Lam Geotechincs Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location	:	ACL1	**Calbration Date**	:	18-Oct-13
Equipment no.	:	EL222	**Calbration Due Dat**	:	18-Dec-13

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition					
Temperature, T_a	302	Kelvin	**Pressure, P_a**	1010	mmHg

Orifice Transfer Standard Information					
Equipment No.	**EL086**	**Slope, m_c**	2.01968	**Intercept, bc**	-0.02746
Last Calibration Date	15-Jul-13	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$			
Next Calibration Date	15-Jul-14	$= m_c \times Q_{std} + b_c$			

Calibration of RSP						
Calibration Point	**Manometer Reading H (inches of water)** (up)	(down)	(difference)	**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**
1	6.1	6.1	12.2	1.7287	62	61.4877
2	4.9	4.9	9.8	1.5508	53	52.5620
3	4.0	4.0	8.0	1.4025	46	45.6199
4	2.5	2.5	5.0	1.1116	33	32.7273
5	1.6	1.6	3.2	0.8920	23	22.8099

By Linear Regression of Y on X

Slope, m = 45.8969 Intercept, b = -18.3277

Correlation Coefficient* = 0.9997

Calibration Accepted = Yes/~~No~~**

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

** Delete as appropriate.

Remarks :

Calibrated by	:	Henry	**Checked by**	:	Derek Lo
Date	:	18-Oct-13	**Date**	:	18-Oct-13

Lam Geotechincs Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location	:	ACL1	**Calbration Date**	:	18-Dec-13
Equipment no.	:	EL222	**Calbration Due Dat**	:	18-Feb-14

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T_a	284 Kelvin	**Pressure, P_a**	1020 mmHg

Orifice Transfer Standard Information					
Equipment No.	**EL086**	**Slope, m_c**	2.01968	**Intercept, bc**	-0.02746
Last Calibration Date	15-Jul-13	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$			
Next Calibration Date	15-Jul-14	$= m_c \times Q_{std} + b_c$			

Calibration of RSP						
Calibration Point	**Manometer Reading H (inches of water)**			**Q_{std}** (m^3 / min.)	**Continuous Flow Recorder, W**	**IC** $(W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31)$
	(up)	(down)	(difference)	**X-axis**	(CFM)	**Y-axis**
1	6.1	6.1	12.2	1.7910	62	63.7194
2	5.0	5.0	10.0	1.6227	53	54.4698
3	4.0	4.0	8.0	1.4529	45	46.2480
4	2.5	2.5	5.0	1.1514	31	31.8597
5	1.5	1.5	3.0	0.8950	20	20.5546

By Linear Regression of Y on X

Slope, m = 47.9532 Intercept, b = -22.9296

Correlation Coefficient* = 0.9994

Calibration Accepted = Yes/~~No~~**

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

** Delete as appropriate.

Remarks :

Calibrated by	:	Henry	**Checked by**	:	Derek Lo
Date	:	18-Dec-13	**Date**	:	18-Dec-13

Lam Geotechincs Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location	:	ACL2a	**Calbration Date**	:	4-Dec-13
Equipment no.	:	EL111	**Calbration Due Dat**	:	4-Feb-14

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition					
Temperature, T_a	295	Kelvin	**Pressure, P_a**	1020	mmHg

Orifice Transfer Standard Information					
Equipment No.	**EL086**	**Slope, m_c**	2.01968	**Intercept, bc**	-0.02746
Last Calibration Date	15-Jul-13	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$			
Next Calibration Date	15-Jul-14	$= m_c \times Q_{std} + b_c$			

Calibration of RSP						
Calibration Point	**Manometer Reading H (inches of water)**			**Q_{std}** (m^3 / min.)	**Continuous Flow Recorder, W**	**IC** ($W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31$)
	(up)	(down)	(difference)	**X-axis**	(CFM)	**Y-axis**
1	6.2	6.2	12.4	1.7717	61	61.5117
2	4.9	4.9	9.8	1.5766	55	55.4614
3	3.9	3.9	7.8	1.4080	49	49.4111
4	2.5	2.5	5.0	1.1300	40	40.3356
5	1.5	1.5	3.0	0.8784	32	32.2685

By Linear Regression of Y on X

Slope, m	=	32.9378	Intercept, b	=	3.2344
Correlation Coefficient*	=	0.9999			
Calibration Accepted	=	Yes/~~No~~**			

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

** Delete as appropriate.

Remarks : _____

Calibrated by	:	Henry	**Checked by**	:	Derek Lo
Date	:	4-Dec-13	**Date**	:	4-Dec-13

TISCH ENVIROMENTAL, INC.
145 SOUTH MIAMI AVE.
VILLAGE OF CLEVES, OH 45002
513.467.9000
877.263.7610 TOLL FREE
513.467.9009 FAX
WWW.TISCH-ENV.COM

AIR POLLUTION MONITORING EQUIPMENT

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Jul 15, 2013 Rootsmeter S/N 0438320 Ta (K) - 300
Operator Tisch Orifice I.D. - 0005 Pa (mm) - 759.46

PLATE OR Run #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORFICE DIFF H2O (in.)
1	NA	NA	1.00	1.3910	3.2	2.00
2	NA	NA	1.00	0.9830	6.4	4.00
3	NA	NA	1.00	0.8800	7.9	5.00
4	NA	NA	1.00	0.8380	8.8	5.50
5	NA	NA	1.00	0.6930	12.7	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)		Va	(x axis) Qa	(y axis)
0.9884	0.7106	1.4090		0.9958	0.7159	0.8888
0.9843	1.0013	1.9926		0.9916	1.0087	1.2570
0.9822	1.1161	2.2278		0.9895	1.1244	1.4054
0.9811	1.1708	2.3365		0.9884	1.1795	1.4740
0.9760	1.4084	2.8180		0.9832	1.4188	1.7777
Qstd slope (m) =		2.01968		Qa slope (m) =		1.26469
intercept (b) =		-0.02746		intercept (b) =		-0.01732
coefficient (r) =		0.99999		coefficient (r) =		0.99999
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}

PCB PIEZOTRONICS
A PCB GROUP COMPANY

Certificate of Calibration and Conformance

Certificate Number 2013-172795

Instrument Model 831, Serial Number 0003227, was calibrated on 16APR2013. The instrument meets factory specifications per Procedure D0001.8310, ANSI S1.4-1983 (R 2006) Type 1; S1.4A-1985 ; S1.43-1997 Type 1; S1.11-2004 Octave Band Class 1; S1.25-1991; IEC 61672-2002 Class 1; 60651-2001 Type 1; 60804-2000 Type 1; 61260-2001 Class 1; 61252-2002.

New Instrument
Date Calibrated: 16APR2013
Calibration due:

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Stanford Research Systems	DS360	61889	12 Months	30JAN2014	61889-013013

Reference Standards are traceable to the National Institute of Standards and Technology (NIST)

Calibration Environmental Conditions

Temperature: 23 ° Centigrade

Relative Humidity: 30 %

Affirmations

This Certificate attests that this instrument has been calibrated under the stated conditions with Measurement and Test Equipment (M&TE) Standards traceable to the U.S. National Institute of Standards and Technology (NIST). All of the Measurement Standards have been calibrated to their manufacturers' specified accuracy / uncertainty. Evidence of traceability and accuracy is on file at Provo Engineering & Manufacturing Center. An acceptable accuracy ratio between the Standard(s) and the item calibrated has been maintained. This instrument meets or exceeds the manufacturer's published specification unless noted.

The collective uncertainty of the Measurement Standard used does not exceed 25% of the applicable tolerance for each characteristic calibrated unless otherwise noted.

The results documented in this certificate relate only to the item(s) calibrated or tested. A one year calibration is recommended, however calibration interval assignment and adjustment are the responsibility of the end user. This certificate may not be reproduced, except in full, without the written approval of the issuer.

Tested with PRM831-023959

Signed: Ron Harris

Technician: Ron Harris

Provo Engineering and Manufacturing Center, 1681 West 820 North, Provo, Utah 84601
Toll Free: 888.258.3222 Telephone: 716.926.8243 Fax: 716.926.8215
ISO 9001-2008 Certified

~ *Certificate of Calibration and Compliance* ~

Microphone Model: 377B02 Serial Number: LW135892 Manufacturer: PCB

Calibration Environmental Conditions

Environmental test conditions as printed on microphone calibration chart.

Reference Equipment

Manufacturer	Model #	Serial #	PCB Control #	Cal Date	Due Date
Hewlett Packard	34401A	MY41045214	LD-001	3/8/12	3/8/13
Bruel & Kjaer	4192	2657834	CA1270	11/16/12	11/15/13
Newport	BTH-W/N	8410668	CA1187	not required	not required
Larson Davis	PRM915	124	CA-1024	12/6/12	12/6/13
Larson Davis	PRM902	4709	CA1453	10/16/12	10/16/13
Larson Davis	2559LF	3216	CA-883	not required	not required
Larson Davis	ADP005	1	LD-017	not required	not required
Larson Davis	PRM916	127	CA-924	4/4/12	4/4/13
Larson Davis	CAL250	5025	CA1277	3/7/12	3/7/13
Larson Davis	2201	140	CA-891	4/20/12	4/19/13
Larson Davis	2900	1079	CA-521A	6/10/11	6/10/13
Larson Davis	PRA951-4	234	CA1154	9/19/12	9/19/13
0	0	0	0	not required	not required
0	0	0	0	not required	not required

Frequency sweep performed with B&K UA0033 electrostatic actuator.

Condition of Unit

As Found: N/A

As Left: New unit in tolerance

Notes

1. Calibration of reference microphone is traceable through PTB.
2. This certificate shall not be reproduced, except in full, without written approval from PCB Piezotronics, Inc.
3. Calibration is performed in compliance with ISO 9001, ISO 10012-1, ANSI/NCSL Z540.3 and ISO 17025.
4. See Manufacturer's Specification Sheet for a detailed listing of performance specifications.
5. Open circuit sensitivity is measured using the insertion voltage method following procedure AT603-5.
6. Measurement uncertainty (95% confidence level with coverage factor of 2) for sensitivity is +/-0.20 dB.
7. Unit calibrated per ACS-20.

Technician: Milton Munger mlm Date: February 25, 2013

ilac-MRA ACCREDITED

CALIBRATION CERT #1862.01

PCB PIEZOTRONICS VIBRATION DIVISION

3425 Walden Avenue, Depew, New York, 14043

TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL60-3444681319.486

~ Calibration Report ~

Microphone Model: 377B02 Serial Number: LW135892 Description: 1/2" Free-Field Microphone

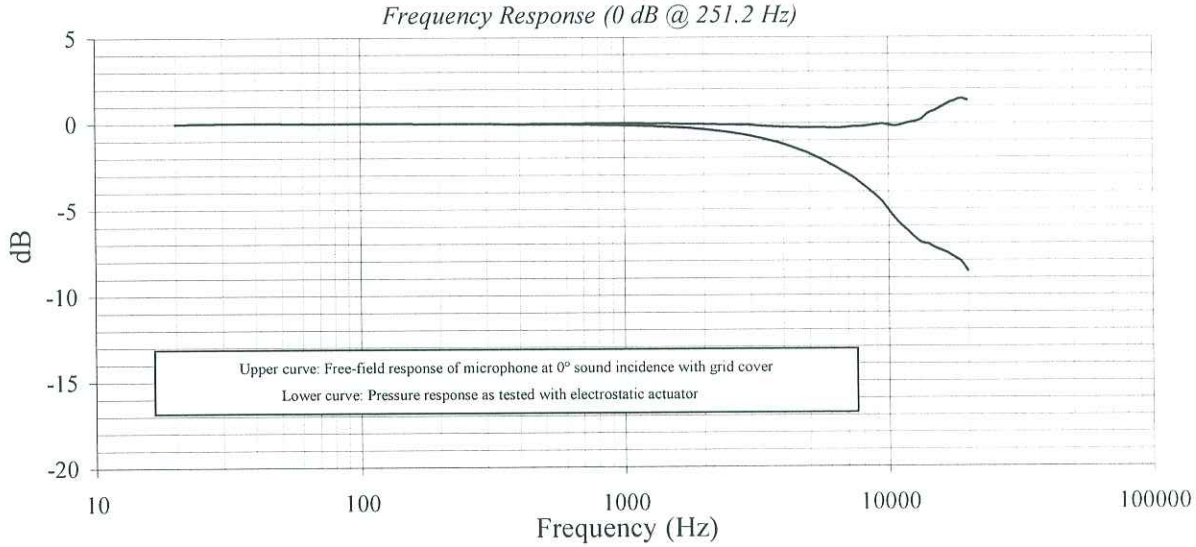
Calibration Data

Open Circuit Sensitivity @ 251.2 Hz: 47.69 mV/Pa
-26.43 dB re 1V/Pa

Polarization Voltage, External: 0 V
Capacitance: 12.6 pF

Temperature: 71 °F (22°C) Ambient Pressure: 996 mbar Relative Humidity: 25 %

Frequency Response (0 dB @ 251.2 Hz)



Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)	Freq (Hz)	Lower (dB)	Upper (dB)
20.0	-0.01	-0.01	1584.9	-0.23	-0.02	6683.4	-2.79	-0.27	-	-	-
25.1	0.02	0.02	1678.8	-0.25	-0.02	7079.5	-3.01	-0.23	-	-	-
31.6	0.04	0.04	1778.3	-0.28	-0.03	7498.9	-3.26	-0.19	-	-	-
39.8	0.04	0.04	1883.7	-0.31	-0.03	7943.3	-3.58	-0.19	-	-	-
50.1	0.03	0.03	1995.3	-0.35	-0.04	8414.0	-3.88	-0.15	-	-	-
63.1	0.03	0.03	2113.5	-0.39	-0.05	8912.5	-4.21	-0.10	-	-	-
79.4	0.02	0.02	2238.7	-0.43	-0.06	9440.6	-4.57	-0.05	-	-	-
100.0	0.02	0.02	2371.4	-0.48	-0.07	10000.0	-5.07	-0.12	-	-	-
125.9	0.02	0.02	2511.9	-0.53	-0.07	10592.5	-5.57	-0.17	-	-	-
158.5	0.01	0.01	2660.7	-0.59	-0.08	11220.2	-5.96	-0.10	-	-	-
199.5	0.01	0.01	2818.4	-0.65	-0.09	11885.0	-6.31	0.01	-	-	-
251.2	0.00	0.00	2985.4	-0.72	-0.10	12589.3	-6.68	0.09	-	-	-
316.2	-0.01	0.00	3162.3	-0.82	-0.14	13335.2	-6.97	0.22	-	-	-
398.1	-0.02	-0.02	3349.7	-0.90	-0.16	14125.4	-7.05	0.54	-	-	-
501.2	-0.03	0.01	3548.1	-1.00	-0.18	14962.4	-7.27	0.70	-	-	-
631.0	-0.04	0.00	3758.4	-1.10	-0.20	15848.9	-7.43	0.92	-	-	-
794.3	-0.07	0.02	3981.1	-1.22	-0.22	16788.0	-7.59	1.13	-	-	-
1000.0	-0.10	0.02	4217.0	-1.34	-0.23	17782.8	-7.83	1.28	-	-	-
1059.3	-0.11	0.02	4466.8	-1.47	-0.24	18836.5	-8.09	1.42	-	-	-
1122.0	-0.12	0.02	4731.5	-1.62	-0.25	19952.6	-8.61	1.32	-	-	-
1188.5	-0.14	0.01	5011.9	-1.78	-0.25	-	-	-	-	-	-
1258.9	-0.15	0.01	5308.8	-1.96	-0.26	-	-	-	-	-	-
1333.5	-0.17	0.01	5623.4	-2.14	-0.26	-	-	-	-	-	-
1412.5	-0.19	0.00	5956.6	-2.35	-0.28	-	-	-	-	-	-
1496.2	-0.21	-0.01	6309.6	-2.56	-0.27	-	-	-	-	-	-

Technician: Milton Munger MM Date: February 25, 2013

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CALIBRATION CERT #1862.01

PCB PIEZOTRONICS
VIBRATION DIVISION
3425 Walden Avenue, Depew, New York, 14043
TEL: 888-684-0013 FAX: 716-685-3886 www.pcb.com

ID:CAL60-3444681319.486

Hong Kong Calibration Ltd.
香 港 校 正 有限公司

Calibration Certificate

Certificate No. 34228 Page 1 of 2 Pages

Customer : Lam Geotechnics Limited

Address : 11/F, Centre Point, 181-185 Gloucester Road, Wanchai, Hong Kong.

Order No. : Q31610 **Date of receipt :** 21-Jun-13

Item Tested

Description : Sound Level Calibrator

Manufacturer : Rion

Model : NC-73 **Serial No. :** 10707358

Test Conditions

Date of Test : 25-Jun-13 **Supply Voltage :** --

Ambient Temperature : (23 ± 3)°C **Relative Humidity :** (50 ± 25) %

Test Specifications

Calibration check.

Ref. Document/Procedure : F21, Z02.

Test Results

All results were within the manufacturer's specification.

The results are shown in the attached page(s).

Main Test equipment used:

Equipment No.	Description	Cert. No.	Traceable to
S014	Spectrum Analyzer	30259	NIM-PRC & SCL-HKSAR
S024	Sound Level Calibrator	30620	NIM-PRC & SCL-HKSAR
S041	Universal Counter	28347	SCL-HKSAR
S206	Sound Level Meter	30655	SCL-HKSAR

The values given in this Calibration Certificate only relate to the values measured at the time of the test and any uncertainties quoted will not include allowance for the equipment long term drift, variations with environmental changes, vibration and shock during transportation, overloading, mis-handling, or the capability of any other laboratory to repeat the measurement. Hong Kong Calibration Ltd. shall not be liable for any loss or damage resulting from the use of the equipment.

The test equipment used for calibration are traceable to International System of Units (SI).
The test results apply to the above Unit-Under-Test only

Calibrated by : Liam Wong

Approved by : Dorothy Cheuk

Date: 25-Jun-13

This Certificate is issued by:
Hong Kong Calibration Ltd.
Unit 8B, 24/F., Well Fung Industrial Centre, No. 58-76, Ta Chuen Ping Street,Kwai Chung, NT,Hong Kong.
Tel: 2425 8801 Fax: 2425 8646

Calibration Certificate

Results :

1. **Level Accuracy (at 1 kHz)**

UUT Nominal Value	Measured Value	Mfr's Spec.
94 dB	93.88 dB	± 1 dB

Uncertainty : ± 0.2 dB

2. **Frequency Accuracy**

UUT Nominal Value	Measured Value	Mfr's Spec.
1 kHz	0.995 kHz	± 2 %

Uncertainty : ± 0.1 %

3. **Level Stability** : 0.0 dB
   Uncertainty : ± 0.01 dB

4. **Total Harmonic Distortion** : < 0.2 %
   Mfr's Spec. : < 3 %
   Uncertainty : ± 2.3 % of reading

Remark : 1. UUT : Unit-Under-Test
2. The uncertainty claimed is for a confidence probability of not less than 95%.
3. The above measured values were the mean of 3 measurements.
4. Atmospheric Pressure : 999 hPa

---------- END ----------