

**Annex 2 High Volume Air Sampler Calibration Worksheet**

**Project Title:** Expansion of Shek Wu Hui Sewage Treatment Works  
**Monitoring Location:** Sewage Pumping Station at j/o San Po Street and Po Wan Road (CAM1a)  
**Date:** 10-May-06  
**Time:** 09:40

Sampler Model:	GBM2000H1
Calibrator Orifice no.:	517N
Slope (m):	2.01069
Intercept (b):	-0.00482
Correction coeff. (r)	0.9999
Serial No.:	1101

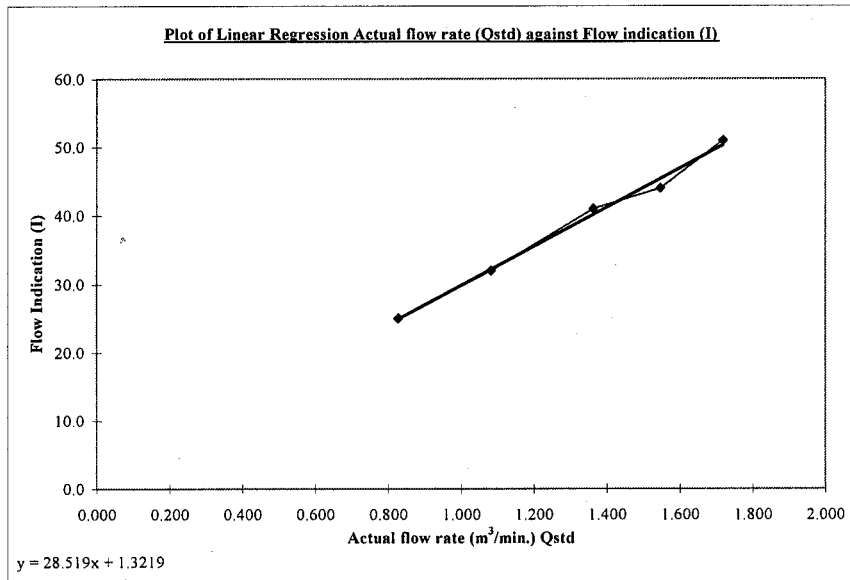
$$\text{Flow (corrected)} = \sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}}$$

Standard pressure (mmHg) Pstd:	760.0
Standard temp. (K) Tstd:	297.18
Calibration pressure (mmHg) Pa:	759.6
Calibration temp. (K) Ta:	303.0

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

Sample no.	Pressure Drop (H), inch	Flow (corrected), m <sup>3</sup> /min	Actual flow rate (Qstd), m <sup>3</sup> /min	Flow indication (I), arbitrary
1	12.1	3.449	1.718	51.0
2	9.8	3.104	1.546	44.0
3	7.6	2.733	1.362	41.0
4	4.8	2.172	1.083	32.0
5	2.8	1.659	0.827	25.0

Correlation Coefficient : 0.9961



Remark  
 Qstd Range 0.6 - 1.7  
 1HPa = 0.750062 mmHg

**Calibrated by:** Kenneth H.C. Choi ( *[Signature]* ) **Date:** 10/05/06

**Checked by:** Adi Lee ( *[Signature]* ) **Date:** 11/5/06

**Annex 2 High Volume Air Sampler Calibration Worksheet**

Project Title: Expansion of Shek Wu Hui Sewage Treatment Works  
 Monitoring Location: Flood Balancing Pumping Station at Po Wan Road near Wai Loi Tsuen (CAM2a)  
 Date: 16-May-06  
 Time: 13:30

Sampler Model:	GBM2000H1
Calibrator Orifice no.:	517N
Slope (m):	2.01069
Intercept (b):	-0.00482
Correction coeff. (r)	0.9999
Serial No.:	1097

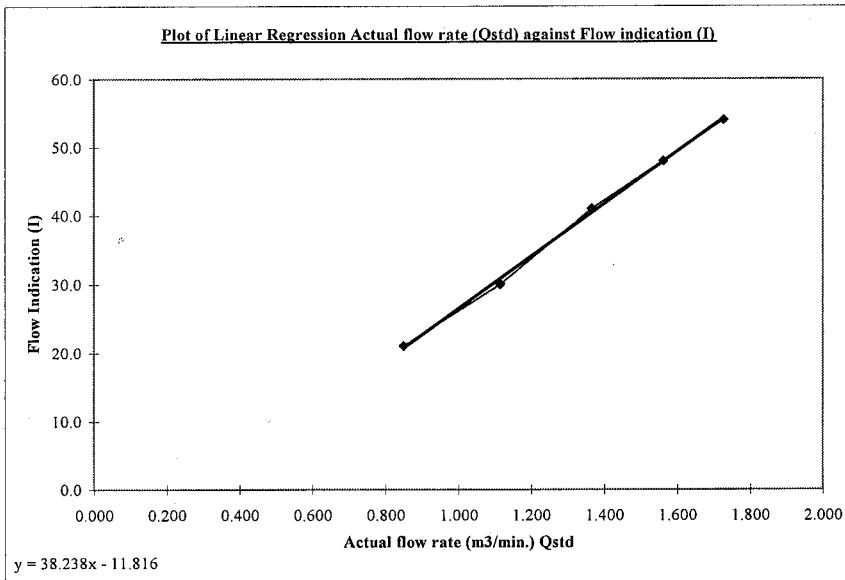
$$Flow(\text{corrected}) = \sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}}$$

Standard pressure (mmHg) Pstd:	760.0
Standard temp. (K) Tstd:	297.18
Calibration pressure (mmHg) Pa:	761.3
Calibration temp. (K) Ta:	298.0

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

Sample no.	Pressure Drop (H), inch	Flow (corrected), m <sup>3</sup> /min	Actual flow rate (Qstd), m <sup>3</sup> /min	Flow indication (I), arbitrary
1	12.0	3.467	1.727	54.0
2	9.8	3.133	1.561	48.0
3	7.5	2.741	1.366	41.0
4	5.0	2.238	1.115	30.0
5	2.9	1.704	0.850	21.0

Correlation Coefficient : 0.9991



Remark  
 Qstd Range 0.6 - 1.7  
 1HPa = 0.750062 mmHg

Calibrated by: **Kenneth H.C. Choi** ( *[Signature]* ) Date: 16/05/06

Checked by: **Adi Lee** ( *[Signature]* ) Date: 16/5/06

**Annex 2 High Volume Air Sampler Calibration Worksheet**

**Project Title:** Expansion of Shek Wu Hui Sewage Treatment Works  
**Monitoring Location:** Sewage Pumping Station at j/o San Po Street and Po Wan Road (CAM1a)  
**Date:** 12-Jul-06  
**Time:** 09:56

Sampler Model:	GBM2000H1
Calibrator Orifice no.:	517N
Slope (m):	2.01069
Intercept (b):	-0.00482
Correction coeff. (r):	0.9999
Serial No.:	1101

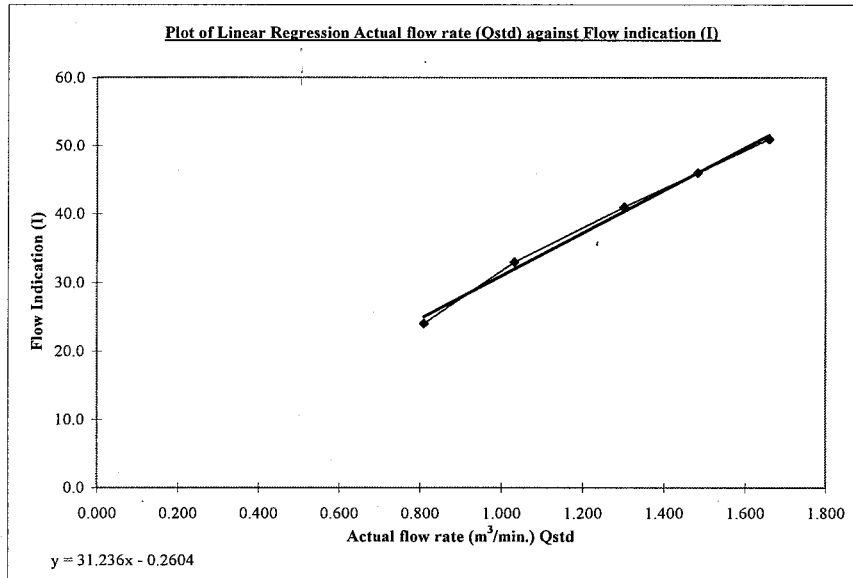
$$\text{Flow (corrected)} = \sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}}$$

Standard pressure (mmHg) Pstd:	760.0
Standard temp. (K) Tstd:	297.18
Calibration pressure (mmHg) Pa:	760.1
Calibration temp. (K) Ta:	306.0


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

Sample no.	Pressure Drop (H), inch	Flow (corrected), m <sup>3</sup> /min	Actual flow rate (Qstd), m <sup>3</sup> /min	Flow indication (I), arbitrary
1	11.4	3.332	1.660	51.0
2	9.1	2.977	1.483	46.0
3	7.0	2.611	1.301	41.0
4	4.4	2.070	1.032	33.0
5	2.7	1.622	0.809	24.0


Correlation Coefficient : 0.9969



Remark  
 Qstd Range 0.6 - 1.7  
 1HPa = 0.750062 mmHg

**Calibrated by:** Kenneth H.C. Choi  
 (  )

**Date:** 12/07/06

**Checked by:** Adi Lee  
 (  )

**Date:** 12/7/06

**Annex 2 High Volume Air Sampler Calibration Worksheet**

**Project Title:** Expansion of Shek Wu Hui Sewage Treatment Works  
**Monitoring Location:** Flood Balancing Pumping Station at Po Wan Road near Wai Loi Tsuen (CAM2a)  
**Date:** 12-Jul-06  
**Time:** 13:20

Sampler Model:	GBM2000H1
Calibrator Orifice no.:	517N
Slope (m):	2.01069
Intercept (b):	-0.00482
Correction coeff. (r)	0.9999
Serial No.:	1097

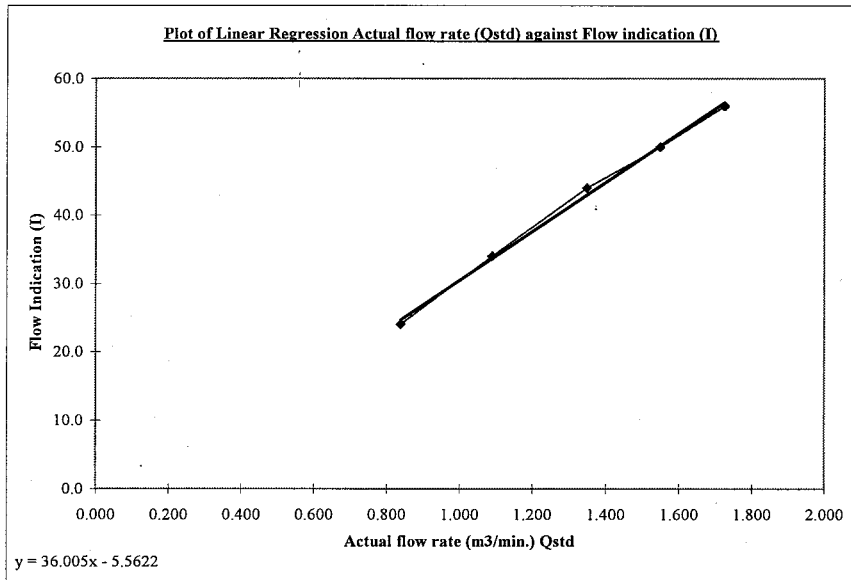
$$\text{Flow (corrected)} = \sqrt{H \times \frac{Pa}{Pstd} \times \frac{Tstd}{Ta}}$$

Standard pressure (mmHg) Pstd:	760.0
Standard temp. (K) Tstd:	297.18
Calibration pressure (mmHg) Pa:	761.3
Calibration temp. (K) Ta:	306.0

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

Sample no.	Pressure Drop (H), inch	Flow (corrected), m <sup>3</sup> /min	Actual flow rate (Qstd), m <sup>3</sup> /min	Flow indication (I), arbitrary
1	12.3	3.464	1.725	56.0
2	9.9	3.108	1.548	50.0
3	7.5	2.705	1.348	44.0
4	4.9	2.186	1.090	34.0
5	2.9	1.682	0.839	24.0

Correlation Coefficient : 0.9985



Remark  
 Qstd Range 0.6 - 1.7  
 1HPa = 0.750062 mmHg

Calibrated by: **Kenneth H.C. Choi**  
 ( *[Signature]* )

Date: 12/07/06

Checked by: **Adi Lee**  
 ( *[Signature]* )

Date: 13/7/06



TISCH ENVIRONMENTAL, INC.  
 145 SOUTH MIAMI AVE.  
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AIR POLLUTION MONITORING EQUIPMENT

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - May 16, 2005 Rootsmeter S/N 9833620 Ta (K) - 294  
 Operator Tisch Orifice I.D. - 517N Pa (mm) - 753.62

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	1.4090	3.2	2.00
2	NA	NA	1.00	0.9950	6.3	4.00
3	NA	NA	1.00	0.8910	7.8	5.00
4	NA	NA	1.00	0.8490	8.6	5.50
5	NA	NA	1.00	0.7010	12.6	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
1.0008	0.7103	1.4178	0.9957	0.7067	0.8833
0.9967	1.0017	2.0051	0.9916	0.9966	1.2492
0.9946	1.1163	2.2418	0.9895	1.1106	1.3966
0.9936	1.1703	2.3512	0.9886	1.1644	1.4648
0.9882	1.4098	2.8356	0.9832	1.4026	1.7666
Qstd slope (m) = 2.02844			Qa slope (m) = 1.27017		
intercept (b) = -0.02391			intercept (b) = -0.01489		
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

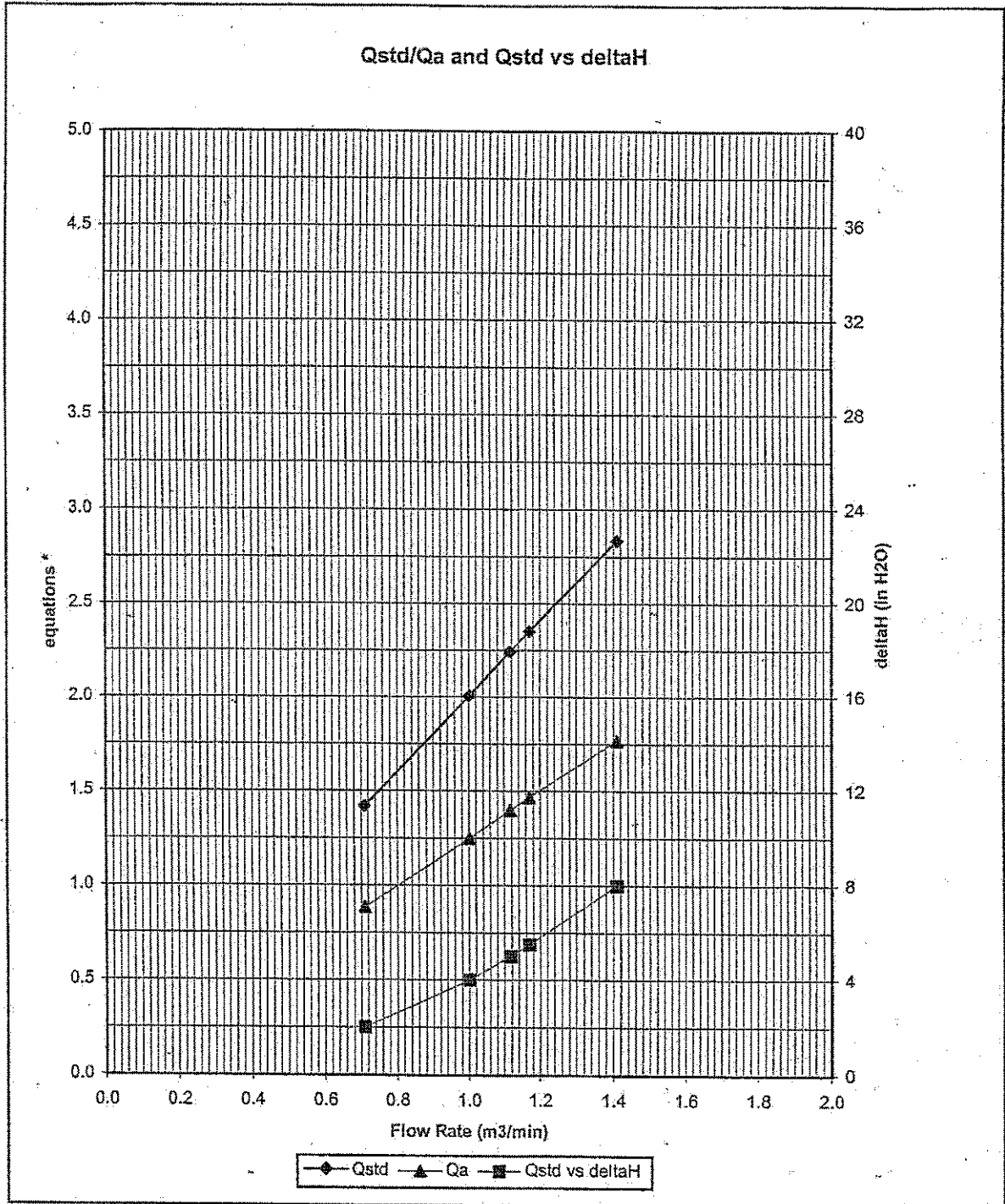
For subsequent flow rate calculations:

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



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AIR POLLUTION MONITORING EQUIPMENT



\* y-axis equations:

Qstd series: 
$$\sqrt{\Delta H \left( \frac{P_a}{P_{std}} \right) \left( \frac{T_{std}}{T_a} \right)}$$

Qa series: 
$$\sqrt{\Delta H (T_a / P_a)}$$

# 517N



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AIR POLLUTION MONITORING EQUIPMENT

ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Apr 26, 2006 Rootsmeter S/N 9833620 Ta (K) - 294  
 Operator Tisch Orifice I.D. - 517N 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	1.4140	3.2	2.00
2	NA	NA	1.00	0.9910	6.3	4.00
3	NA	NA	1.00	0.8890	7.8	5.00
4	NA	NA	1.00	0.8480	8.7	5.50
5	NA	NA	1.00	0.6980	12.5	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
0.9967	0.7049	1.4149	0.9957	0.7042	0.8851
0.9926	1.0016	2.0010	0.9916	1.0006	1.2517
0.9905	1.1142	2.2372	0.9895	1.1131	1.3995
0.9894	1.1667	2.3464	0.9884	1.1656	1.4678
0.9843	1.4102	2.8299	0.9833	1.4087	1.7702
Qstd slope (m) = 2.01069			Qa slope (m) = 1.25906		
intercept (b) = -0.00482			intercept (b) = -0.00301		
coefficient (r) = 0.99990			coefficient (r) = 0.99990		
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

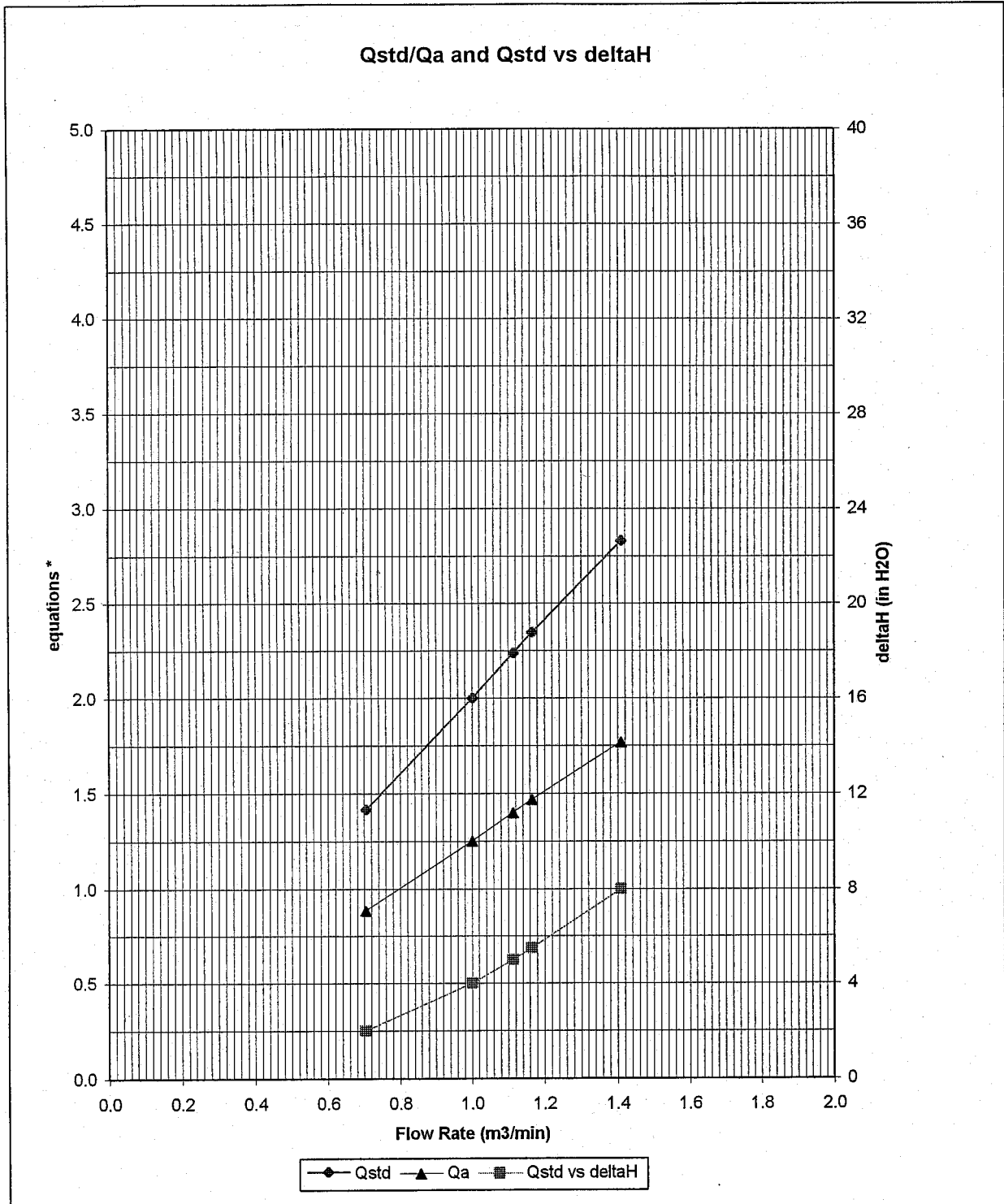
For subsequent flow rate calculations:

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: 
$$\sqrt{\Delta H \left( \frac{P_a}{P_{std}} \right) \left( \frac{T_{std}}{T_a} \right)}$$

Qa series: 
$$\sqrt{(\Delta H (T_a / P_a))}$$

#517N





# Calibration Certificate

Certificate No. **55747**

Page 1 of 2 Pages

**Customer :** Hyder Consulting Limited

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

**Order No. :** Q52108

**Date of receipt :** 7-Dec-05

## Item Tested

**Description :** Sound Level Calibrator

**Manufacturer :** B&K

**Model :** Type 4231

**Serial No. :** 1770806

## Test Conditions

**Date of Test :** 15-Dec-05

**Supply Voltage :** --

**Ambient Temperature :** (23 ± 3)°C

**Relative Humidity :** (50 ± 25) %

## Test Specifications

Calibration check according to customer's requirement.

Calibration procedure : F21, Z02.

## Test Results

All results were within the manufacturer's, IEC 942 Class 1 specification.

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

Test equipment used:

<u>Equipment No.</u>	<u>Cert. No.</u>	<u>Due Date</u>	<u>Traceable to</u>
S014	53024	7-Jul-06	PRC-NIM
S024	S41431	22-May-06	PRC-NIM
S041	53972	26-Aug-06	HKGSL

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 :** 

**Approved by :** 

Dorothy Cheuk

**Date:** 15-Dec-05

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. 55747

Page 2 of 2 Pages

Results :

## 1. Level Accuracy

UUT Nominal Value (dB)	Measured Value (dB)	IEC 942 Class 1 Spec.
94	94.0	± 0.3 dB
114	114.0	

Uncertainty : ± 0.2 dB

## 2. Frequency

UUT Nominal Value	Measured Value	IEC 942 Class 1 Spec.
1 kHz	1.005 kHz	± 2 %

Uncertainty : ± 3.6 x 10<sup>-6</sup>

## 3. Level Stability : 0.0 dB

IEC 942 Class 1 Spec. : ± 0.1 dB

Uncertainty : ± 0.01 dB

## 4. Total Harmonic Distortion : < 0.4 %

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 measurements.

3. The uncertainty claimed is for a confidence probability of not less than 95%.

4. Atmospheric Pressure : 1 004 hPa.

----- END -----



## CERTIFICATE OF CALIBRATION

Certificate No. : 2KS051204-1

Page 1 of 2

### Calibration of :

Description :	Sound Level Meter	,	Microphone
Manufacture :	Brüel & Kjær		
Type No. :	2238	,	4188
Serial No. :	2285726	,	2462195

### Client :

Hyder Consulting Limited  
47/F, Hopewell Centre,  
183 Queen's Road East,  
Wanchai, Hong Kong.

### Calibration Conditions :

Air Temperature :	23.0	°C
Air Pressure :	101.1	kPa
Relative Humidity :	61	%

### Test Specifications :

The Sound Level Meter has been calibrated in accordance with the requirements as specified in IEC 60651 and IEC 60804 type 1, and vendor specific procedures.

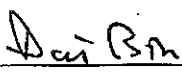
The measurements has been performed with the assistance of :  
Brüel & Kjær's Sound Level Meter Calibration System B&K 9600 CAL2238A, Ver.25.10.1999  
The standard(s) and instrument(s) used in the calibration are traceable to international standard and are calibrated on a schedule which is adjusted to maintain the required accuracy level.

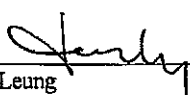
### Test Result :

A list of the performed (sub) tests is stated on page 2 of this certificate. Actual Measurement are documented on worksheet.

Date of Calibration : 08 December, 2005  
Calibrated By :

Certificate issued : 09 December, 2005  
Approved signatory :

  
Dai Bin

  
Jacky Leung

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## CERTIFICATE OF CALIBRATION

Certificate No. : 2KS051204-1

Page 2 of 2

### Results :

List of performed (sub) test with test status:

“OK” Means the result of the (sub)test is Inside the tolerances stated in the test specifications.

“ - ” Means the result of the (sub)test is Outside these tolerances.

Test :	Subtest :	Status :
Noise	A	OK
Noise	C	OK
Noise	Lin	OK
Frequency Weighting	A	OK
Frequency Weighting	C	OK
Frequency Weighting	Lin	OK
Level Range Control	1000 Hz	OK
Linearity Range	SPL 10dB 4000 Hz	OK
Linearity Range	SPL 1dB 1000 Hz	OK
Linearity Range	Leq	OK
Linearity Range	SEL	OK
RMS Detector	CF 3	OK
RMS Detector	CF 5	OK
RMS Detector	CF 10	OK
RMS Detector	Symmetry	OK
Time Weighting	Difference Indication	OK
Time Weighting	Single Burst FAST	OK
Time Weighting	Single Burst SLOW	OK
Time Weighting	Single Burst IMPULSE	OK
Time Weighting	Repetitive Burst	OK
Time Weighting	Peak	OK
Time Averaging		OK
Pulse Range		OK
Overload	SPL	OK
Overload	SEL	OK
Acoustic Response	A	OK
Acoustic Response	Lin	OK

### Calibration Equipment :

Description :	Make & Model :	Serial No. :	Last Cal. Date :	Traceable to :
Brüel & Kjør's Sound Level Meter Calibration System				B&K 9600 CAL2238A, Ver.25.10.1999
Digital Multi-meter	Datron 1281	27361	05 Oct, 2005	HKSL (HOKLAS)
Sine/Noise Generator	B&K 1049	1314978	Test	B&K Conformance
Test Waveform Generator	B&K 5918	1482949	Test	B&K Conformance
Acoustical Calibrator	B&K 4226	1551627	11 Jul, 2005	NPL via B&K (UKAS)

Calibrated By : *Ant Row*  
Date : 08 December, 2005

Checked By : *Janly*  
Date : 09 December, 2005



# Calibration Certificate

Certificate No. **55892**

Page 1 of 3 Pages

**Customer :** Hyder Consulting Limited

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

**Order No. :** Q52108

**Date of receipt :** 19-Dec-05

## Item Tested

**Description :** Digital Sound Level Meter

**Manufacturer :** B & K

**Model :** Type 2236

**Serial No. :** 1785701

## Test Conditions

**Date of Test :** 23-Dec-05

**Supply Voltage :** --

**Ambient Temperature :** (23 ± 3)°C

**Relative Humidity :** (50 ± 25) %

## Test Specifications

Calibration check.

Calibration 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).

Test equipment used:

<u>Equipment No.</u>	<u>Cert. No.</u>	<u>Due Date</u>	<u>Traceable to</u>
S017	C051022	21-Mar-06	HKGSCCL
S024	S41431	22-May-06	PRC-NIM
S031	45853	30-Dec-05	PRC-NIM

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 : 

Approved by :   
Dorothy Cheuk

Date: 23-Dec-05

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. 55892

Page 2 of 3 Pages

Results :

## 1. SPL Accuracy

UUT Setting				Applied Value (dB)	UUT Reading (dB)
Range	Parameter	Frequency Wt.	Freq. Response		
20 - 100	SPL	dBA	F	94.0	94.1
			S		94.1
		dBC	F		94.1
		dBL	F		94.1
40 - 120	SPL	dBA	F	94.0	94.1
	SPL	dBA	F	113.9	114.0
			S		114.0
		dBC	F		114.0
		dBL	F		114.0

IEC 651 Type 1 Spec. :  $\pm 0.7$  dB

Uncertainty :  $\pm 0.2$  dB

## 2. Level Stability : 0.0 dB

IEC 651 Type 1 Spec. :  $\pm 0.3$  dB

Uncertainty :  $\pm 0.01$  dB



# Calibration Certificate

Certificate No. 55892

Page 3 of 3 Pages

### 3. Frequency Weighting

A weighting

Frequency	Attenuation (dB)	IEC 651 Type 1 Spec.
31.5 Hz	- 39.6	- 39.4 dB, $\pm 1.5$ dB
63 Hz	- 26.3	- 26.2 dB, $\pm 1.5$ dB
125 Hz	- 16.2	- 16.1 dB, $\pm 1$ dB
250 Hz	- 8.7	- 8.6 dB, $\pm 1$ dB
500 Hz	- 3.3	- 3.2 dB, $\pm 1$ dB
1 kHz	0.0 (Ref)	0 dB, $\pm 1$ dB
2 kHz	+ 1.2	+ 1.2 dB, $\pm 1$ dB
4 kHz	+ 0.9	+ 1.0 dB, $\pm 1$ dB
8 kHz	- 1.3	- 1.1 dB, + 1.5 dB $\sim$ -3 dB
16 kHz	- 7.1	- 6.6 dB, + 3 dB $\sim$ - $\infty$

Uncertainty :  $\pm 0.1$  dB

### 4. 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	$\pm 0.5$ dB
1/10 <sup>2</sup>	40.0	39.8	
1/10 <sup>3</sup>	40.0	39.5	$\pm 1.0$ dB
1/10 <sup>4</sup>	40.0	39.1	

Uncertainty :  $\pm 0.1$  dB

Remark : 1. UUT : Unit-Under-Test

2. The uncertainty claimed is for a confidence probability of not less than 95%.

3. Atmospheric Pressure : 1 004 hPa

----- END -----