Lam Geotechincs Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location	:	ACL1	**Calbration Date**	:	19-Apr-14
Equipment no.	:	EL222	**Calbration Due Dat**	:	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, 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 TSP						
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	1.7419	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 Geotechincs Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location	:	ACL1	**Calbration Date**	:	21-Jun-14
Equipment no.	:	EL222	**Calbration Due Dat**	:	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, 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 TSP						
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	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 Geotechincs Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location	:	ACL2a	**Calbration Date**	:	2-Apr-14
Equipment no.	:	EL111	**Calbration 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	$(H \times P_a / 1013.3 \times 298 / T_a)^{1/2}$			
Next Calibration Date	15-Jul-14	$= m_c \times Q_{std} + b_c$			

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

Lam Geotechincs Limited

Calibration Data for High Volume Sampler (TSP Sampler)

Location	:	ACL2a	**Calbration Date**	:	3-Jun-14
Equipment no.	:	EL111	**Calbration 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, 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 TSP						
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	6.2	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	**Checked by**	:	Derek Lo
Date	:	3-Jun-14	**Date**	:	3-Jun-14

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 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: 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: 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

ACCREDITED
CALIBRATION CERT #1862.01

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

~ *Calibration Report* ~

Microphone Model: 377B02 Serial Number: 140872 Description: 1/2" Free-Field Microphone

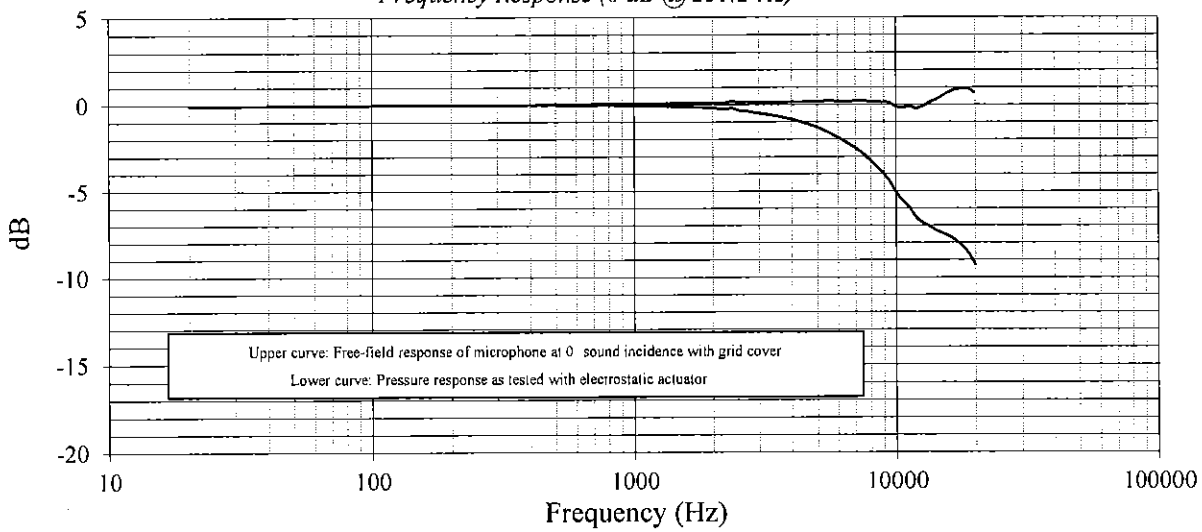
Calibration Data

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)



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 Lukasik Date: November 25, 2013

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CALIBRATION CERT #1862.01

PCB PIEZOTRONICS VIBRATION DIVISION

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ID:CAL60-3458230671.246

綜合試驗有限公司
SOILS & MATERIALS ENGINEERING CO., LTD.
G/F., 9/F., 12/F., 13/F. & 20/F., Leader Centre, 37 Wong Chuk Hang Road, Aberdeen, Hong Kong.
香港黃竹坑道37號利達中心地下，9樓，12樓，13樓及20樓
E-mail: smec@cigismec.com Website: www.cigismec.com
Tel : (852) 2873 6860
Fax : (852) 2555 7533
HOKLAS 028

CERTIFICATE OF CALIBRATION

Certificate No.: 14CA0529 01-02 **Page:** 1 **of** 2

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

Curstomer:	Lam Geotechnics Limited
Address of Customer:	-
Request No.:	-
Date of receipt:	29-May-2014

Date of test: 30-May-2014

Reference equipment used in the calibration

Description:	Model:	Serial No.	Expiry Date:	Traceable to:
Lab standard microphone	B&K 4180	2412857	13-May-2015	SCL
Preamplifier	B&K 2673	2239857	10-Apr-2015	CEPREI
Measuring amplifier	B&K 2610	2346941	08-Apr-2015	CEPREI
Signal generator	DS 360	61227	09-Apr-2015	CEPREI
Digital multi-meter	34401A	US36087050	17-Dec-2014	CEPREI
Audio analyzer	8903B	GB41300350	07-Apr-2015	CEPREI
Universal counter	53132A	MY40003662	11-Apr-2015	CEPREI

Ambient conditions

Temperature:	22 ± 1 °C
Relative humidity:	60 ± 10 %
Air pressure:	1000 ± 10 hPa

Test specifications

1, 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: Huang Jian Min/Feng Jun Qi **Date:** 30-May-2014 **Company Chop:** SOILS & MATERIALS ENGINEERING COMPANY LTD 綜合試驗有限公司

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

綜合試驗有限公司
SOILS & MATERIALS ENGINEERING CO., LTD.
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HOKLAS 028

CERTIFICATE OF CALIBRATION

(Continuation Page)

Certificate No.: 14CA0529 01-02 **Page:** 2 **of** 2

1, Measured Sound Pressure Level

The output Sound Pressure Level in the calibrator head was measured at the setting and frequency shown using a calibrated laboratory standard microphone and insert voltage technique. The results are given in below with the estimated uncertainties.

(Output level in dB re 20 μPa)

Frequency Shown Hz	Output Sound Pressure Level Setting dB	Measured Output Sound Pressure Level dB	Estimated Expanded Uncertainty dB
1000	94.00	94.57	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 = 0.001 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 = 965.6 Hz**

Estimated expanded uncertainty 0.1 Hz Coverage factor k = 2.2

4, Total Noise and Distortion

For the Total Noise and Distortion measurement, the unfiltered AC output of the B&K 2610 measuring amplifier was connected to an Agilent Type 8903 B distortion analyser. The TND result at 1 KHz was:

At 1000 Hz **TND = 0.9 %**

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.

- End -

Calibrated by: Fung Chi Yip **Date:** 30-May-2014

Checked by: Lam Tze Wai **Date:** 30-May-2014

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.