5%

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:

End

Date:

Funa Chi Yip 20-Nov-2020 Checked by:

Date:

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