



CERTIFICATE OF CALIBRATION

Certificate No.: 15CA1203 04-01 Page 1 of 2

Item tested

Description:	Sound Level Meter (Type 1)	Microphone
Manufacturer:	B & K	B & K
Type/Model No.:	2236	4188
Serial/Equipment No.:	2100736	2288941
Adaptors used:	-	-

Item submitted by

Customer Name: Lam Geotechnics Limited
Address of Customer: -
Request No.: -
Date of receipt: 03-Dec-2015

Date of test: 04-Dec-2015

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Multi function sound calibrator	B&K 4226	2288444	19-Jun-2016	CIGISMEC
Signal generator	DS 360	33873	16-Apr-2016	CEPREI
Signal generator	DS 360	61227	16-Apr-2016	CEPREI

Ambient conditions

Temperature: 22 ± 1 °C
Relative humidity: 50 ± 10 %
Air pressure: 1010 ± 10 hPa

Test specifications

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

Test results

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

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

Actual Measurement data are documented on worksheets.

Approved Signatory:

Huang Jian Min/Feng Jun Qi

Date: 05-Dec-2015

Company Chop:



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



CERTIFICATE OF CALIBRATION

(Continuation Page)

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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 Uncertainty (dB)	Coverage Factor
Self-generated noise	A	Pass	0.3	2.1
	C	Pass	1.0	
	Lin	Pass	2.0	
Linearity range for Leq	At reference range , Step 5 dB at 4 kHz	Pass	0.3	2.2
	Reference SPL on all other ranges	Pass	0.3	
	2 dB below upper limit of each range	Pass	0.3	
	2 dB above lower limit of each range	Pass	0.3	
Linearity range for SPL	At reference range , Step 5 dB at 4 kHz	Pass	0.3	
	A	Pass	0.3	
	C	Pass	0.3	
Frequency weightings	Lin	Pass	0.3	
	Single Burst Fast	Pass	0.3	
	Single Burst Slow	Pass	0.3	
Peak response	Single 100µs rectangular pulse	Pass	0.3	
	R.M.S. accuracy	Pass	0.3	
Time weighting I	Single burst 5 ms at 2000 Hz	Pass	0.3	
	Repeated at frequency of 100 Hz	Pass	0.3	
Time averaging	1 ms burst duty factor 1/10 ³ at 4kHz	Pass	0.3	
	1 ms burst duty factor 1/10 ⁴ at 4kHz	Pass	0.3	
Pulse range	Single burst 10 ms at 4 kHz	Pass	0.4	
Sound exposure level	Single burst 10 ms at 4 kHz	Pass	0.4	
Overload indication	SPL	Pass	0.3	
	Leq	Pass	0.4	

2. Acoustic tests


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


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

3. Response to associated sound calibrator

N/A

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

Calibrated by:  - End -
Date: 04-Dec-2015

Checked by: 
Date: 05-Dec-2015

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



CERTIFICATE OF CALIBRATION

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Item tested

Description: Acoustical Calibrator (Class 1)
Manufacturer: Rion Co., Ltd.
Type/Model No.: NC-73
Serial/Equipment No.: 10465798
Adaptors used: -

Item submitted by

Customer: Lam Geotechnics Ltd.
Address of Customer: -
Request No.: -
Date of receipt: 28-May-2015

Date of test: 30-May-2015

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2341427	15-Apr-2016	SCL
Preamplifier	B&K 2673	2239857	22-Apr-2016	CEPREI
Measuring amplifier	B&K 2610	2346941	22-Apr-2016	CEPREI
Signal generator	DS 360	61227	16-Apr-2016	CEPREI
Digital multi-meter	34401A	US36087050	17-Apr-2016	CEPREI
Audio analyzer	8903B	GB41300350	17-Apr-2016	CEPREI
Universal counter	53132A	MY40003662	16-Apr-2016	CEPREI

Ambient conditions

Temperature: 21 ± 1 °C
Relative humidity: 60 ± 10 %
Air pressure: 1000 ± 5 hPa

Test specifications

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

Test results

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

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

Approved Signatory:


Huang Jian Min/Feng Jun Qi

Date: 01-Jun-2015

Company Chop:



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



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ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Jun 30, 2015 Rootsmeter S/N 0438320 Ta (K) - 296
 Operator Tisch Orifice I.D. - 0005 Pa (mm) - 749.3

PLATE OR Run #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER	ORFICE
					DIFF Hg (mm)	DIFF H2O (in.)
1	NA	NA	1.00	1.3930	3.2	2.00
2	NA	NA	1.00	0.9800	6.4	4.00
3	NA	NA	1.00	0.8790	7.9	5.00
4	NA	NA	1.00	0.8350	8.7	5.50
5	NA	NA	1.00	0.6900	12.7	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
0.9883	0.7095	1.4090	0.9957	0.7148	0.8889
0.9841	1.0042	1.9926	0.9915	1.0117	1.2570
0.9820	1.1172	2.2278	0.9894	1.1256	1.4054
0.9810	1.1749	2.3365	0.9884	1.1837	1.4740
0.9757	1.4141	2.8179	0.9830	1.4247	1.7777
Qstd slope (m) = 2.00072			Qa slope (m) = 1.25282		
intercept (b) = -0.01209			intercept (b) = -0.00763		
coefficient (r) = 0.99995			coefficient (r) = 0.99995		
y axis = SQRT[H2O(Pa/760) (298/Ta)]			y axis = SQRT[H2O(Ta/Pa)]		

CALCULATIONS

Vstd = Diff. Vol [(Pa-Diff. Hg)/760] (298/Ta)
 Qstd = Vstd/Time

Va = Diff Vol [(Pa-Diff Hg)/Pa]
 Qa = Va/Time

For subsequent flow rate calculations:

Qstd = 1/m{ [SQRT(H2O(Pa/760) (298/Ta))] - b}
 Qa = 1/m{ [SQRT H2O(Ta/Pa)] - b}



Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA1b Calibration Date : 21-Mar-16
 Equipment no. : HVS001 Calibration Due Date : 21-May-16

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	290	Kelvin	Pressure, P _a 1015 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori001	Slope, m _c	2.00072	Intercept, b _c	-0.01209
Last Calibration Date	30-Jun-15	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$			
Next Calibration Date	30-Jun-16	= m _c × Q _{std} + b _c			

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3×298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	6.2	6.2	12.4	1.7917	58	58.8439
2	4.8	4.8	9.6	1.5772	52	52.7566
3	3.6	3.6	7.2	1.3667	44	44.6402
4	2.4	2.4	4.8	1.1170	36	36.5238
5	1.6	1.6	3.2	0.9132	24	24.3492

By Linear Regression of Y on X	
Slope, m	= <u>38.3937</u> Intercept, b = <u>-8.5301</u>
Correlation Coefficient*	= <u>0.9915</u>
Calibration Accepted	= <u>Yes/No**</u>

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

** Delete as appropriate.

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

Calibrated by : Kit Au Checked by : Pauline Wong
 Date : 21-Mar-16 Date : 21-Mar-16



Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA2a Calibration Date : 21-Mar-16
 Equipment no. : HVS002 Calibration Due Date : 21-May-16

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	290	Kelvin	Pressure, P _a
			1015 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori001	Slope, m _c	2.00072	Intercept, b _c	-0.01209
Last Calibration Date	30-Jun-15	$\left(\frac{H \times P_a}{1013.3 \times 298 / T_a} \right)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	30-Jun-16				

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3x298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	6.8	6.8	13.6	1.8761	64	64.9312
2	5.4	5.4	10.8	1.6725	55	55.8002
3	4.1	4.1	8.2	1.4581	48	48.6984
4	2.8	2.8	5.6	1.2060	38	38.5529
5	1.8	1.8	3.6	0.9682	30	30.4365

By Linear Regression of Y on X

Slope, m = 37.7519 Intercept, b = -6.5353
 Correlation Coefficient* = 0.9990
 Calibration Accepted = Yes/No**

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

** Delete as appropriate.

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

Calibrated by : Kit Au Checked by : Pualine Wong
 Date : 21-Mar-16 Date : 21-Mar-16



Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA3a Calibration Date : 21-Mar-16
 Equipment no. : HVS012 Calibration Due Date : 21-May-16

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	290	Kelvin	Pressure, P _a
			1015 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori001	Slope, m _c	2.00072	Intercept, b _c	-0.01209
Last Calibration Date	30-Jun-15	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	30-Jun-16				

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3x298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	7.0	7.0	14.0	1.9034	54	54.7857
2	5.6	5.6	11.2	1.7031	49	49.7129
3	4.2	4.2	8.4	1.4757	42	42.6111
4	3.1	3.1	6.2	1.2687	38	38.5529
5	1.8	1.8	3.6	0.9682	30	30.4365

By Linear Regression of Y on X

Slope, m = 25.9695 Intercept, b = 5.2051
 Correlation Coefficient* = 0.9985
 Calibration Accepted = Yes/No**

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

** Delete as appropriate.

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

Calibrated by : Kit Au Checked by : Pauline Wong
 Date : 21-Mar-16 Date : 21-Mar-16



Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA4a Calibration Date : 21-Mar-16
 Equipment no. : HVS004 Calibration Due Date : 21-May-16

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	290	Kelvin	Pressure, P _a
			1015 mmHg

Orifice Transfer Standard Information					
Equipment No.	Ori001	Slope, m _c	2.00072	Intercept, b _c	-0.01209
Last Calibration Date	30-Jun-15	$\left(H \times P_a / 1013.3 \times 298 / T_a \right)^{1/2}$ $= m_c \times Q_{std} + b_c$			
Next Calibration Date	30-Jun-16				

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3x298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	7.9	7.9	15.8	2.0217	52	52.7566
2	6.8	6.8	13.6	1.8761	48	48.6984
3	5.4	5.4	10.8	1.6725	42	42.6111
4	3.8	3.8	7.6	1.4040	34	34.4947
5	2.1	2.1	4.2	1.0453	28	28.4074

By Linear Regression of Y on X

Slope, m = 25.5259 Intercept, b = 0.4522

Correlation Coefficient* = 0.9928

Calibration Accepted = Yes/No**

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

** Delete as appropriate.

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

Calibrated by : Kit Au Checked by : Pauline Wong
 Date : 21-Mar-16 Date : 21-Mar-16



Calibration Data for High Volume Sampler (TSP Sampler)

Location : CMA5b
 Equipment no. : HVS010

Calibration Date : 21-Mar-16
 Calibration Due Date : 21-May-16

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	290	Kelvin	Pressure, P _a
			1015 mmHg

Orifice Transfer Standard Information			
Equipment No.	Ori001	Slope, m _c	2.00072
		Intercept, b _c	-0.01209
Last Calibration Date	30-Jun-15	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$	
Next Calibration Date	30-Jun-16	$= m_c \times Q_{std} + b_c$	

Calibration of TSP						
Calibration Point	Manometer Reading H (inches of water)			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3x298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	6.2	6.2	12.4	1.7917	64	64.9312
2	4.9	4.9	9.8	1.5935	58	58.8439
3	3.4	3.4	6.8	1.3284	54	54.7857
4	2.1	2.1	4.2	1.0453	46	46.6693
5	1.4	1.4	2.8	0.8546	40	40.5820

By Linear Regression of Y on X

Slope, m = 25.0375 Intercept, b = 20.0458
 Correlation Coefficient* = 0.9942
 Calibration Accepted = Yes/No**

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

** Delete as appropriate.

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

Calibrated by : Kit Au
 Date : 21-Mar-16

Checked by : Pauline Wong
 Date : 21-Mar-16



Calibration Data for High Volume Sampler (TSP Sampler)

Location : MA1e
 Equipment no. : HVS007

Calibration Date : 21-Mar-16
 Calibration Due Date : 21-May-16

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T_a	290	Kelvin	Pressure, P_a
			1015 mmHg

Orifice Transfer Standard Information			
Equipment No.	Ori001	Slope, m_c	2.00072
		Intercept, b_c	-0.01209
Last Calibration Date	30-Jun-15	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$	
Next Calibration Date	30-Jun-16		

Calibration of TSP						
Calibration Point	Manometer Reading			Q_{std} ($m^3 / min.$) X-axis	Continuous Flow Recorder, W (CFM)	IC ($W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31$) Y-axis
	(up)	(down)	(difference)			
1	6.2	6.2	12.4	1.7917	59	59.8584
2	5.3	5.3	10.6	1.6570	50	50.7275
3	4.0	4.0	8.0	1.4403	44	44.6402
4	2.5	2.5	5.0	1.1399	30	30.4365
5	1.4	1.4	2.8	0.8546	20	20.2910

By Linear Regression of Y on X

Slope, m = 41.2980 Intercept, b = -15.6646
 Correlation Coefficient* = 0.9957
 Calibration Accepted = Yes/No**

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

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

Calibrated by : Kit Au
 Date : 21-Mar-16

Checked by : Pauline Wong
 Date : 21-Mar-16



Calibration Data for High Volume Sampler (TSP Sampler)

Location : MA1w
 Equipment no. : HVS008

Calibration Date : 21-Mar-16
 Calibration Due Date : 21-May-16

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	290	Kelvin	Pressure, P _a
			1015 mmHg

Orifice Transfer Standard Information				
Equipment No.	Ori001	Slope, m _c	2.00072	Intercept, b _c
				-0.01209
Last Calibration Date	30-Jun-15	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$ $= m_c \times Q_{std} + b_c$		
Next Calibration Date	30-Jun-16			

Calibration of TSP						
Calibration Point	Manometer Reading			Q _{std} (m ³ / min.) X-axis	Continuous Flow Recorder, W (CFM)	IC (W(P _a /1013.3x298/T _a) ^{1/2} /35.31) Y-axis
	(up)	(down)	(difference)			
1	6.5	6.5	13.0	1.8344	58	58.8439
2	5.2	5.2	10.4	1.6414	51	51.7420
3	4.1	4.1	8.2	1.4581	43	43.6256
4	2.5	2.5	5.0	1.1399	32	32.4656
5	1.5	1.5	3.0	0.8844	25	25.3637

By Linear Regression of Y on X

Slope, m = 35.7112 Intercept, b = -7.2889
 Correlation Coefficient* = 0.9973
 Calibration Accepted = Yes/No**

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

Remarks : As per client's provided information, the equipment reference no. of the calibrated High Volume Sampler has been re-assigned from EL080 to HVS008 with respect to the update in quality management system.

Calibrated by : Kit Au
 Date : 21-Mar-16

Checked by : Pauline Wong
 Date : 21-Mar-16