

Annex A1

# Calibration Certificates for Dust Monitoring Equipment











Calibration Report  
of  
High Volume Air Sampler

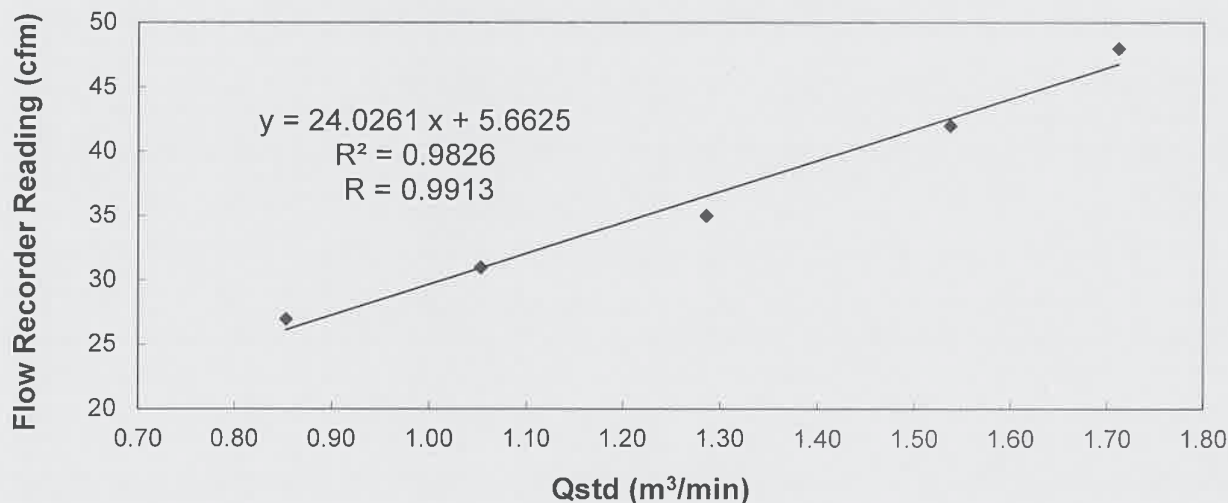
Manufacturer : Graseby 105 Date of Calibration : 08 January 2018

Serial No. : 9795 ( ET / EA / 003 / 18 ) Calibration Due Date : 07 March 2018

Method : Five-point calibration by using standard calibration kit Tisch TE-5025A refer to the Operations Manual

Results	Flow recorder reading (cfm)	48	42	35	31	27
	Qstd (Actual flow rate, m <sup>3</sup> /min)	1.71	1.54	1.29	1.05	0.85
	Pressure : 762.81 mm Hg	Temp. : 290 K				

**Sampler 9795 Calibration Curve**  
Site: Tseung Kwan O 137 (TKO-A1)

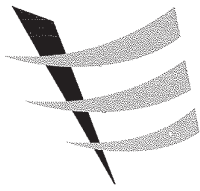


Acceptance Criteria : Correlation coefficient (r) of the calibration curve greater than 0.990 after a 5-point calibration

The high volume sampler complies\* / ~~does not comply\*~~ with the specified requirements and is deemed acceptable\* / unacceptable\* for use.

Calibrated by : MAK, Kei Wai  
MAK, Kei Wai  
(Assistant Supervisor)

Checked by : LAU, Chi Leung  
LAU, Chi Leung  
(Environmental Team Leader)



**Calibration Report**  
of  
**High Volume Air Sampler**

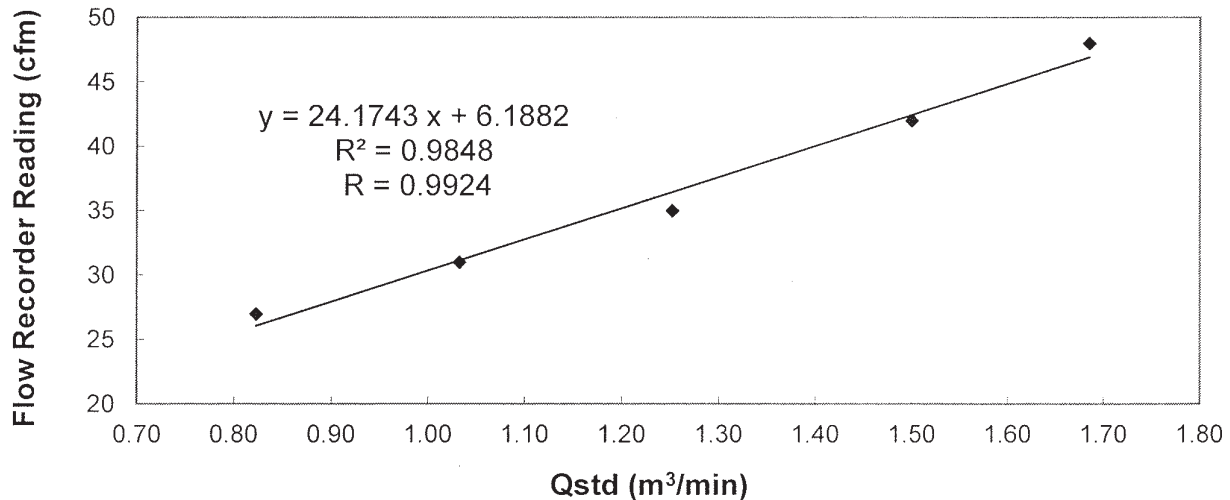
Manufacturer : Graseby 105 Date of Calibration : 05 March 2018

Serial No. : 9795 ( ET / EA / 003 / 18 ) Calibration Due Date : 04 May 2018

Method : Five-point calibration by using standard calibration kit Tisch TE-5025A refer to the Operations Manual

Results	Flow recorder reading (cfm)	48	42	35	31	27
	Qstd (Actual flow rate, m <sup>3</sup> /min)	1.68	1.50	1.25	1.03	0.82
	Pressure : 763.56 mm Hg	Temp. : 302 K				

**Sampler 9795 Calibration Curve**  
Site: Tseung Kwan O 137 (TKO-A1)

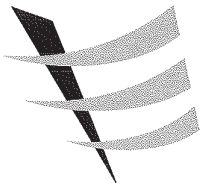


Acceptance Criteria : Correlation coefficient (r) of the calibration curve greater than 0.990 after a 5-point calibration

The high volume sampler complies\* / ~~does not comply\*~~ with the specified requirements and is deemed acceptable\* / ~~unacceptable\*~~ for use.

Calibrated by : MAK, Kei Wai  
MAK, Kei Wai  
(Assistant Supervisor)

Checked by : LAU, Chi Leung  
LAU, Chi Leung  
(Environmental Team Leader)



**Calibration Report**  
of  
**High Volume Air Sampler**

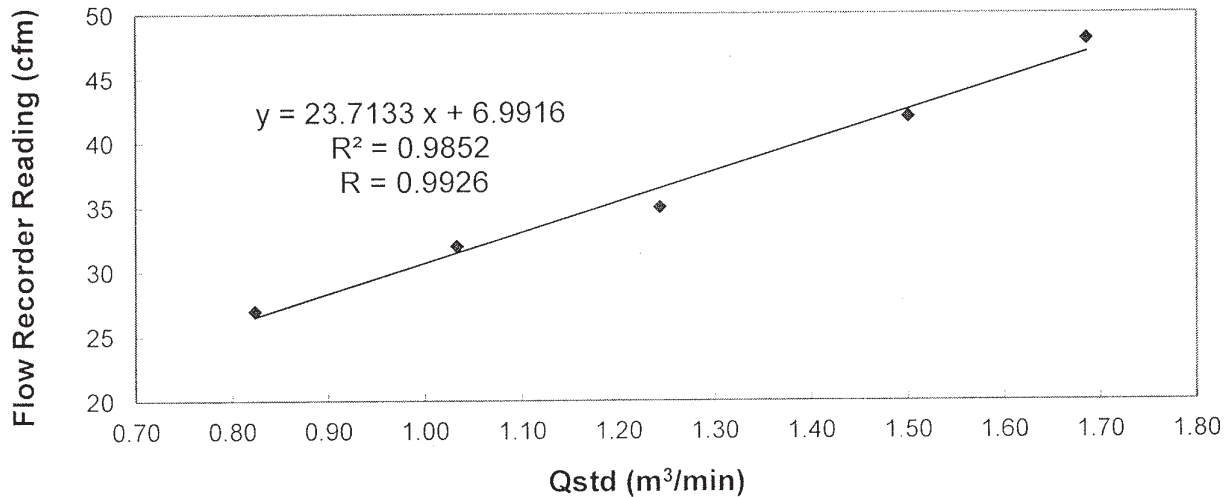
Manufacturer : Graseby 105 Date of Calibration : 02 May 2018

Serial No. : 9795 ( ET / EA / 003 / 18 ) Calibration Due Date : 01 July 2018

Method : Five-point calibration by using standard calibration kit Tisch TE-5025A refer to the Operations Manual


Results	Flow recorder reading (cfm)	48	42	35	32	27
	Qstd (Actual flow rate, m <sup>3</sup> /min)	1.69	1.50	1.24	1.03	0.82
	Pressure :	762.06 mm Hg			Temp. :	301 K

**Sampler 9795 Calibration Curve**  
Site: Tseung Kwan O 137 (TKO-A1)



Acceptance Criteria : Correlation coefficient (r) of the calibration curve greater than 0.990 after a 5-point calibration

The high volume sampler complies\* / does not comply\* with the specified requirements and is deemed acceptable\* / unacceptable\* for use.

Calibrated by :   
CHAN, Wai Man  
(Technician)

Checked by :   
LAU, Chi Leung  
(Environmental Team Leader)





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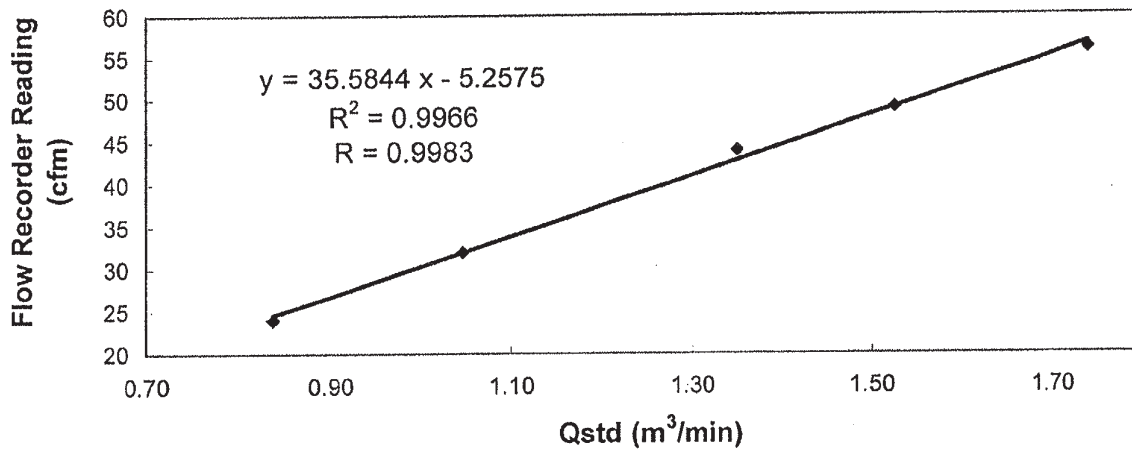
Calibration Report  
of  
High Volume Air Sampler

**Manufacturer** : Andersen G1051      **Date of Calibration** : 16 May 2017  
**Serial No.** : 1176 ( ET / EA / 003 / 05 )      **Calibration Due Date** : 15 July 2017  
**Method** : Based on Operations Manual for the 5-point calibration using standard calibration kit manufactured by Tisch TE-5025 A

**Results** :

Flow recorder reading (cfm)	56	49	44	32	24
Qstd (Actual flow rate, m <sup>3</sup> /min)	1.74	1.52	1.35	1.05	0.84
Pressure :	759.06 mm Hg			Temp. :	299 K

**Sampler 1176 Calibration Curve**  
Site: Tseung Kwan O 137 (TKO-A2a)



Acceptance Criteria : Correlation coefficient (r) of the calibration curve greater than 0.990 after a 5-point calibration

The high volume sampler complies\* / ~~does not comply\*~~ with the specified requirements and is deemed acceptable\* / unacceptable\* for use.

Calibrated by : MAK Kei Wai  
MAK, Kei Wai  
(Assistant Supervisor)

Checked by : LAW Sau Yee  
LAW, Sau Yee  
(Senior Environmental Officer)



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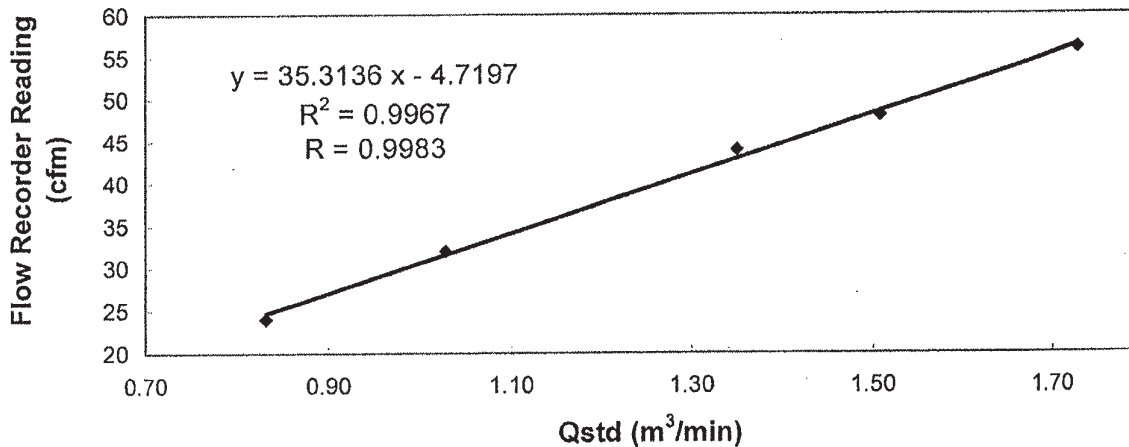
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Calibration Report  
 of  
High Volume Air Sampler

Manufacturer : Andersen G1051 Date of Calibration : 14 July 2017  
 Serial No. : 1176 ( ET / EA / 003 / 05 ) Calibration Due Date : 13 September 2017  
 Method : Based on Operations Manual for the 5-point calibration using standard calibration kit  
 manufactured by Tisch TE-5025 A


Results	Flow recorder reading (cfm)	56	48	44	32	24
	Qstd (Actual flow rate, m <sup>3</sup> /min)	1.73	1.51	1.35	1.03	0.83
	Pressure :	756.06 mm Hg		Temp. :	302 K	

**Sampler 1176 Calibration Curve**  
 Site: Tseung Kwan O 137 (TKO-A2a)



Acceptance Criteria : Correlation coefficient (r) of the calibration curve greater than 0.990 after a 5-point calibration

The high volume sampler complies\* / ~~does not comply\*~~ with the specified requirements and is deemed acceptable\* / unacceptable\* for use.

Calibrated by :   
 KWAN, King Ming  
 (Assistant Supervisor)

Checked by :   
 LAW, Sau Yee  
 (Senior Environmental Officer)



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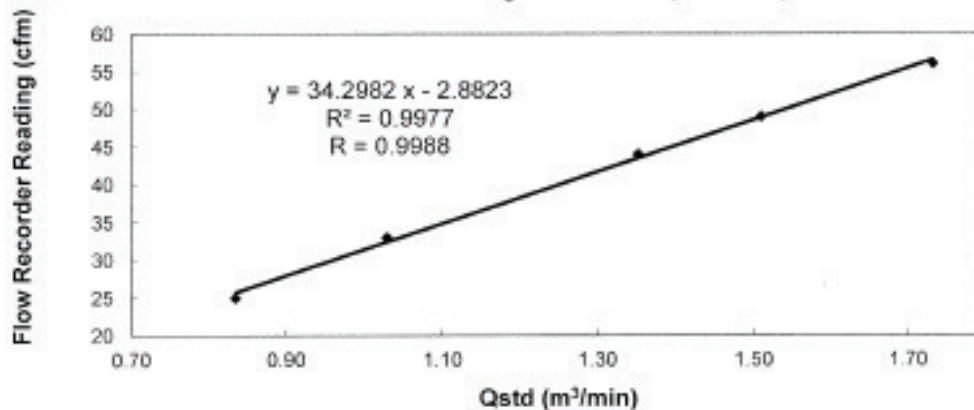
**Calibration Report**  
of  
**High Volume Air Sampler**

**Manufacturer** : Andersen G1051                      **Date of Calibration** : 11 September 2017  
**Serial No.** : 1176 ( ET / EA / 003 / 05 )                      **Calibration Due Date** : 10 November 2017  
**Method** : Based on Operations Manual for the 5-point calibration using standard calibration kit manufactured by Tisch TE-5025 A

**Results** :

Flow recorder reading (cfm)	56	49	44	33	25
Qstd (Actual flow rate, m <sup>3</sup> /min)	1.73	1.51	1.35	1.03	0.83
Pressure :	763.56 mm Hg		Temp. : 304 K		

**Sampler 1176 Calibration Curve**  
Site: Tseung Kwan O 137 (TKO-A2a)



Acceptance Criteria : Correlation coefficient (r) of the calibration curve greater than 0.990 after a 5-point calibration

The high volume sampler complies\* / ~~does not comply\*~~ with the specified requirements and is deemed acceptable\* / unacceptable\* for use.

Calibrated by : MAK, Kei Wai  
MAK, Kei Wai  
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Checked by : LAW, Sau Yee  
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(Senior Environmental Officer)



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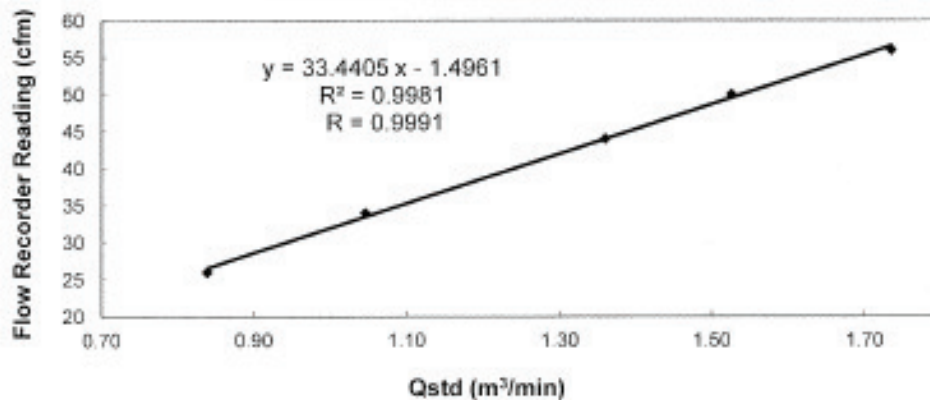
**Calibration Report  
of  
High Volume Air Sampler**

**Manufacturer** : Andersen G1051                      Date of Calibration : 10 November 2017  
**Serial No.** : 1176 ( ET / EA / 003 / 05 )                      Calibration Due Date : 09 January 2018  
**Method** : Based on Operations Manual for the 5-point calibration using standard calibration kit manufactured by Tisch TE-5025 A

**Results** :


Flow recorder reading (cfm)	56	50	44	34	26
Qstd (Actual flow rate, m <sup>3</sup> /min)	1.73	1.53	1.36	1.05	0.84
Pressure :	762.06 mm Hg			Temp. : 300 K	

**Sampler 1176 Calibration Curve  
Site: Tseung Kwan O 137 (TKO-A2a)**



Acceptance Criteria : Correlation coefficient (r) of the calibration curve greater than 0.990 after a 5-point calibration

The high volume sampler complies\* / does-not-comply\* with the specified requirements and is deemed acceptable\* / unacceptable \* for use.

Calibrated by :   
CHAN, Wai Man  
(Technician)

Checked by :   
LAW, Sau Yee  
(Senior Environmental Officer)



Calibration Report  
of  
High Volume Air Sampler

Manufacturer : Andersen G1051 Date of Calibration : 08 January 2018

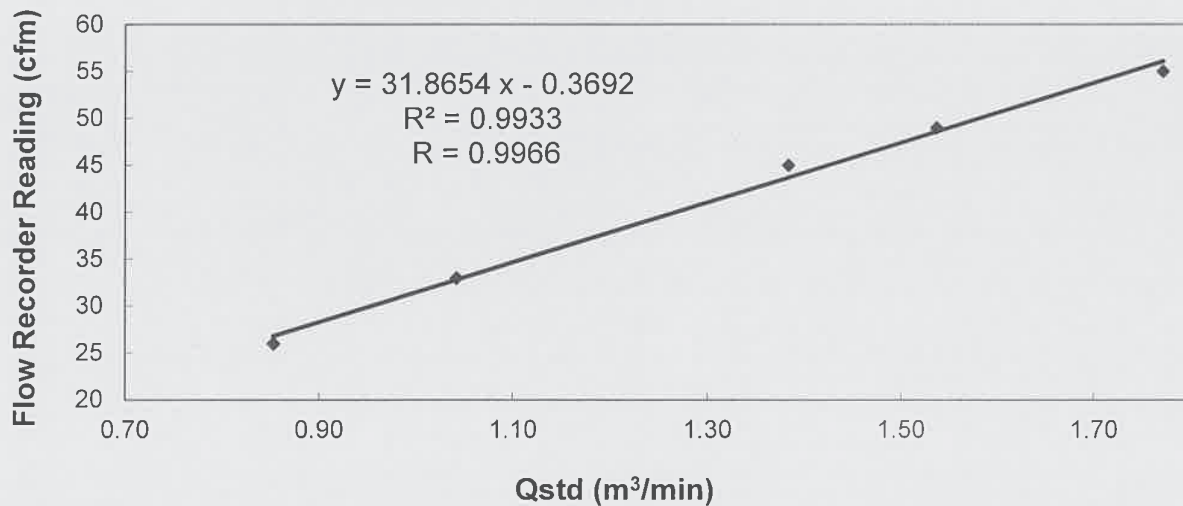
Serial No. : 1176 ( ET / EA / 003 / 05 ) Calibration Due Date : 07 March 2018

Method : Based on Operations Manual for the 5-point calibration using standard calibration kit manufactured by Tisch TE-5025 A

Results

Flow recorder reading (cfm)	55	49	45	33	26
Qstd (Actual flow rate, m <sup>3</sup> /min)	1.77	1.54	1.38	1.04	0.85
Pressure :	762.81 mm Hg		Temp. :	290 K	

**Sampler 1176 Calibration Curve**  
Site: Tseung Kwan O 137 (TKO-A2a)

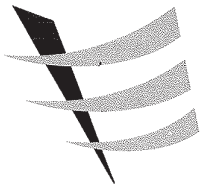


Acceptance Criteria : Correlation coefficient (r) of the calibration curve greater than 0.990 after a 5-point calibration

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Calibrated by : MAK Kei Wai  
MAK, Kei Wai  
(Assistant Supervisor)

Checked by : LAU Chi Leung  
LAU, Chi Leung  
(Environmental Team Leader)



**Calibration Report**  
of  
**High Volume Air Sampler**

**Manufacturer** : Andersen G1051      **Date of Calibration** : 05 March 2018

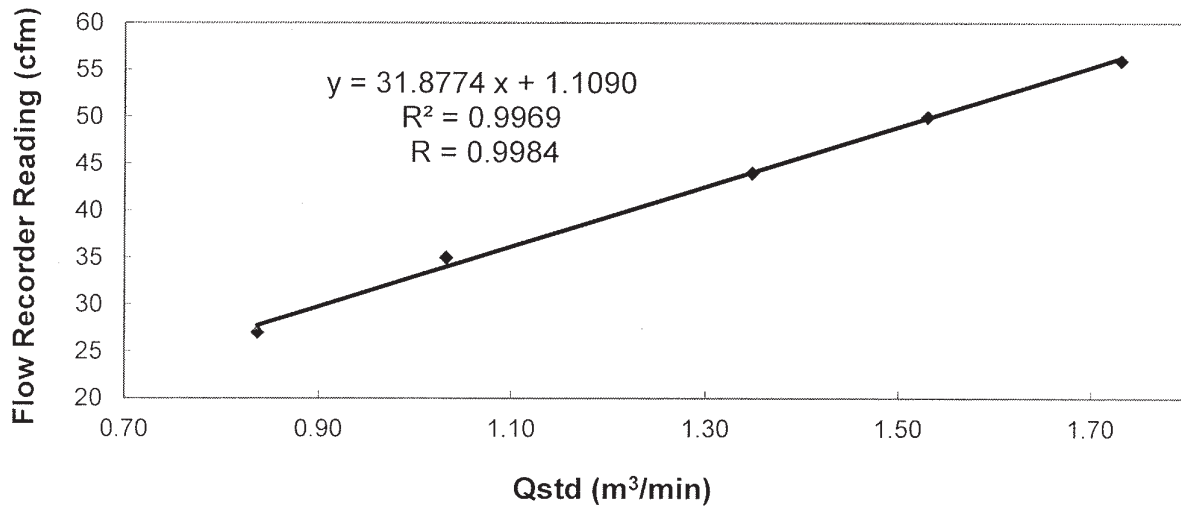
**Serial No.** : 1176 ( ET / EA / 003 / 05 )      **Calibration Due Date** : 04 May 2018

**Method** : Based on Operations Manual for the 5-point calibration using standard calibration kit manufactured by Tisch TE-5025 A

**Results** :

Flow recorder reading (cfm)	56	50	44	35	27
Qstd (Actual flow rate, m <sup>3</sup> /min)	1.73	1.53	1.35	1.03	0.84
Pressure :	763.56 mm Hg		Temp. :	302 K	

**Sampler 1176 Calibration Curve**  
Site: Tseung Kwan O 137 (TKO-A2a)

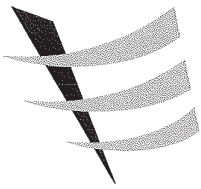


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(Environmental Team Leader)



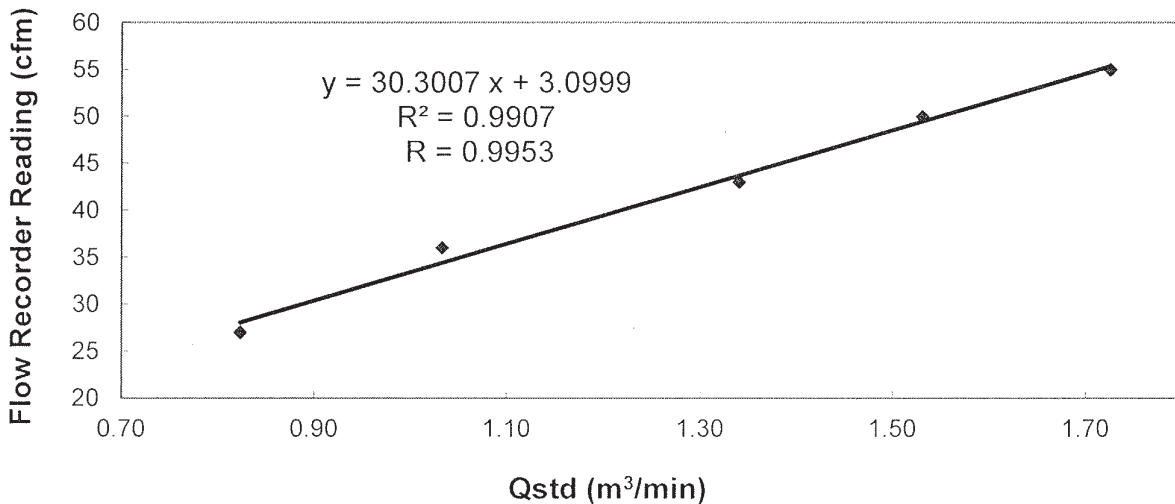
**Calibration Report**  
of  
**High Volume Air Sampler**

**Manufacturer** : Andersen G1051 Date of Calibration : 02 May 2018  
**Serial No.** : 1176 ( ET / EA / 003 / 05 ) Calibration Due Date : 01 July 2018  
**Method** : Based on Operations Manual for the 5-point calibration using standard calibration kit manufactured by Tisch TE-5025 A

**Results** :

Flow recorder reading (cfm)	55	50	43	36	27
Qstd (Actual flow rate, m <sup>3</sup> /min)	1.73	1.53	1.34	1.03	0.82
Pressure :	762.06 mm Hg		Temp. :	301 K	

**Sampler 1176 Calibration Curve**  
Site: Tseung Kwan O 137 (TKO-A2a)



Acceptance Criteria : Correlation coefficient (r) of the calibration curve greater than 0.990 after a 5-point calibration

The high volume sampler complies\* / does not comply\* with the specified requirements and is deemed acceptable\* / unacceptable\* for use.

Calibrated by :   
CHAN, Wai Man  
(Technician)

Checked by :   
LAU, Chi Leung  
(Environmental Team Leader)



ET/EA/004/14

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ORIFICE TRANSFER STANDARD CERTIFICATION WORKSHEET TE-5025A

Date - Apr 03, 2017 Roots-meter S/N 0438320 Ta (K) - 295  
 Operator Tisch Orifice I.D. - 3297 Pa (mm) - 748.03

PLATE OR Run #	VOLUME START (m3)	VOLUME STOP (m3)	DIFF VOLUME (m3)	DIFF TIME (min)	METER DIFF Hg (mm)	ORIFICE DIFF H2O (in.)
1	NA	NA	1.00	1.4360	3.2	2.00
2	NA	NA	1.00	1.0230	6.4	4.00
3	NA	NA	1.00	0.9170	7.9	5.00
4	NA	NA	1.00	0.8720	8.8	5.50
5	NA	NA	1.00	0.7180	12.7	8.00

DATA TABULATION

Vstd	(x axis) Qstd	(y axis)	Va	(x axis) Qa	(y axis)
0.9900	0.6894	1.4101	0.9957	0.6934	0.8881
0.9858	0.9636	1.9943	0.9915	0.9692	1.2560
0.9837	1.0727	2.2296	0.9893	1.0789	1.4042
0.9825	1.1268	2.3385	0.9882	1.1333	1.4728
0.9773	1.3612	2.8203	0.9830	1.3691	1.7762
Qstd slope (m) = 2.10166			Qa slope (m) = 1.31603		
intercept (b) = -0.03302			intercept (b) = -0.02080		
coefficient (r) = 0.99984			coefficient (r) = 0.99984		
y axis = SQRT[H2O(Pa/760)(298/Ta)]			y axis = SQRT[H2O(Ta/Pa)]		

CALCULATIONS

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

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

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

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

For subsequent flow rate calculations:

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

$$Qa = 1/m \{ [\text{SQRT} H2O(Ta/Pa)] - b \}$$



# Certificate of Calibration

Calibration Certification Information			
Cal. Date: March 21, 2018	Rootsmeter S/N: 438320	Ta: 293	°K
Operator: Jim Tisch		Pa: 756.9	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: <b>3480</b>		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4200	3.2	2.00
2	3	4	1	1.0000	6.4	4.00
3	5	6	1	0.8950	7.9	5.00
4	7	8	1	0.8570	8.8	5.50
5	9	10	1	0.7070	12.7	8.00

Data Tabulation					
Vstd (m3)	Qstd (x-axis)	$\sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)}$ (y-axis)	Va	Qa (x-axis)	$\sqrt{\Delta H (Ta/Pa)}$ (y-axis)
1.0087	0.7103	1.4233	0.9958	0.7012	0.8799
1.0044	1.0044	2.0129	0.9915	0.9915	1.2443
1.0024	1.1200	2.2505	0.9896	1.1057	1.3912
1.0012	1.1682	2.3603	0.9884	1.1533	1.4591
0.9959	1.4087	2.8467	0.9832	1.3907	1.7598
<b>QSTD</b>	m=	<b>2.04113</b>	<b>QA</b>	m=	<b>1.27812</b>
	b=	<b>-0.03040</b>		b=	<b>-0.01879</b>
	r=	<b>0.99994</b>		r=	<b>0.99994</b>

Calculations	
Vstd= $\Delta Vol((Pa-\Delta P)/Pstd)(Tstd/Ta)$	Va= $\Delta Vol((Pa-\Delta P)/Pa)$
Qstd= $Vstd/\Delta Time$	Qa= $Va/\Delta Time$
<b>For subsequent flow rate calculations:</b>	
<b>Qstd=</b> $1/m \left( \left( \sqrt{\Delta H \left( \frac{Pa}{Pstd} \right) \left( \frac{Tstd}{Ta} \right)} \right) - b \right)$	<b>Qa=</b> $1/m \left( \left( \sqrt{\Delta H (Ta/Pa)} \right) - b \right)$

Standard Conditions	
Tstd:	298.15 °K
Pstd:	760 mm Hg
Key	
ΔH:	calibrator manometer reading (in H2O)
ΔP:	rootsmeter manometer reading (mm Hg)
Ta:	actual absolute temperature (°K)
Pa:	actual barometric pressure (mm Hg)
b:	intercept
m:	slope

RECALIBRATION
US EPA recommends annual recalibration per 1998 40 Code of Federal Regulations Part 50 to 51, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere, 9.2.17, page 30