High Volume Air Sampler Calibration Worksheet

Project Title: Design and Construction of Tsuen Wan Drainage Tunnel
Monitoring Location: Ho Fung College (ASR 1)
Calibration Date: 17-Mar-11
Calibration Due Date 16-May-11
Time: 08:00

Sampler Model:	BM2000HX
Serial No.:	4994
Calibrator Orifice no.:	1785
Slope (m):	2.01637
Intercept (b):	-0.02316
Correction coeff. (r)	0.99996

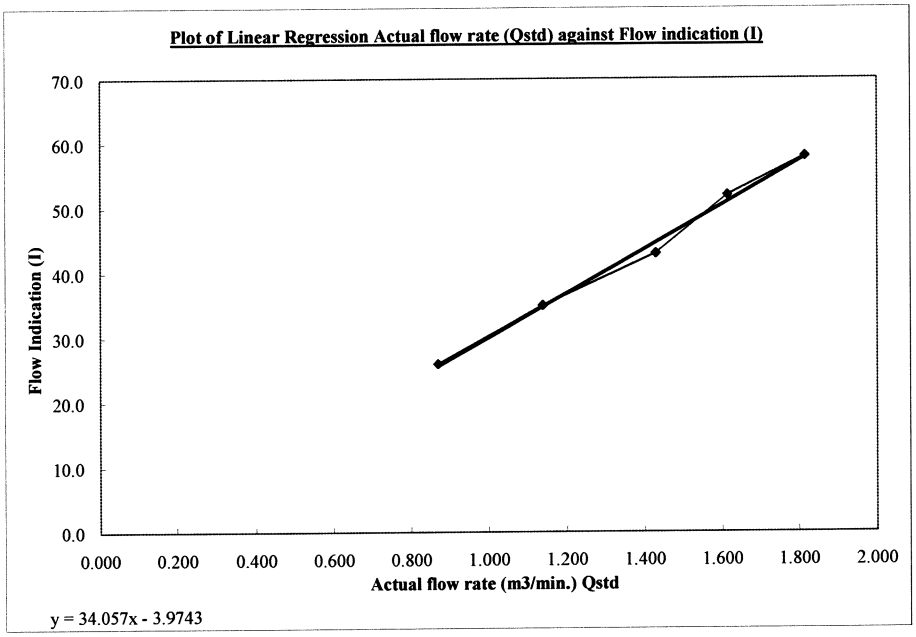
$$Flow(corrected) = \sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}}$$

$$Qstd = \frac{1}{m} \times (\sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}} - b)$$

Standard pressure (mmHg) Pstd:	763.9
Standard temp. (K) Tstd:	290.8
Calibration pressure (mmHg) Pa:	766.3
Calibration temp. (K) Ta:	289.2

Sample no.	Pressure Drop (H), inch	Flow (corrcted), m^3/min	Actual flow rate (Qstd), m^3/min	Flow indication (I), arbitrary
1	12.8	3.637	1.815	58.0
2	10.1	3.231	1.614	52.0
3	7.9	2.858	1.429	43.0
4	5.0	2.273	1.139	35.0
5	2.9	1.731	0.870	26.0

Correlation Coefficient : 0.9969



Remark
1HPa = 0.750062 mmHg

Calibrated by: Arthur Chiu ( ) **Date:** 17/3/2011

Checked by: F.C. Tsang ( ) **Date:** 17/3/2011

High Volume Air Sampler Calibration Worksheet

Project Title: Design and Construction of Tsuen Wan Drainage Tunnel
Monitoring Location: Heng Hoi Chi Hong Ship Temple (ASR 3)
Calibration Date: 17-Mar-11
Calibration Due Date 16-May-11
Time: 08:15

Sampler Model:	BM2000HX
Serial No.:	5875
Calibrator Orifice no.:	1785
Slope (m):	2.01637
Intercept (b):	-0.02316
Correction coeff. (r)	0.99996

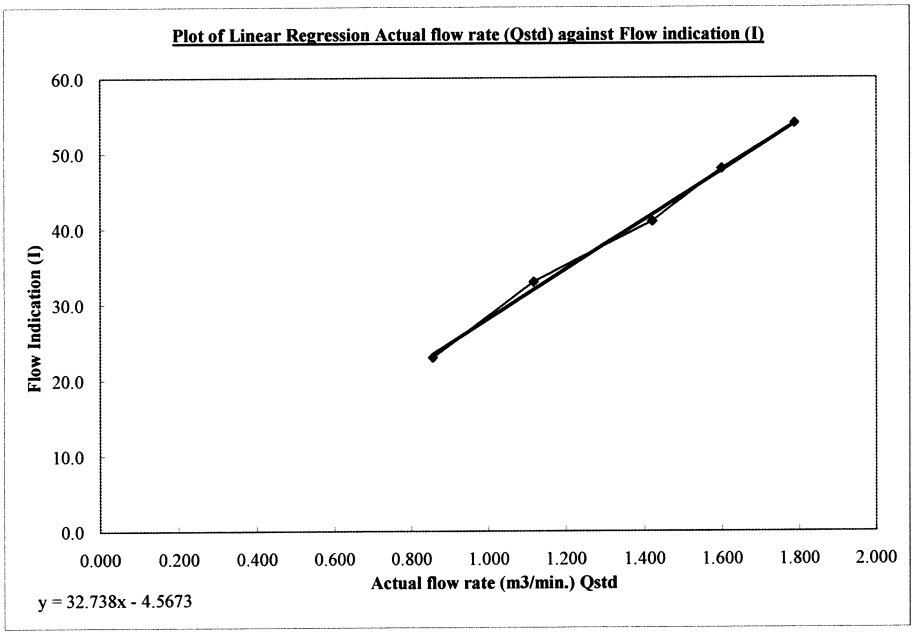
Standard pressure (mmHg) Pstd:	763.9
Standard temp. (K) Tstd:	290.8
Calibration pressure (mmHg) Pa:	766.3
Calibration temp. (K) Ta:	289.2

$$Flow(corrected) = \sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}}$$

$$Qstd = \frac{1}{m} \times (\sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}} - b)$$

Sample no.	Pressure Drop (H), inch	Flow (corrcted), m^3/min	Actual flow rate (Qstd), m^3/min	Flow indication (I), arbitrary
1	12.4	3.580	1.787	54.0
2	9.9	3.199	1.598	48.0
3	7.8	2.839	1.420	41.0
4	4.8	2.227	1.116	33.0
5	2.8	1.701	0.855	23.0

Correlation Coefficient : 0.9982



Remark
1HPa = 0.750062 mmHg

Calibrated by: **Arthur Chiu** **Date:** 17/3/2011
( )

Checked by: **F.C. Tsang** **Date:** 17/3/2011
( )

High Volume Air Sampler Calibration Worksheet

Project Title: Design and Construction of Tsuen Wan Drainage Tunnel
Monitoring Location: Long Beach Gardan (ASR 8)
Calibration Date: 17-Mar-11
Calibration Due Date 16-May-11
Time: 08:30

Sampler Model:	TE5005X
Serial No.:	1059
Calibrator Orifice no.:	1785
Slope (m):	2.01637
Intercept (b):	-0.02316
Correction coeff. (r)	0.99996

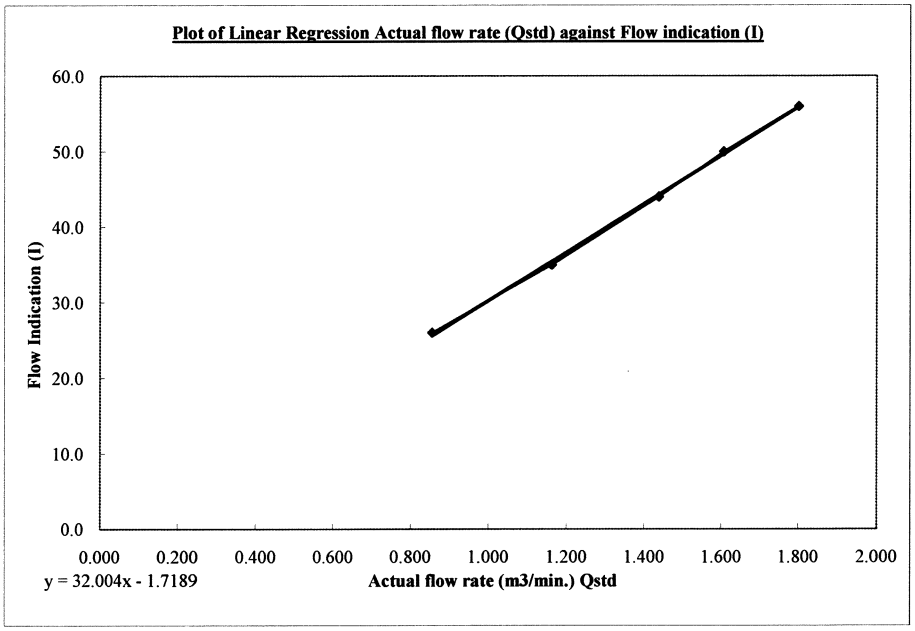
$$Flow(corrected) = \sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}}$$

$$Qstd = \frac{1}{m} \times (\sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}} - b)$$

Standard pressure (mmHg) Pstd:	763.9
Standard temp. (K) Tstd:	290.8
Calibration pressure (mmHg) Pa:	766.3
Calibration temp. (K) Ta:	289.2

Sample no.	Pressure Drop (H), inch	Flow (corrcted), m^3/min	Actual flow rate (Qstd), m^3/min	Flow indication (I), arbitrary
1	12.6	3.609	1.801	56.0
2	10.0	3.215	1.606	50.0
3	8.0	2.876	1.438	44.0
4	5.2	2.318	1.161	35.0
5	2.8	1.701	0.855	26.0

Correlation Coefficient : 0.9995



Remark
1HPa = 0.750062 mmHg

Calibrated by: Arthur Chiu ( ) **Date:** 17/3/2011

Checked by: F.C. Tsang ( ) **Date:** 17/3/2011

High Volume Air Sampler Calibration Worksheet

Project Title: Design and Construction of Tsuen Wan Drainage Tunnel
Monitoring Location: Greenview Terrance (ASR 9)
Calibration Date: 17-Mar-11
Calibration Due Date 16-May-11
Time: 08:45

Sampler Model:	TE5005X
Serial No.:	1713
Calibrator Orifice no.:	1785
Slope (m):	2.01637
Intercept (b):	-0.02316
Correction coeff. (r)	0.99996

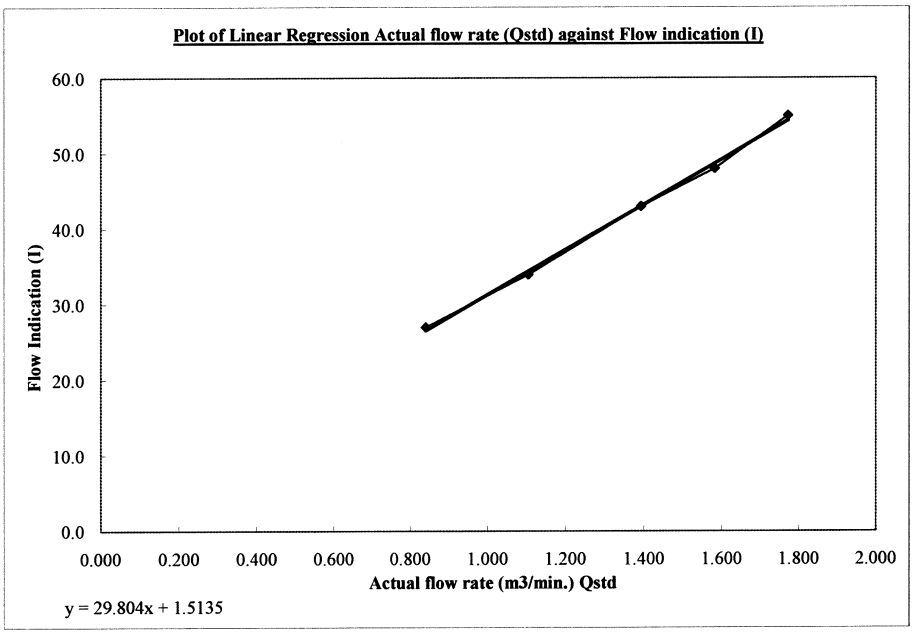
$$Flow(corrected) = \sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}}$$

$$Qstd = \frac{1}{m} \times (\sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}} - b)$$

Standard pressure (mmHg) Pstd:	763.9
Standard temp. (K) Tstd:	290.8
Calibration pressure (mmHg) Pa:	766.3
Calibration temp. (K) Ta:	289.2

Sample no.	Pressure Drop (H), inch	Flow (corrcted), m^3/min	Actual flow rate (Qstd), m^3/min	Flow indication (I), arbitrary
1	12.2	3.551	1.773	55.0
2	9.7	3.166	1.582	48.0
3	7.5	2.784	1.392	43.0
4	4.7	2.204	1.105	34.0
5	2.7	1.671	0.840	27.0

Correlation Coefficient : 0.9987



Remark
1HPa = 0.750062 mmHg

Calibrated by: Arthur Chiu ( ) **Date:** 17/3/2011

Checked by: F.C. Tsang ( ) **Date:** 17/3/2011

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 - May 10, 2010 Rootsmeter S/N 9833620 Ta (K) - 296
Operator Tisch Orifice I.D. - 1785 Pa (mm) - 750.57

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	1.3960	3.2	2.00
2	NA	NA	1.00	0.9840	6.4	4.00
3	NA	NA	1.00	0.8790	7.9	5.00
4	NA	NA	1.00	0.8390	8.7	5.50
5	NA	NA	1.00	0.6940	12.7	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)		Va	(x axis) Qa	(y axis)
0.9900	0.7092	1.4102		0.9957	0.7133	0.8881
0.9858	1.0018	1.9943		0.9915	1.0076	1.2560
0.9837	1.1191	2.2296		0.9894	1.1256	1.4042
0.9827	1.1713	2.3385		0.9884	1.1781	1.4728
0.9774	1.4084	2.8203		0.9830	1.4165	1.7762
Qstd slope (m) =		2.01637		Qa slope (m) =		1.26262
intercept (b) =		-0.02316		intercept (b) =		-0.01458
coefficient (r) =		0.99996		coefficient (r) =		0.99996
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}

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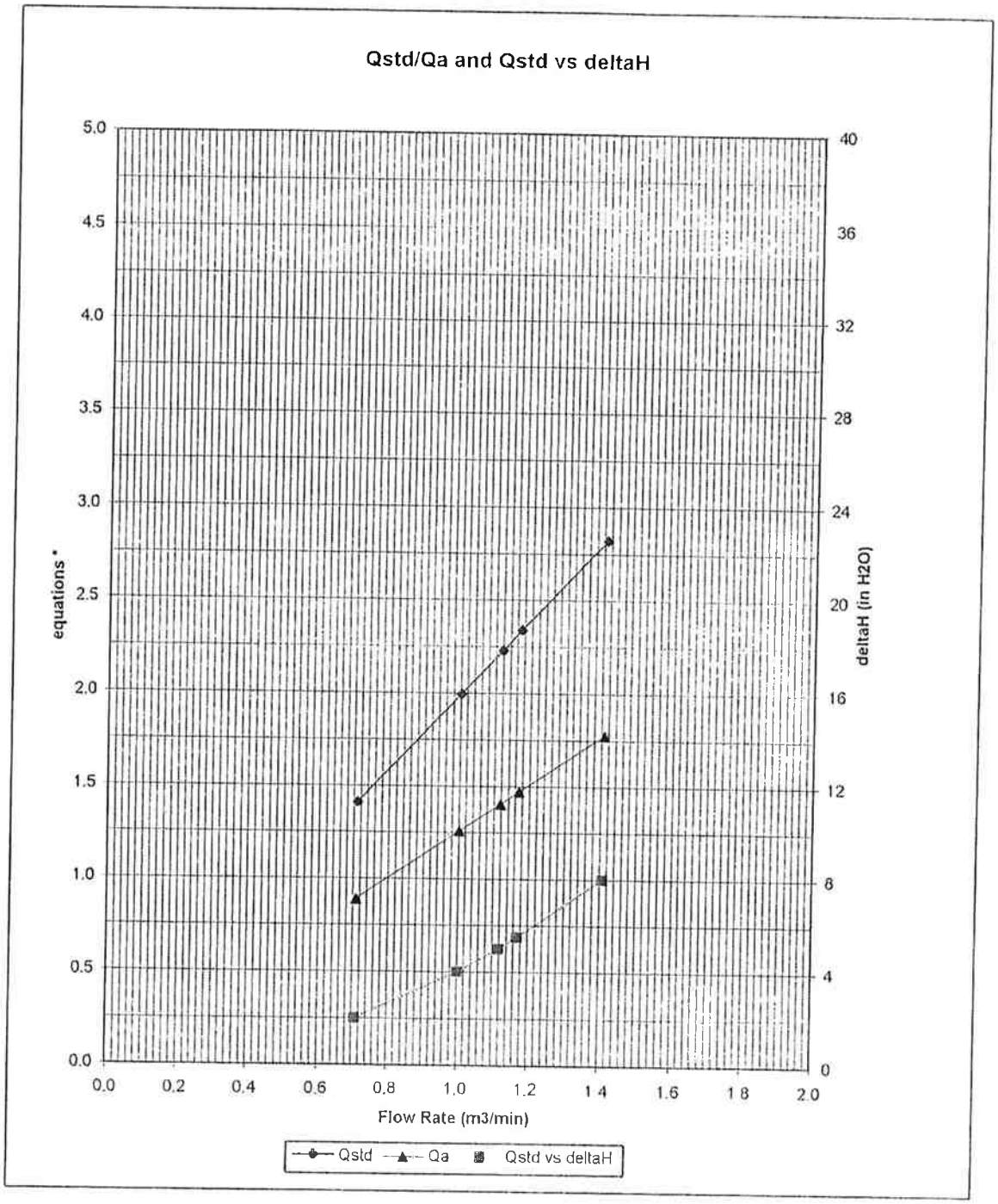
AIR POLLUTION MONITORING EQUIPMENT



* y-axis equations:

Qstd series: $\sqrt{\Delta H \left(\frac{Pa}{Pstd}\right)\left(\frac{Tstd}{Ta}\right)}$

Qa series: $\sqrt{(\Delta H\ (Ta\ /\ Pa))}$

#1785

輝創工程有限公司

Sun Creation Engineering Limited Calibration and Testing Laboratory

Certificate No. : C102904

Certificate of Calibration

This is to certify that the equipment

Description : Sound Level Meter

Manufacturer : Rion

Model No. : NL-31

Serial No. : 00410224

has been calibrated for the specific items and ranges.
The results are shown in the Calibration Report No. C102904.

The equipment is supplied by

Co. Name : Envirotech Services Co.

Address : Shop 6, G/F., Casio Mansion, 209 Shaukeiwan Road, Hong Kong

Date of Issue : 31 May 2010

Certified by : K C Lee

Calibration and Testing Laboratory of Sun Creation Engineering Limited
c/o 4/F, Tsing Shan Wan Exchange Building, 1 Hing On Lane, Tuen Mun, New Territories, Hong Kong
Tel: 2927 2606 Fax: 2744 8656 E-mail: call@suncreation.com Website: www.suncreation.com

輝創工程有限公司
Sun Creation Engineering Limited Calibration and Testing Laboratory

Certificate No. : C106297

Certificate of Calibration

This is to certify that the equipment

Description : Integrating Sound Level Meter

Manufacturer : Bruel & Kjaer

Model No. : 2238

Serial No. : 2448529

has been calibrated for the specific items and ranges.
The results are shown in the Calibration Report No. C106297.

The equipment is supplied by

Co. Name : Hyder Consulting Limited

Address : 47/F., Hopewell Centre, 183 Queen's Road East,
Wanchai, Hong Kong

Date of Issue : 16 November 2010

Certified by : K C Lee

Calibration and Testing Laboratory of Sun Creation Engineering Limited
c/o 4/F, Tsing Shan Wan Exchange Building, 1 Hing On Lane, Tuen Mun, New Territories, Hong Kong
Tel: 2927 2606 Fax: 2744 8986 E-mail: callab@suncreation.com Website: www.suncreation.com

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

Calibration Certificate

Certificate No. **07436**

Customer : Hyder Consulting Limited

Address : 47/F., Hopewell Centre, 183 Queens Road East, Wanchai, Hong Kong

Order No. : Q02884 **Date of receipt :** 28-Dec-10

Item Tested

Description : Sound Level Meter

Manufacturer : B&K

Model : 2238 **Serial No. :** 2562782

Test Conditions

Date of Test : 29-Dec-10 **Supply Voltage :** --

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

Test Specifications

Calibration check.

Ref. Document/Procedure: Z01.

Test Results

All results were within the IEC 651 Type 1 & IEC 804 Type 1 specification.

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

Main Test equipment used:

Equipment No.	Description	Cert. No.	Traceable to
S017A	Multi-Function Generator	07279	SCL-HKSAR
S024	Sound Level Calibrator	04062	NIM-PRC & 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 : P. F. Wong

Approved by : Dorothy Cheuk

Date: 30-Dec-10

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. SPL Accuracy

UUT Setting				Applied Value (dB)	UUT Reading (dB)
Range	Freq. Wgt.	Bandwith	Center Freq.		
20 ~ 100	A	BB/F	--	94.0	94.1
	A	BB/S	--		94.1
	C	BB/F	--		94.0
40 ~ 120	A	BB/F	--	94.0	94.1
	A	BB/F	--	114.0	113.9

IEC 651 Type 1 Spec. : ± 0.7 dB
Uncertainty : ± 0.1 dB

2. Level Stability : 0.0 dB

IEC 651 Type 1 Spec. : ± 0.3 dB
Uncertainty : ± 0.01 dB

3. Linearity

3.1 Level Linearity

UUT Range (dB)	Applied Value (dB)	UUT Reading (dB)	Variation (dB)	IEC 651 Type 1 Spec. (Primary Indicator Range)
140	114.0	114.3	+0.2	± 0.7 dB
130	104.0	104.3	+0.2	
120	94.0	94.1 (Ref.)	- -	
110	84.0	83.9	-0.2	
100	74.0	73.9	-0.2	
90	64.0	63.9	-0.2	
80	54.0	54.2	+0.1	

Uncertainty : ± 0.1 dB

Calibration Certificate

3.2 Differential level linearity

UUT Range (dB)	Applied Value (dB)	UUT Reading (dB)	Variation (dB)	IEC 651 Type 1 Spec.
120	84.0	83.9	-0.2	± 0.4 dB
	94.0	94.1 (Ref.)	- -	
	95.0	95.1	0.0	± 0.2 dB

Uncertainty : ± 0.1 dB

4. Frequency Weighting

A weighting

Frequency	Attenuation (dB)	IEC 651 Type 1 Spec.
31.5 Hz	-40.0	- 39.4 dB, ± 1.5 dB
63 Hz	-26.7	- 26.2 dB, ± 1.5 dB
125 Hz	-16.6	- 16.1 dB, ± 1 dB
250 Hz	-9.1	- 8.6 dB, ± 1 dB
500 Hz	-3.5	- 3.2 dB, ± 1 dB
1 kHz	0.0 (Ref)	0 dB, ± 1 dB
2 kHz	+1.5	+ 1.2 dB, ± 1 dB
4 kHz	+1.3	+ 1.0 dB, ± 1 dB
8 kHz	-0.7	- 1.1 dB, + 1.5 dB ~ -3 dB
16 kHz	-6.3	- 6.6 dB, + 3 dB ~ - ∞

Uncertainty : ± 0.1 dB

5. Time Averaging

Applied Burst duty Factor	Applied Leq Value (dB)	UUT Reading (dB)	IEC 804 Type 1 Spec.
continuous	40.0	40.0	--
1/10	40.0	39.9	± 0.5 dB
$1/10^2$	40.0	40.0	
$1/10^3$	40.0	40.5	± 1.0 dB
$1/10^4$	40.0	41.0	

Uncertainty : ± 0.1 dB

Remarks : 1. UUT : Unit-Under-Test
2. The uncertainty claimed is for a confidence probability of not less than 95%.
3. Atmospheric pressure : 1 012 hPa.

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

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

Calibration Certificate

Certificate No. **07437** Page 1 of 2 Pages

Customer : Hyder Consulting Limited

Address : 47/F., Hopewell Centre, 183 Queens Road East, Wanchai, Hong Kong

Order No. : Q02884 **Date of receipt :** 28-Dec-10

Item Tested

Description : Sound Level Calibrator

Manufacturer : B&K

Model : Type 4231 **Serial No. :** 2699361

Test Conditions

Date of Test : 29-Dec-10 **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 IEC 942 Class 1 specification.

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

Main Test equipment used:

Equipment No.	Description	Cert. No.	Traceable to
S014	Spectrum Analyzer	03926	NIM-PRC & SCL-HKSAR
S024	Sound Level Calibrator	04062	NIM-PRC & SCL-HKSAR
S041	Universal Counter	04461	SCL-HKSAR
S206	Sound Level Meter	04462	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 : P. F. Wong

Approved by : Dorothy Cheuk

Date: 30-Dec-10

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

Certificate No. 07437

Results :

1. Level Accuracy

UUT Nominal Value (dB)	Measured Value (dB)	IEC 942 Class 1 Spec.
94	94.02	± 0.3 dB
114	114.10	

Uncertainty : ± 0.1 dB

2. Frequency

UUT Nominal Value	Measured Value	IEC 942 Class 1 Spec.
1 kHz	1.000 kHz	± 2 %

Uncertainty : $\pm 3.6 \times 10^{-6}$

3. Level Stability : 0.0 dB
IEC 942 Class 1 Spec. : ± 0.1 dB
Uncertainty : ± 0.01 dB

4. Total Harmonic Distortion : < 0.5 %
IEC 942 Class 1 Spec. : < 3 %
Uncertainty : ± 2.3 % of reading

Remark : 1. UUT : Unit-Under-Test
2. The above measured values are the mean of 3 measurement.
3. The uncertainty claimed is for a confidence probability of not less than 95%.
4. Atmospheric Pressure : 1012 hPa.

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

CERTIFICATE OF ANALYSIS

Work Order: HK1104774
Date of Issue: 02/03/2011
Client: HYDER CONSULTING LIMITED
Client Reference:

Calibration of Mulitimeter

Item : Mulitimeter
ALS Lab ID: HK1104774 -001
Date of Calibration: 01 March 2011

Model No.: WTW pH/Oxi 340i
Serial No.: 08101283

Testing Results :

pH

Expected Reading	Recording Reading
4.00	4.10
7.00	7.10
10.0	10.18
Allowing Deviation	± 0.2 unit

Testing Method:

APHA (20th edition), 4500-H^+B

Temperature

Expected Reading	Recording Reading
17.0 °C	16.5 °C
21.0 °C	20.5 °C
34.5 °C	34.3 °C
Allowing Deviation	±2.0°C

Testing Method:

In-House Method

Dissolved Oxygen

Expected Reading	Recording Reading
7.92 mg/L	8.08 mg/L
8.62 mg/L	8.71 mg/L
9.26 mg/L	9.36 mg/L
Allowing Deviation	± 0.2 mg/L

Testing Method:

APHA (20th edition), 4500-OC & G

Mr Chan Kwok Fai, Godfrey
Laboratory Manager - Hong Kong

REPORT OF EQUIPMENT PERFORMANCE CHECK/CALIBRATION

Work Order: HK1106728
Date of Issue: 22/03/2011
Client: HYDER CONSULTING LIMITED

Description: Turbidimeter
Brand Name: Eutech Instruments
Model No.: TN-100
Serial No.: 215619
Equipment No.: N/A
Date of Calibration: 22 March, 2011 Date of next Calibration: 22 June, 2011

Parameters:

Turbidity

Method Ref: ALPHA 21st Ed. 2130B

Expected Reading (NTU)	Displayed Reading (NTU)	Tolerance (%)
0	0.19	--
4	3.99	-0.2%
40	37.8	-5.5%
80	74.2	-7.3%
400	419	4.8%
800	744	-7.0%
	Tolerance Limit (±%)	10.0

Mr Chan Kwok Fai, Godfrey
Laboratory Manager - Hong Kong