



Lam Geotechnics Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : ACL1
 Equipment no. : EL222
 Calibration Date : 19-Apr-14
 Calibration Due Date : 19-Jun-14

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T_a	298	Kelvin	Pressure, P_a
			1012 mmHg

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

Calibration of TSP						
Calibration Point	Manometer Reading H (inches of water)			Q_{std} ($m^3 / min.$) X-axis	Continuous Flow Recorder, W (CFM)	IC ($W(P_a/1013.3 \times 298/T_a)^{1/2}/35.31$) Y-axis
	(up)	(down)	(difference)			
1	6.1	6.1	12.2	1.7419	62	61.9602
2	5.0	5.0	10.0	1.5783	53	52.9660
3	4.0	4.0	8.0	1.4131	45	44.9711
4	2.5	2.5	5.0	1.1200	30	29.9807
5	1.6	1.6	3.2	0.8987	20	19.9872

By Linear Regression of Y on X

Slope, m = 49.7861 Intercept, b = -25.2593
 Correlation Coefficient* = 0.9996
 Calibration Accepted = Yes/No**

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

** Delete as appropriate.

Remarks : _____

Calibrated by : Felix Li Checked by : Derek Lo
 Date : 19-Apr-14 Date : 19-Apr-14



Lam Geotechnics Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : ACL1 Calibration Date : 21-Jun-14
 Equipment no. : EL222 Calibration Due Date : 21-Aug-14

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	301	Kelvin	Pressure, P _a
			1003 mmHg

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

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	5.8	5.8	11.6	1.6830	56	55.4363
2	4.4	4.4	8.8	1.4676	48	47.5168
3	3.7	3.7	7.4	1.3469	43	42.5672
4	2.2	2.2	4.4	1.0417	34	33.6578
5	1.5	1.5	3.0	0.8626	26	25.7383

By Linear Regression of Y on X

Slope, m = 35.2472 Intercept, b = -4.1457
 Correlation Coefficient* = 0.9981
 Calibration Accepted = Yes/No**

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

** Delete as appropriate.

Remarks : _____

Calibrated by : Felix Li Checked by : Pauline Wong
 Date : 21-Jun-14 Date : 21-Jun-14



Lam Geotechnics Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : ACL2a
 Equipment no. : EL111

Calibration Date : 2-Apr-14
 Calibration Due Dat : 2-Jun-14

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	292	Kelvin	Pressure, P _a
			1012 mmHg

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

Calibration of RSP						
Calibration Point	Manometer Reading			Q _{std}	Continuous Flow	IC
	H (inches of water)			(m ³ / min.)	Recorder, W	(W(P _a /1013.3x298/T _a) ^{1/2} /35.31)
	(up)	(down)	(difference)	X-axis	(CFM)	Y-axis
1	6.2	6.2	12.4	1.7738	61	61.5840
2	4.9	4.9	9.8	1.5784	52	52.4978
3	4.1	4.1	8.2	1.4450	46	46.4404
4	2.6	2.6	5.2	1.1535	33	33.3159
5	1.7	1.7	3.4	0.9353	24	24.2298

By Linear Regression of Y on X

Slope, m = 44.6179 Intercept, b = -17.8344
 Correlation Coefficient* = 0.9998
 Calibration Accepted = Yes/No**

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

** Delete as appropriate.

Remarks : _____

Calibrated by : Henry
 Date : 2-Apr-14

Checked by : Derek Lo
 Date : 2-Apr-14



Lam Geotechnics Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location : ACL2a
 Equipment no. : EL111

Calibration Date : 3-Jun-14
 Calibration Due Dat : 3-Aug-14

CALIBRATION OF CONTINUOUS FLOW RECORDER

Ambient Condition			
Temperature, T _a	303	Kelvin	Pressure, P _a
			1004 mmHg

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

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	6.2	6.2	12.4	1.7347	61	60.2164
2	5.1	5.1	10.2	1.5746	53	52.3191
3	4.2	4.2	8.4	1.4302	46	45.4091
4	2.6	2.6	5.2	1.1282	33	32.5761
5	1.6	1.6	3.2	0.8879	23	22.7045

By Linear Regression of Y on X

Slope, m = 44.0592 Intercept, b = -16.8841
 Correlation Coefficient* = 0.9993
 Calibration Accepted = Yes/No**

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

** Delete as appropriate.

Remarks : _____

Calibrated by : Henry
 Date : 3-Jun-14

Checked by : Derek Lo
 Date : 3-Jun-14



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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	ORFICE
					DIFF Hg (mm)	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 = $\text{SQRT}[\text{H}_2\text{O}(\text{Pa}/760)(298/\text{Ta})]$			y axis = $\text{SQRT}[\text{H}_2\text{O}(\text{Ta}/\text{Pa})]$		

CALCULATIONS

$$\text{Vstd} = \text{Diff. Vol} [(\text{Pa} - \text{Diff. Hg}) / 760] (298 / \text{Ta})$$

$$\text{Qstd} = \text{Vstd} / \text{Time}$$

$$\text{Va} = \text{Diff Vol} [(\text{Pa} - \text{Diff Hg}) / \text{Pa}]$$

$$\text{Qa} = \text{Va} / \text{Time}$$

For subsequent flow rate calculations:

$$\text{Qstd} = 1/m \{ [\text{SQRT}(\text{H}_2\text{O}(\text{Pa}/760)(298/\text{Ta}))] - b \}$$

$$\text{Qa} = 1/m \{ [\text{SQRT}(\text{H}_2\text{O}(\text{Ta}/\text{Pa}))] - b \}$$

Certificate of Calibration and Conformance

Certificate Number 2014-185089

Instrument Model LXT1, Serial Number 0003737, was calibrated on 20 Jan 2014. The instrument meets factory specifications per Procedure D0001.8306, ANSI S1.4-1983 (R 2006) Type 1, S1.43-1997, S1.25-1991; S1.11-2004; IEC 61672-2002, 60651-2001, 60804-2000, 61260-2001, 61252-2002.

New Instrument
Date Calibrated: 20 Jan 2014
Calibration due:

Calibration Standards Used

MANUFACTURER	MODEL	SERIAL NUMBER	INTERVAL	CAL. DUE	TRACEABILITY NO.
Stanford Research Systems	DS360	61889	12 Months	30 Jan 2014	61889-013013

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

Calibration Environmental Conditions

Temperature: 22 ° Centigrade

Relative Humidity: 22 %

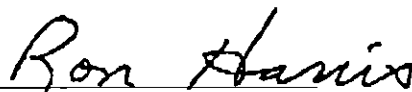
Affirmations

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 PRMLXT1L-028019

Signed: 
Technician: Ron Harris

~ Certificate of Calibration and Compliance ~

Microphone Model: 377B02

Serial Number: 140872

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	3/6/13	3/6/14
Bruel & Kjaer	4192	2493415	LD028	1/16/13	1/16/14
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	4943	CA1162	10/21/13	10/21/14
Larson Davis	2559LF	3216	CA-883	not required	not required
Larson Davis	ADP005	1	LD-017	not required	not required
Larson Davis	PRM916	127	CA924	4/15/13	4/15/14
Larson Davis	CAL250	5025	CA1277	7/25/13	7/25/14
Larson Davis	2201	140	CA-1409	3/22/13	3/21/14
Larson Davis	2900	1079	CA-521A	6/4/13	6/4/14
Larson Davis	PRA951-4	234	CA1154	9/17/13	9/17/14
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: Lenard Lukasik

Date: November 25, 2013



PCB PIEZOTRONICS
VIBRATION DIVISION

3425 Walden Avenue, Depew, New York, 14043

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

ID:CAL60-3486230871.248

~ Calibration Report ~

Microphone Model: 377B02

Serial Number: 140872

Description: 1/2" Free-Field Microphone

Calibration Data

Open Circuit Sensitivity @ 251.2 Hz: 50.64 mV/Pa
-25.91 dB re 1V/Pa

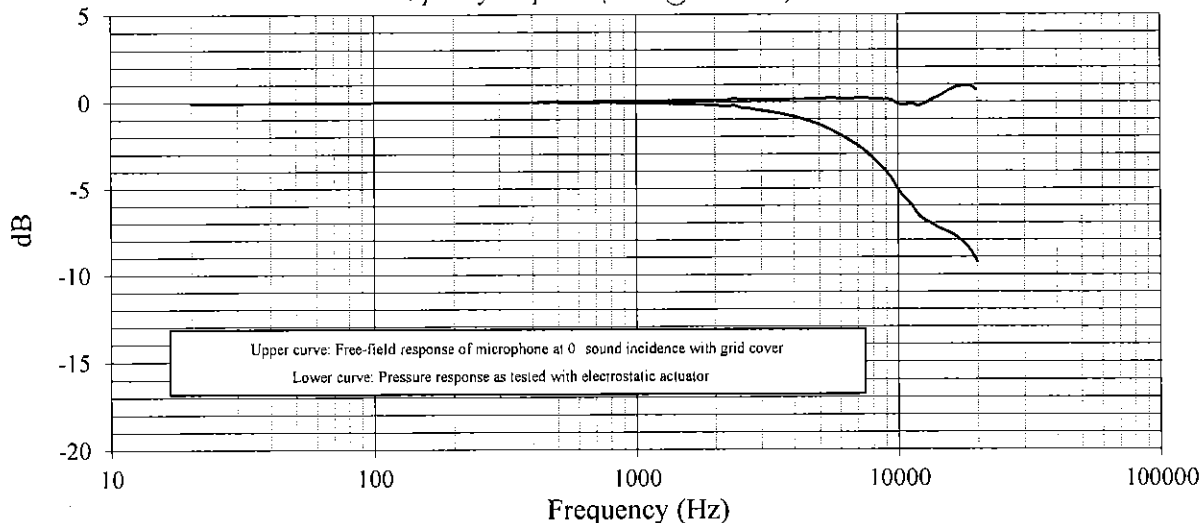
Polarization Voltage, External: 0 V
Capacitance: 10.7 pF

Temperature: 69 °F (21°C)

Ambient Pressure: 1001 mbar

Relative Humidity: 28 %

Frequency Response (0 dB @ 251.2 Hz)



Upper curve: Free-field response of microphone at 0° sound incidence with grid cover
Lower curve: Pressure response as tested with electrostatic actuator

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	-0.06	-0.06	1584.9	-0.12	0.09	6683.4	-2.32	0.20	-	-	-
25.1	-0.06	-0.06	1678.8	-0.14	0.09	7079.5	-2.56	0.22	-	-	-
31.6	-0.05	-0.05	1778.3	-0.15	0.10	7498.9	-2.85	0.22	-	-	-
39.8	-0.03	-0.03	1883.7	-0.18	0.10	7943.3	-3.22	0.17	-	-	-
50.1	-0.02	-0.02	1995.3	-0.20	0.11	8414.0	-3.57	0.16	-	-	-
63.1	-0.02	-0.02	2113.5	-0.22	0.12	8912.5	-3.96	0.15	-	-	-
79.4	-0.01	-0.01	2238.7	-0.25	0.12	9440.6	-4.41	0.11	-	-	-
100.0	-0.01	-0.01	2371.4	-0.20	0.21	10000.0	-5.07	-0.12	-	-	-
125.9	0.00	0.00	2511.9	-0.32	0.14	10592.5	-5.57	-0.17	-	-	-
158.5	0.00	0.00	2660.7	-0.34	0.17	11220.2	-5.96	-0.10	-	-	-
199.5	0.00	0.00	2818.4	-0.43	0.13	11885.0	-6.54	-0.22	-	-	-
251.2	0.00	0.00	2985.4	-0.47	0.15	12589.3	-6.86	-0.09	-	-	-
316.2	0.00	0.01	3162.3	-0.53	0.15	13335.2	-7.06	0.13	-	-	-
398.1	0.00	0.00	3349.7	-0.60	0.14	14125.4	-7.30	0.29	-	-	-
501.2	-0.01	0.03	3548.1	-0.67	0.15	14962.4	-7.46	0.51	-	-	-
631.0	-0.01	0.03	3758.4	-0.75	0.15	15848.9	-7.63	0.72	-	-	-
794.3	-0.02	0.07	3981.1	-0.84	0.16	16788.0	-7.86	0.86	-	-	-
1000.0	-0.05	0.07	4217.0	-0.94	0.17	17782.8	-8.19	0.92	-	-	-
1059.3	-0.05	0.08	4466.8	-1.06	0.17	18836.5	-8.61	0.90	-	-	-
1122.0	-0.06	0.08	4731.5	-1.18	0.19	19952.6	-9.28	0.65	-	-	-
1188.5	-0.07	0.08	5011.9	-1.32	0.21	-	-	-	-	-	-
1258.9	-0.08	0.08	5308.8	-1.49	0.21	-	-	-	-	-	-
1333.5	-0.09	0.09	5623.4	-1.66	0.22	-	-	-	-	-	-
1412.5	-0.10	0.09	5956.6	-1.87	0.20	-	-	-	-	-	-
1496.2	-0.11	0.09	6309.6	-2.08	0.21	-	-	-	-	-	-

Technician: Lenard Lukasic *W*

Date: November 25, 2013



CALIBRATION CERT #1862.01



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