

Appendix C

Calibration Certificate for
Construction Dust Monitoring
Equipment



FUGRO TECHNICAL SERVICES LIMITED

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Profit Industrial Building,
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TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : M-A3
Date of Calibration: 23-Mar-23
Location : S.K.H Tsoi Kung Po Secondary School
Next Calibration Date: 22-Jun-23
Make: Tisch
Technician: Dickson Yeung
Model: TE-5170 S/N: 4388

CONDITIONS

Sea Level Pressure (hPa): 1009 Corrected Pressure (mm Hg): 757
Temperature (°C): 25 Temperature (K): 298

CALIBRATION ORIFICE

Make: Tisch Qstd Slope: 2.11005
Model: TE-5025A Qstd Intercept: -0.01868
Calibration Date: 24-Apr-22 Expiry Date: 24-Apr-23
S/N: 2154

CALIBRATIONS

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	7.30	-4.40	11.700	1.627	54.00	53.89	Slope = 19.6371
13	6.10	-3.20	9.300	1.451	51.00	50.89	Intercept = 22.4389
10	5.00	-2.00	7.000	1.260	48.00	47.90	Corr. coeff.= 0.9947
7	3.70	-0.80	4.500	1.012	43.00	42.91	
5	3.00	0.00	3.000	0.828	38.00	37.92	

Calculations:

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$

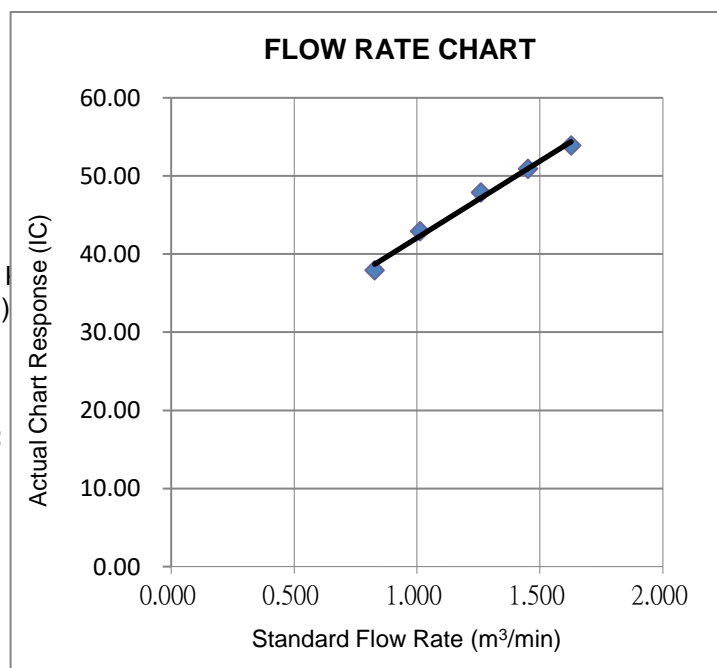
$$IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$$

Qstd = standard flow rate
IC = corrected chart response
I = actual chart response
m = calibrator Qstd slope
b = calibrator Qstd intercept
Ta = actual temperature during calibration (deg K)
Pa = actual pressure during calibration (mm Hg)
Tstd = 298 deg K
Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m((I)[\text{Sqrt}(298/Tav)(Pav/760)]-b)$$

m = sampler slope
b = sampler intercept
I = chart response
Tav = daily average temperature
Pav = daily average pressure



RECALIBRATION
DUE DATE:
April 24, 2023

Certificate of Calibration

Calibration Certification Information			
Cal. Date: April 24, 2022	Rootsmeter S/N: 438320	Ta: 295	°K
Operator: Jim Tisch		Pa: 751.1	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: 2154		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4680	3.2	2.00
2	3	4	1	1.0350	6.4	4.00
3	5	6	1	0.9240	8.0	5.00
4	7	8	1	0.8800	8.8	5.50
5	9	10	1	0.7290	12.8	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)
0.9941	0.6772	1.4130	0.9957	0.6783	0.8863
0.9898	0.9563	1.9983	0.9915	0.9580	1.2534
0.9877	1.0689	2.2342	0.9893	1.0707	1.4014
0.9866	1.1212	2.3432	0.9883	1.1230	1.4698
0.9813	1.3461	2.8260	0.9830	1.3484	1.7726
QSTD	m=	2.11005	QA	m=	1.32128
	b=	-0.01868		b=	-0.01172
	r=	0.99998		r=	0.99998

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

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



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TSP SAMPLER CALIBRATION CALCULATION SPREADSHEET

Location : M-A3
Date of Calibration: 23-Jun-23
Location : S.K.H Tsoi Kung Po Secondary School
Next Calibration Date: 22-Sep-23
Make: Tisch
Technician: Eve Ma
Model: TE-5170
S/N: 4388

CONDITIONS

Sea Level Pressure (hPa): 1007
Corrected Pressure (mm Hg): 755
Temperature (°C): 30
Temperature (K): 303

CALIBRATION ORIFICE

Make: Tisch
Qstd Slope: 2.08482
Model: TE-5025A
Qstd Intercept: -0.02977
Calibration Date: 1-Jun-23
Expiry Date: 1-Jun-24
S/N: 2456

CALIBRATIONS

Plate No.	H2O (L) (in)	H2O (R) (in)	H2O (in)	Qstd (m ³ /min)	I (chart)	IC (corrected)	LINEAR REGRESSION
18	5.50	-7.50	13.000	1.723	64.00	63.24	Slope = 31.9626
13	4.50	-6.50	11.000	1.586	57.00	56.33	Intercept = 6.9150
10	3.00	-5.00	8.000	1.355	51.00	50.40	Corr. coeff.= 0.9935
7	2.00	-4.00	6.000	1.175	44.00	43.48	
5	1.00	-3.00	4.000	0.962	39.00	38.54	

Calculations:

$$Qstd = 1/m[\text{Sqrt}(H2O(Pa/Pstd)(Tstd/Ta))-b]$$

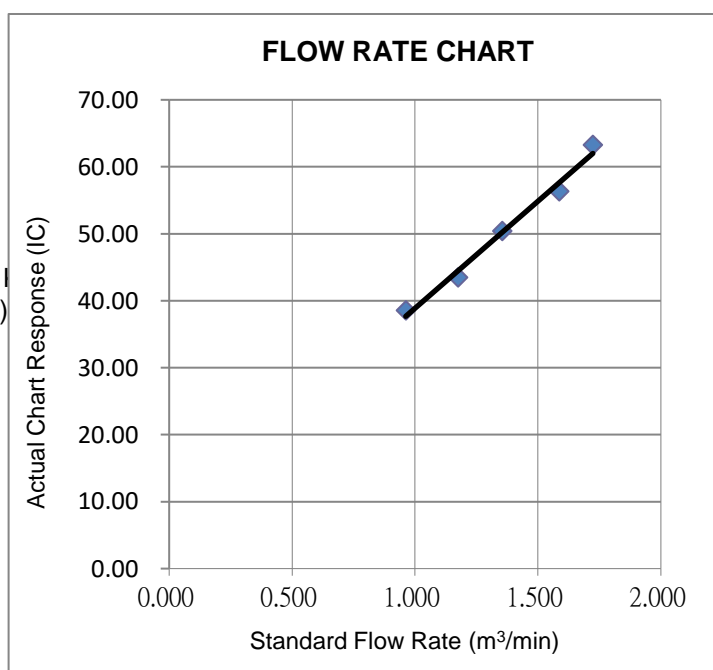
$$IC = I[\text{Sqrt}(Pa/Pstd)(Tstd/Ta)]$$

Qstd = standard flow rate
IC = corrected chart response
I = actual chart response
m = calibrator Qstd slope
b = calibrator Qstd intercept
Ta = actual temperature during calibration (deg K)
Pa = actual pressure during calibration (mm Hg)
Tstd = 298 deg K
Pstd = 760 mm Hg

For subsequent calculation of sampler flow:

$$1/m((I)[\text{Sqrt}(298/Tav)(Pav/760)]-b)$$

m = sampler slope
b = sampler intercept
I = chart response
Tav = daily average temperature
Pav = daily average pressure





Certificate of Calibration

Calibration Certification Information			
Cal. Date: June 1, 2023	Rootsmeter S/N: 438320	Ta: 295	°K
Operator: Jim Tisch		Pa: 751.8	mm Hg
Calibration Model #: TE-5025A	Calibrator S/N: 2456		

Run	Vol. Init (m3)	Vol. Final (m3)	ΔVol. (m3)	ΔTime (min)	ΔP (mm Hg)	ΔH (in H2O)
1	1	2	1	1.4360	3.2	2.00
2	3	4	1	1.0210	6.4	4.00
3	5	6	1	0.9080	8.0	5.00
4	7	8	1	0.8670	8.8	5.50
5	9	10	1	0.7170	12.8	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)	$\sqrt{\Delta H \left(\frac{Ta}{Pa} \right)}$ (y-axis)
0.9951	0.6929	1.4137	0.9957	0.6934	0.8859
0.9908	0.9704	1.9993	0.9915	0.9711	1.2528
0.9887	1.0889	2.2353	0.9894	1.0896	1.4007
0.9876	1.1391	2.3444	0.9883	1.1399	1.4690
0.9823	1.3700	2.8275	0.9830	1.3710	1.7717
QSTD	m=	2.08482	QA	m=	1.30548
	b=	-0.02977		b=	-0.01866
	r=	0.99997		r=	0.99997

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

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
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Report no. : 940891CA222379(3)

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CALIBRATION CERTIFICATE OF DUST METER

Client : Fugro Technical Services Limited

Project : Calibration Services

Client Supplied Information

Details of Unit Under Test, UUT -

Description : Laser Dust Monitor

Manufacturer : SIBATA

Model No. : LD-5R

Serial No. : 114892

Specification Limit : NA

Next Calibration Date : 25-Aug-2023

Laboratory Information

Details of Reference Equipment -

Description : 1.Reference balance 2. TSP high Volume air sampler

Equipment ID / Serial no. : 1.C-065-5 2. 4350

Date of Calibration : 26-Aug-2022 Ambient Temperature : 33 °C

Calibration Location : Calibration Lab. of FTS

Method Used : By direct comparison the weight of dust particle trapped in a filter paper using high volume sampler (TSP method) for a certain period, with the reading of the UUT. They should be placed at the same location and powered on and off at the same time.

Calibration Results :

Reference concentration (mg/m ³)	Total count for 1 hour	CPM (Count per minute)
0.0501	1531	25.52
0.0366	1075	17.92
0.0443	1290	21.50

Remarks:

1. The equipment being used in this calibration is traceable to recognized National Standards.
2. The interpolation equation : Concentration (mg/m³) = K x UUT reading (CPM) where K = 0.002014
3. Correlation coefficient (r) : 0.9936

Checked by : Alloy Date : 18/10-2022 Certified by : P.T. Leung Date : 19-10-2022
CA-R-297 (22/07/2009) Leung Kwok Tai (Assistant Manager)

** End of Report **