Particle Size Distribution of PFOA in Ambient Air
Data Summary and Analysis

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Prepared for

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SUMMARY

A sampling program was conducted to evaluate the particle size distribution (PSD) of PFOA in ambient air at the Washington Works site. PSD information is a critical input for air deposition modeling. In addition to providing a measure of the PSD, the sampling program also was used to calculate 72-hour average ambient air concentrations at 4 fence-line locations.

Results from the sampling program are summarized below.

- An average PSD was calculated using data collected during a 72-hour sampling event at four fence-line locations. The average PSD is shown in the following table.

Particle Diameter, microns	Mass Fraction	Cumulative % Less Than Particle Size
4.0	0.056	94.4%
1.7	0.129	81.5%
0.8	0.092	72.3%
0.5	0.072	65.1%
0.3	0.053	59.8%
0.28	0.598	

- These results compare favorably with previous PSD measurements for PFOA collected at the Washington Works site (circa 1995), shown in the table below.

Particle Diameter, microns	Mass Fraction	Cumulative % Less Than Particle Size
4.0	0.033	96.7%
2.0	0.127	84.0%
0.75	0.035	80.5%
0.4	0.267	53.8%
0.2	0.538	

- The overall mass concentration of PFOA for the 3-day test period is as follows:
  - Station 1: 0.0099 ug/m^3
  - Station 2: 0.1099 ug/m^3
  - Station 3: 0.1030 ug/m^3
  - Station 4: 0.0034 ug/m^3

Concentrations compare favorably to previous 24-hour sampling collected using OSHA Versatile Sampling (OVS) tubes, where the majority of monitored data was below a quantitation limit of approximately 0.14 ug/m3. In addition, sample results from this study show co-located samples at Stations 2 and 3 differ by less than 6%, showing acceptable precision in the sampling methodology. Also, the concentrations above are consistent with predicted model results and with previous OVS tube sampling which show the location of Station 4 as the predominant upwind location and Stations 2 and 3 as the predominant downwind location.

INTRODUCTION

The intent of this report is to describe the sampling technique used to determine the particle size distribution (PSD) of PFOA in the ambient air around the Washington Works Plant. This report will further present and discuss the results from a field test to measure the particle size distribution.

SAMPLING STRATEGY

The particle size program was conducted during a 72-hour period at four locations, shown in Figure 1. Locations were selected to represent areas of the predicted maximum ambient air concentrations, according to air dispersion modeling. Two samplers were co-located (at Stations 2 and 3) to provide information about sampling precision. One background sampler was located to collect predicted upstream concentrations, assuming wind patterns follow predominant directions in the valley.

SAMPLING METHODOLOGY AND DATA COLLECTION

The PSD measurement was accomplished by means of a cascade impactor, an inertial classification device. An impactor operates under the principle that if a stream of particle-laden air is directed at a surface, particles of sufficient inertia will impact upon the surface and the smaller particles will follow the air streamlines and will not be collected. Thus, an impactor consists simply of a nozzle or jet stage, either round or rectangular in shape, and an impaction plate or substrate.

At each location, sampling equipment consisted of a Tisch Model 235 High Volume Cascade Impactor rented from RAMCON Environmental in Kingston Springs, Tennessee. The complete sampler consisted of the 5-stage impactor head attached to a high volume sampling pump. (See Figure 2.) RAMCON also provided on-site support to mobilize and operate sampling equipment. Each sampler was operated for a nominal 72-hr period in order to maximize the potential for collecting sufficient mass of the target analyte.

The impactors were calibrated in accordance with *Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method), CFR 40 Part 50.11, Appendix B, July 1, 1976* (Reference 1) and operated in accordance with the manufacturer's instructions (Reference 2). One exception to routine procedure was made, in order to accommodate the objective of the program. Normally, the substrates (cellulose targets and filter) are dried in a desiccator and pre-weighed and the process is repeated post-test to obtain the mass collected. However, this gravimetric protocol was not followed, in order to distinguish only the mass of PFOA collected in the sampler from other compounds and dusts that may have been collected. Instead, material from each of the collection stages was analyzed separately, specifically to determine the mass of the target analyte at each stage, or cut size.

In order to ensure the material was adequately retained on filters during the sampling period, preliminary laboratory testing was performed. Results from lab testing showed that acceptable analytical recovery was demonstrated. Details are included in Appendix 1.

At each of the four locations, flow rates and run time were recorded and calibrations were performed to determine cut sizes and actual airflow during the sampling period. Calibration tables are included in Appendix 2.

ANALYTICAL METHODS

Cellulose filters were extracted and analyzed for PFOA by Exygen Research, State College, PA. Exygen extracted the sample with water using methods that are currently being validated. Following extraction, the samples were analyzed using methodology described in documentation submitted to the public docket under OPPT-2003-0012-0040. That methodology uses a methanol extraction with liquid chromatograph/mass spectrometer/mass spectrometer (LC/MS/MS). Exygen's complete report (entitled Particle Size Distribution Study 3/04) is included in the public docket as OPPT-2003-0012-0659.

RESULTS

For each of the four sampling locations, a mass of PFOA was determined for separate cut sizes. This information was used to calculate the PSD both as a weight fraction and as a cumulative distribution. Sampling data for each station is included in Appendix 3. Because impactor gas flow rate effects the calculated cut size, slight differences in cut sizes were apparent (a maximum of 6%). These data were averaged to provide a single representative PSD for PFOA in ambient air. Table 1 summarizes particle size data from each of the station. Table 2 shows the final representative PSD, based on averaging from four sampling locations.

In addition to determining the PSD, sampling data were also used to determine concentrations of PFOA at each sampling location. The overall mass concentration of PFOA for the 3-day test period is as follows:

Station 1:	0.0099 ug/m^3
Station 2:	0.1099 ug/m^3
Station 3:	0.1030 ug/m^3
Station 4:	0.0034 ug/m^3

Concentrations compare favorably to previous 24-hour sampling collected using OSHA Versatile Sampling (OVS) tubes, where the majority of monitored data was below a quantitation limit of approximately 0.14 ug/m3. In addition, sample results from this study show co-located samples at Stations 2 and 3 differ by less than 6%, showing acceptable precision in the sampling methodology. Also, the concentrations above are consistent with predicted model results and with previous OVS tube sampling which show the location of Station 4 as the predominant upwind location and Stations 2 and 3 as the predominant downwind location.

Table 1
NORMALIZED PARTICLE SIZE DISTRIBUTION DATA SUMMARY

Station 1	Station 2	Station 3	Station 5	Avg. PSD	Station 1	Station 2	Station 3	Station 4
Particle Size Um	Particle Size um	Particle Size um	Particle Size um	Particle Size um	Cum % < %	Cum % < %	Cum % < %	Cum % < %
4.1	4.19	3.96	3.93	4.0	92.1%	95.9%	96.6%	93.2%
1.71	1.75	1.66	1.65	1.7	74.2%	82.5%	85.1%	84.3%
0.86	0.87	0.83	0.83	0.8	64.1%	73.9%	74.6%	76.7%
0.55	0.55	0.53	0.53	0.5	54.6%	68.5%	68.1%	69.3%
0.28	0.29	0.27	0.27	0.3	47.6%	67.9%	61.8%	61.9%
<0.28	<0.29	<0.27	<0.27	<0.28				

Table 2. Representative PSD for PFOA at Washington Works Site

Particle Diameter, microns	Mass Fraction	Cumulative % Less Than Particle Size
4.0	0.056	94.4%
1.7	0.129	81.5%
0.8	0.092	72.3%
0.5	0.072	65.1%
0.3	0.053	59.8%
0.28	0.598	

Figure 1: Approximate Air Sampling Locations

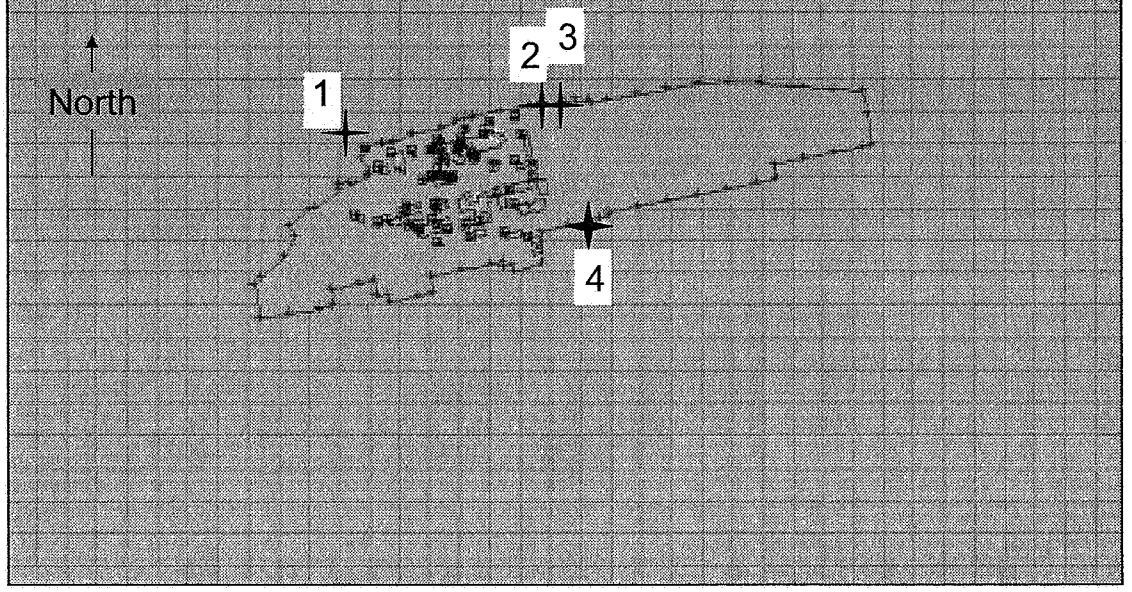
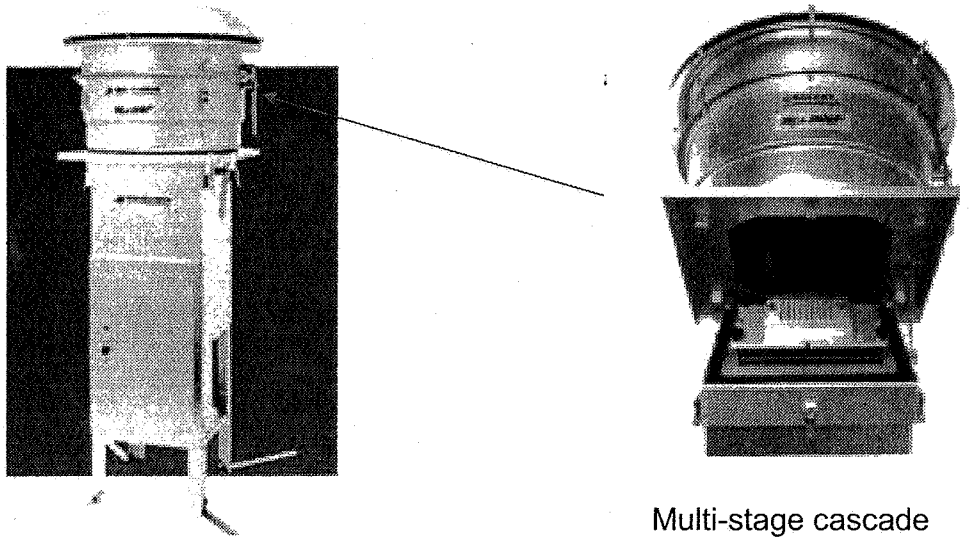


Figure 2: High Volume Sampler with Cascade Impactor



Size selective particulate high volume sampler

Multi-stage cascade impactor

REFERENCE DOCUMENTS

1. Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method), CFR 40 Part 50.11, Appendix B, July 1, 1976
2. Series 230 High Volume Cascade Impactor Operation Manual, Tisch Environmental, Clevis, OH 45002, March, 2004

APPENDIX 1

Laboratory Test Report for Determination of Filter Paper Retention Efficiency

Laboratory Apparatus

Apparatus: 3 Cole Parmer rotometers, cat. # A-32461-58
6 filter cartridges
2 Air pumps, MICRO-MAX 1, Micro-Trap, Inc.
Stainless steel manifold w/vacuum gauge
¼" Tygon® tubing
Whatman 41 filter paper, cat. # 1441 866
Pentadecafluorooctanoic acid (PFOA), Oakwood Products
20 mL scintillation vials w/screw caps

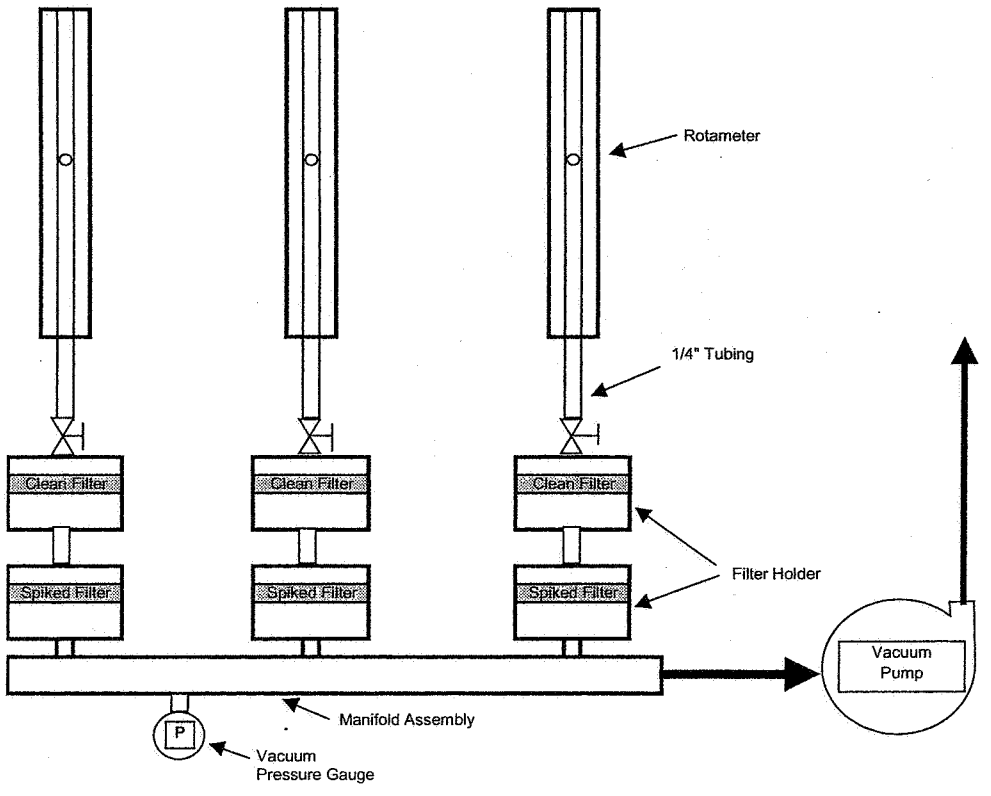


Figure 1: Experimental Apparatus for Filter Retention Study

Laboratory Procedure

To determine the retention efficiency of the filter paper used for the high-volume cascade impactor, a 1-µg spike (10µL of 100.7µg/mL in acetone) of PFOA was applied to five 47-mm circles of filter paper cut from the larger paper used in the impactor. The circles were contained in a standard filter cassette (cat. # 225-4702 SKC, Inc., Eighty Four, PA, USA). The spiked cassettes were allowed to air dry and then placed in series with air first passing through an unspiked filter paper cassette then the spiked cassette. The flowrate used for this lab test was 10.5 liters per minute, to simulate the airflow used during high-volume sampling. Specific procedures are described below.

1. Assemble the experimental apparatus as depicted in Figure 1. Cut out eight circular filter disks having a diameter of 4.5 cm. Use gloves to prevent contamination. Soak eight vials/caps in deionized water and air-dry two times.

2. Load a filter disk into each filter cartridge. Turn on the air pumps and calibrate the airflow through each rotometer with a bubble flow meter (10.5 L/min.).

3. Put one filter disk into a vial, secure and label as Experiment Blank. Apply 10 µL of the 100.7 ppm PFOA stock solution (in HR-GC acetone) to a filter disk. Put this disk into a vial, secure and label as 1 µg Spike.

4. Turn off the air pumps. Remove each of the three sample filters from the cartridges. Apply 10 µL of the PFOA stock solution to each sample filter. Reinsert each sample filter into its cartridge.

5. Turn on the air pumps. Record the time.

6. Turn off pumps when 24 hours have elapsed. Remove the blank filter paper (closest to the rotometer), insert and secure into a vial and label as 24 hr. blank. Remove the sample filter paper (closest to the manifold), insert and secure into a vial and label as 24 hr. sample. Cap off the manifold line with a ¼" tubing cap. Turn on air pumps.

7. Turn off pumps when 48 hours have elapsed. Repeat step 6 with the exception of labeling the filter papers as 48 hr. blank and 48 hr. sample.

8. Turn of pumps when 72 hours have elapsed. Repeat step 6 with the exception of labeling the filter papers as 72 hr. blank and 72 hr. sample.

9. Ship all vials to Exygen for LC/MS/MS analysis.

Analytical Methodology

Filter paper samples were placed in a 50-mL propylene centrifuge tubes and fortified and air-dried, if needed. Forty mL of water was added, then the tube capped and shaken overnight (12-24 hours) on a wrist-action shaker. The tubes were removed from the shaker and centrifuged at approximately 5000 rpm for approximately 10 minutes. The supernate was decanted into another 50-mL polypropylene centrifuge tube. C_{18} solid-phase extraction cartridges (Waters, Milford, MA, USA) were preconditioned by passing 10-mL of methanol then 5-mL of water through each. The sample was then loaded onto the cartridge and the eluate discarded. The column was then washed with 40% methanol in water and the eluate discarded. The cartridge was then eluted with approximately 5-mL of 100% methanol. Five mL of the eluate was collected in a 15-mL polypropylene centrifuge and transported for LC/MS/MS analysis.

The analysis was performed on a HP 1100 series electrospray mass spectrometer (Agilent, Little Falls, DE, USA) with a 2mM ammonium acetate (A) and methanol (B) gradient (0 time, 70% A; 6.0 min., 10%A; 12 minutes stop; post time 4 minutes) at 0.3 mL/minute. A 5-µL aliquot was injected onto a Betasil C_{18} column (2 mm x 30 mm, 3 µm) (Thermo Hypersil-Keystone, San Jose, CA, USA) at 35 °C. Ions 369 (m/z) (PFOA) and 469 (m/z)(surrogate) were monitored. A six-point (nonzero) linear calibration curve was used for quantitation. The standards were measured both at the beginning of the run sequence and were interspersed throughout the run. For the initial run (6 points) and the combined initial and interspersed set (12 points), the correlation coefficient (R) was $\geq$ 0.992 (coefficient of determination, $R^2 \geq 0.985$). A matrix control sample fortified with PFOA was included with a blank with each set of samples. Fortification and surrogate recoveries falling within 75 to 125% were considered acceptable. Samples in which no peaks were detected (i.e., signal: noise ratio < 3: 1) at the corresponding retention times were reported as ND (not detected). Samples in which peaks are detected at the corresponding analyte retention time but less than the lowest concentration of the calibration standards (50 ng/mL) were reported as NQ (not quantifiable). The limit of quantitation for this method was 50ng/mL (or 50 ng per fraction). Method blanks did not contain analyte at levels greater than the LOQ.

Analytical Results

Table A summarizes results from this experiment.

Table A. Retention of PFOA on Whatman #41 Filter Paper at 10.5 L/min

time (hour)	volume (m^3)	Mass detected (µg)	% retention
0	0	0.02	NA
0	0	0.82	NA
24	15	0.02	NA
24	15	0.75	91

APPENDIX 2

Calibration Tables

Table A

Ramcon Environmental
TE-5100-D MFC Sampler Calibration
(Dickson recorder)

SITE

Location->	Dupont WW #1	Date->	23-Mar-04
Sampler->	TE-5000	Tech->	Dale Sawyer

CONDITIONS

Sampler Elevation (feet)	0		
Sea Level Pressure (in Hg)	30.00	Corrected Pressure (mm Hg)	762
Temperature (deg F)	40	Temperature (deg K)	277
Seasonal SL Press. (in Hg)	30.00	Corrected Seasonal (mm Hg)	762
Seasonal Temp. (deg F)	40	Seasonal Temp. (deg K)	277

CALIBRATION ORIFICE

Make->	Tisch-Env	Qstd Slope->	2.03415
Model->	TE-5025	Qstd Intercept->	-0.02843
Serial#->		Date Certified->	

Plate or Test #	H2O (in)	CALIBRATION Qstd (m3/min)	I (chart)	IC (corrected)
18	10.80	1.691	54.0	56.04
13	9.40	1.578	45.0	46.70
10	6.20	1.284	38.0	39.43
7	4.26	1.067	20.0	20.75
5	2.32	0.791	10.0	10.38

LINEAR REGRESSION

Slope =	50.2351
Intercept =	-29.7495
Corr. coeff.=	0.9856

Calculations

Qstd = 1/m[Sqrt(H2O(Pa/Pstd)(Tstd/Ta))-b]
IC = I[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)[Sqrt(298/Tav)(Pav/760)]-b)

Qstd (ft3/min)	Chart
59.700867	45.0
55.730214	40.0
45.353563	33.0
37.678602	24.0
27.935039	10.0

Chart setting for 40 CFM std
24.825491

First 24 hours		Second 24 hours		Third 24 hours	
7:50	7:46	8:00	8:16	9:42	9:38
Chart Reading		Chart Reading		Chart Reading	
30	18	32	30	32	28
CFM std		CFM std		CFM std	
44.91	33.78	46.76	44.91	46.76	43.05

Average CFM std
43.36

Table B

Ramcon Environmental
TE-5100-D MFC Sampler Calibration
(Dickson recorder)

SITE

Location->	Dupont WW #2	Date->	23-Mar-04
Sampler->	TE-5000	Tech->	Dale Sawyer

CONDITIONS

Sampler Elevation (feet)	0		
Sea Level Pressure (in Hg)	30.00	Corrected Pressure (mm Hg)	762
Temperature (deg F)	40	Temperature (deg K)	277
Seasonal SL Press. (in Hg)	30.00	Corrected Seasonal (mm Hg)	762
Seasonal Temp. (deg F)	40	Seasonal Temp. (deg K)	277

CALIBRATION ORIFICE

Make->	Tisch-Env	Qstd	Slope->	2.03415	
Model->	TE-5025	Qstd Intercept->		-0.02843	
Serial#->		Date Certified->			

Plate or Test #	H2O (in)	CALIBRATION Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
18	11.00	1.706	47.0	48.77	Slope =	36.3187
13	9.00	1.544	41.0	42.55	Intercept =	-13.1594
10	7.00	1.364	35.0	36.32	Corr. coeff.=	0.99
7	4.00	1.034	25.0	25.94		
5	2.50	0.821	15.0	15.57		

Calculations

Qstd = 1/m[Sqrt(H2O(Pa/Pstd)(Tstd/Ta))-b]
IC = I[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)[Sqrt(298/Tav)(Pav/760)]-b)

Qstd (ft3/min)	Chart
60.246568	45.0
54.54219	40.0
48.159973	33.0
36.525984	24.0
28.979694	10.0

Chart setting for 40 CFM std
24.330345

First 24 hours		Second 24 hours		Third 24 hours	
8:00	8:14	8:00	7:44	9:30	9:32
Chart Reading		Chart Reading		Chart Reading	
30	27	24	18	29	24
CFM std		CFM std		CFM std	
45.33	42.58	39.84	34.35	44.41	39.84

Average CFM std
41.06

Table C

Ramcon Environmental
TE-5100-D MFC Sampler Calibration
(Dickson recorder)

SITE

Location->	Dupont WW #3	Date->	23-Mar-04
Sampler->	TE-5000	Tech->	Dale Sawyer

CONDITIONS

Sampler Elevation (feet)	0		
Sea Level Pressure (in Hg)	30.00	Corrected Pressure (mm Hg)	762
Temperature (deg F)	40	Temperature (deg K)	277
Seasonal SL Press. (in Hg)	30.00	Corrected Seasonal (mm Hg)	762
Seasonal Temp. (deg F)	40	Seasonal Temp. (deg K)	277

CALIBRATION ORIFICE

Make->	Tisch-Env	Qstd	Slope->	2.03415	
Model->	TE-5025	Qstd Intercept->		-0.02843	
Serial#->		Date Certified->			

Plate or Test #	H2O (in)	CALIBRATION Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
18	10.00	1.627	49.0	50.85	Slope =	32.8629
13	8.00	1.457	39.0	40.47	Intercept =	-4.8618
10	6.00	1.264	34.0	35.28	Corr. coeff.=	0.9811
7	4.00	1.034	30.0	31.13		
5	2.50	0.821	21.0	21.79		

Calculations

Qstd = 1/m[Sqrt(H2O(Pa/Pstd)(Tstd/Ta))-b]
IC = I[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

Qstd (ft3/min)	Chart
57.465818	45.0
51.451098	40.0
44.624084	33.0
36.525984	24.0
28.979694	10.0

Chart setting for 40 CFM std: 25.815782

For subsequent calculation of sampler flow:
1/m((I)[Sqrt(298/Tav)(Pav/760)]-b)

First 24 hours		Second 24 hours		Third 24 hours	
8:00	8:14	7:50	7:42	9:30	9:34
Chart Reading		Chart Reading		Chart Reading	
38	34	34	28	40	36
CFM std		CFM std		CFM std	
49.97	46.73	46.73	41.86	51.60	48.35

Average CFM std
47.54

Table D

Ramcon Environmental
TE-5100-D MFC Sampler Calibration
(Dickson recorder)

SITE

Location->	Dupont WW #5	Date->	23-Mar-04
Sampler->	TE-5000	Tech->	Dale Sawyer

CONDITIONS

Sampler Elevation (feet)	0		
Sea Level Pressure (in Hg)	30.00	Corrected Pressure (mm Hg)	762
Temperature (deg F)	40	Temperature (deg K)	277
Seasonal SL Press. (in Hg)	30.00	Corrected Seasonal (mm Hg)	762
Seasonal Temp. (deg F)	40	Seasonal Temp. (deg K)	277

CALIBRATION ORIFICE

Make->	Tisch-Env	Qstd	Slope->	2.03415	
Model->	TE-5025	Qstd Intercept->		-0.02843	
Serial#->		Date Certified->			

Plate or Test #	H2O (in)	CALIBRATION Qstd (m3/min)	I (chart)	IC (corrected)	LINEAR REGRESSION	
18	11.00	1.706	45.0	46.70	Slope =	44.6357
13	10.00	1.627	40.0	41.51	Intercept =	-31.4024
10	8.00	1.457	33.0	34.25	Corr. coeff.=	0.9[illegible]
7	7.00	1.364	24.0	24.91		
5	3.00	0.898	10.0	10.38		

Calculations

Qstd = 1/m[Sqrt(H2O(Pa/Pstd)(Tstd/Ta))-b]
IC = I[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)[Sqrt(298/Tav)(Pav/760)]-b)

Qstd (ft3/min)	Chart
60.246568	45.0
57.465818	40.0
51.451098	33.0
48.159973	24.0
31.698556	10.0

Chart setting for 40 CFM std
18.458542

First 24 hours		Second 24 hours		Third 24 hours	
8:50	8:00	8:00	8:42	8:42	8:33
Chart Reading		Chart Reading		Chart Reading	
38	28	28	18	34	25
CFM std		CFM std		CFM std	
55.83	47.90	47.90	39.97	52.66	45.52

Average CFM std
48.30

APPENDIX 3

Sampling Data for Stations 1 - 4

Table 1
EVENT 1- STATION 1 DATA SUMMARY

Analysis Number: Event 1 Sampling Site Station 1
Client: Washington Works Sampling Date 3/23/2004
Contract Number:

Stage #	Filter #	Flow @ Start	Flow @ End	Avg. Flow scfm	Run Time hrs	Analyte ug	Weight ug/m^3	Particle Size um	Weight % %	Cum % <
1	E1-S1-1	3/23/04 8:00 AM	3/26/04 8:33 AM	43.36	72.55	4.28	0.000801	4.1	7.9%	92.1%
2	E1-S1-2			43.36	72.55	9.64	0.001804	1.71	17.9%	74.2%
3	E1-S1-3			43.36	72.55	5.44	0.001018	0.86	10.1%	64.1%
4	E1-S1-4			43.36	72.55	5.12	0.000958	0.55	9.5%	54.6%
5	E1-S1-5			43.36	72.55	3.76	0.000704	0.28	7.0%	47.6%
6	n/a									
8" x 10"	E1-S1-6A E1-S1-6B			43.36	72.55	25.7	0.004810	<0.28	47.6%	
					Total :	53.94			100.0%	

Comments:
Total Mass Emission : 0.0099 ug/m^3

Table 2
EVENT 1- STATION 2 DATA SUMMARY

Analysis Number: Event 1
Client: Washington Works
Contract Number:

Sampling Site: Station 2
Sampling Date: 3/23/2004

Stage #	Filter #	Flow @ Start	Flow @ End	Avg. Flow scfm	Run Time hrs	Analyte ug	Weight ug/m^3	Particle Size um	Weight % %	Cum % <
1	E1-S2-1	3/23/04 9:05 AM	3/26/04 9:33 AM	41.06	72.47	23.1	0.004570	4.19	4.1%	95.9%
2	E1-S2-2			41.06	72.47	76.0	0.015037	1.75	13.4%	82.5%
3	E1-S2-3			41.06	72.47	48.8	0.009655	0.87	8.6%	73.9%
4	E1-S2-4			41.06	72.47	30.3	0.005995	0.55	5.4%	68.5%
5	E1-S2-5			41.06	72.47	3.4	0.000673	0.29	0.6%	67.9%
6	n/a									
8" x 10"	E1-S2-6A E1-S2-6B			41.06	72.47	384.0	0.075977	<0.29	67.9%	
					Total :	565.6			100.0%	

Comments:
Total Mass Emission : 0.1099 ug/m^3

Table 3
EVENT 1- STATION 3 DATA SUMMARY

Analysis Number: Event 1 — Sampling Site: Station 3
Client: Washington Works — Sampling Date: 3/23/2004
Contract Number:

Stage #	Filter #	Flow @ Start	Flow @ End	Avg. Flow scfm	Run Time hrs	Analyte ug	Weight ug/m^3	Particle Size um	Weight % %	Cum % <
1	E1-S3-1	3/23/04 9:05 AM	3/26/04 9:34 AM	43.36	72.48	18.8	0.003522	3.96	3.4%	96.6%
2	E1-S3-2			43.36	72.48	64.8	0.012138	1.66	11.6%	85.1%
3	E1-S3-3			43.36	72.48	58.8	0.011014	0.83	10.5%	74.6%
4	E1-S3-4			43.36	72.48	36.2	0.006781	0.53	6.5%	68.1%
5	E1-S3-5			43.36	72.48	35.2	0.006594	0.27	6.3%	61.8%
6	n/a									
8" x 10"	E1-S3-6A E1-S3-6B			43.36	72.48	346.0	0.064812	<0.27	61.8%	
					Total :	559.8			100.0%	

Comments:
Total Mass Emission : 0.1030 ug/m^3

Table 4
EVENT 1- STATION 5 DATA SUMMARY

Analysis Number: Event 1
Client: Washington Works
Contract Number:

Sampling Site: Station 5
Sampling Date: 3/23/2004

Stage #	Filter #	Flow @ Start	Flow @ End	Avg. Flow scfm	Run Time hrs	Analyte ug	Weight ug/m^3	Particle Size um	Weight % %	Cum % <
1	E1-S5-1	3/23/04 8:50 AM	3/26/04 8:33 AM	43.36	71.72	1.3	0.000239	3.93	6.8%	93.2%
2	E1-S5-2			43.36	71.72	1.7	0.000312	1.65	8.9%	84.3%
3	E1-S5-3			43.36	71.72	1.4	0.000267	0.83	7.6%	76.7%
4	E1-S5-4			43.36	71.72	1.4	0.000259	0.53	7.4%	69.3%
5	E1-S5-5			43.36	71.72	1.4	0.000259	0.27	7.4%	61.9%
6	n/a									
8" x 10"	E1-S5-6A E1-S5-6B			43.36	71.72	11.5	0.002173	<0.27	61.9%	
					Total :	18.54			100.0%	

Comments:
Total Mass Emission : 0.0034 ug/m^3