South Coast Air Quality Management District
Science and Technology Advancement

Monitoring and Analysis Division
Atmospheric Measurements Branch

STANDARD OPERATING PROCEDURE

FOR

SSI PM-10 Sampler Operations

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PREPARATION, REVIEWS AND APPROVALS

SSI PM-10 Sampler Operations

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1.0 General

1.1 Purpose

This document describes the basic procedures needed to setup, calibrate and maintain SSI PM-10 hi-vol samplers. Normal sampling operations are usually carried out by an AQIS I with repair and calibration functions performed by an AQIS II.

1.2 Description/ Principle of Operation

The SSI-PM10 Hi Vol is an FRM designated sampler designed to draw a known volume of ambient air at a constant flow rate of 40 CFM through a size-selective inlet. A quartz filter is used by the sampler to capture the sample. The size selective inlet system is designed to capture particulate 10u or smaller. Typically the sampler is operated on a 1 in 6 day schedule and the sample is collected for 24 hours. The sampler requires only minimal maintenance but should be cleaned, calibrated and oiled on a semi-annual basis.

Siting Requirements

The primary consideration for siting a sampler is to establish that the unit provides a representative sample for the monitored area. Other considerations are that the unit is accessible and has a supply of reliable clean power. Other requirements are as follows:

Scale	Hight above Ground (m)	Vertical	Horizontal
Micro	2 to 7		>2
Middle, Neighborhood, Urban, and regional Scales	2 to 15		>2

1. Should be >10m from trees.
2. Distance from sampler to obstacle such as buildings must be twice the height that the obstacle protrudes above the sampler
3. Must have unrestricted air flow 270^{O} around the sampler inlet.
4. No furnace or incineration flues should be nearby.
5. Spacing from roads varies with traffic (see 40 CFR Part 58, Appendix E).
6. Sampler inlet is a least 2m but not >4 m from any collocated PM10 sampler (see 40 CFR Part 58, Appendix A).

1.3 Safety

1. Operators should be aware of all hazards unique to that particular location. Often, samplers are located in rail yards and industrial areas where multiple hazards exist.

2.0 Procedures

2.1 Software Setup Instructions

The following procedure should be used to enable a laptop or other computer device to download sampling data from the hi-vol unit:

Required Materials:

- ✓ Laptop computer with Unitronics software installed

1. Connect the cable from the controller to the RS-232 port of the computer and turn the HVP-4300AFC unit ON.
2. Open **DataXport** by clicking: **Start → Programs → Unitronics → DataXport → DataXport.**
3. Click **Design → Add Site**. Enter a name under "**PLC Name**" using the format (CRES 1234) if possible. Check "**Create Excel Files**". Check "**Use Excel Template".** Enter "**Start Position"** 3 from top and 3 from left.
4. A download schedule must be created. Click the icon, **"Schedule"**. Click "**Add**" to add a new schedule for automatic data download. Specify a name for the schedule and define the schedule in any unit of time and any frequency of

download. Click "**Close**" to save the schedule. (Note: This step is necessary for the application to function even if only used to perform forced downloads.)

5. To specify the Data table to be downloaded, click "**Tables**". Click "**Add**" to add the table to be downloaded. Click "**Import Data Table**". Give a name for the table to be downloaded (using the same "CRES 1234" format) and click the icon "Read from PLC" and the "Data Table List" will show the table just created. Close this window. Select "**Read Entire Table**". Click on the arbitrary table created, and the tables "**Flow History**" and "**Start-Stop Time**" will appear under "**Table Name**". Click on "**Flow History**". Click "**OK**" to save the table settings. Click "**MB to set"** and enter "10".
6. Click "**Add**" to add the table to be downloaded. Click on the arbitary table created in step 5 and the tables "**Flow History**" and "**Start-Stop Time**" will appear under "**Table Name**". Click on "**Start-Stop Time**". Click "**MB to set"** and enter "10". Click "**OK**" to save the table settings.
7. Close the "**Tables**" window to save the Table settings.
8. Click the icon "**PC Port**" to define the serial port used to connect to the controller. Double click the port used, and define the port parameters. Close the "PC Ports" window.
9. Under "**Connection"**, select the PC port defined in step 6.
10. Select the schedule and table defined in steps 4 and 5.
11. Click "**OK**" to close and save the download settings.
12. Click "**Project**" → "**Define Excel Files Folder**" to define the destination folder for the excel files.
13. Save the project in the desired folder.
14. Excel templates are placed in the following folder: C:\Program files\Unitronics\Unitronics Data Export\Excel Templates. The file name needs to be the same as the table ulp name.

2.2 Instrument Calibration

- ✓ Instrument should have a full calibration upon initial setup and after every six months of operation.
- ✓ Equipment required for the calibration include:
    a. One annually certified VRC or fixed orifice Hi Volume Air Flow Calibrator (VRC)
    b. Quartz filter medium
    c. Calibration Spreadsheet (Figure 2)
    d. Barometer (500 to 800 mm range)

e. Temperature thermometer

1. Record the ambient pressure, temperature, and the seasonal average temperatures on calibration spreadsheet. The average temperatures are obtained for each site from district data records. Currently Calibration Group is using the latest three years of temperature data for each location where temperature is monitored. (2006-2008) See Figure 10
2. Place quartz filter paper directly on inlet screen
3. Install calibrator device over filter
4. Turn switch to "continuous" mode
5. After stabilization, enter Magnehelic reading on spreadsheet. The spreadsheet will calculate the "as found" design flow error. This information should be entered into the station monthly flow check log at the station.

Note: Error values in excess of 10% are considered "failure" and could constitute reasons for data invalidation.

6. Set up 5 evenly spaced test points (in inches of H2O) on the calibration spreadsheet. These values should reflect flow rates ranging from 30 SCFM to the top value not exceeding 50 SCFM. These five points will be entered during the calibration process.

Note: The following equations are used by the calibration spreadsheet (Figure 2) and Sampler Flow Check Data Sheet (Figure 8) to calculate flow:

Qstd = {[ÄH2O (Pa/Ta)}1/2 - b} {1/m} (Standard Flow Calculation)

Qa = {[ÄH2O (Ta/Pa)]1/2 - b} {1/m} (Actual Flow Calculation)

7. From the Main Menu press "2" to enter into the "Calibration Password" display. The factory pre-set password for Calibration is 250.
8. Enter 250 using the keypad and press OK (or ESC to return to Main Display). When the password is accepted the PLC enters calibration mode. To cancel the calibration procedure and retain the previous calibration, press ESC at any stage of the calibration procedure.
9. Turn off the blower switch and wait for 30 seconds and press NEXT. The zero point (0 SCFM) will be set and the "Calibration Point 1" screen (Figure 1) will be displayed.
10. Turn on the blower switch. To change the flow rate display point of the calibration table, press the Left Arrow. The "Change Flow Rate" screen will be displayed. Using the keypad, enter the first desired flow rate point in SCFM and press OK. The "Calibration Point 1" screen will be updated with the new flow rate value. Press 1 (up Arrow) or 2 (Down Arrow) to increase or decrease the speed of the blower, thereby changing the flow rate, until the flow rate displayed

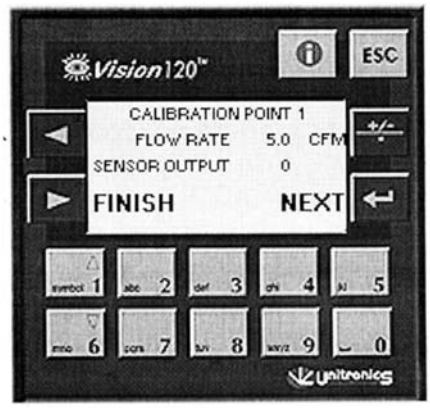


Figure 1

11. Repeat the above steps up to the desired number of calibration points ranging from ~ 30 SCFM to 50 SCFM. Generally 5 points are sufficient. To complete calibration after the desired number of points, press FINISH (Right Arrow) at any stage of calibration. In case of error or doubt, press ESC to restore the previous calibration table and start over again.
12. After the instrument calibration is complete take note that the spreadsheet calculates the appropriate seasonal set point for each of the four seasons. (Figure 2, Page1)
13. Adjust the instrument set point to the appropriate seasonal set point as found in the calibration spreadsheet. Conduct a final flow check, and note the result in the spreadsheet. Seasons are defined as follows:
    - Winter (Jan, Feb, March)
    - Spring (April, May, June)
    - Summer (July, Aug, Sep)
    - Fall (Oct, Nov, Dec)

Note: The final flow-check standard flow should not deviate from the seasonal set point flow by more than 1% following a calibration. The calibration technician should inspect page two of the calibration spreadsheet. All five points should appear reasonably correlated with no obvious outliers. The correlation coefficient should be at or near 0.999.

SSI Sampler Calibration

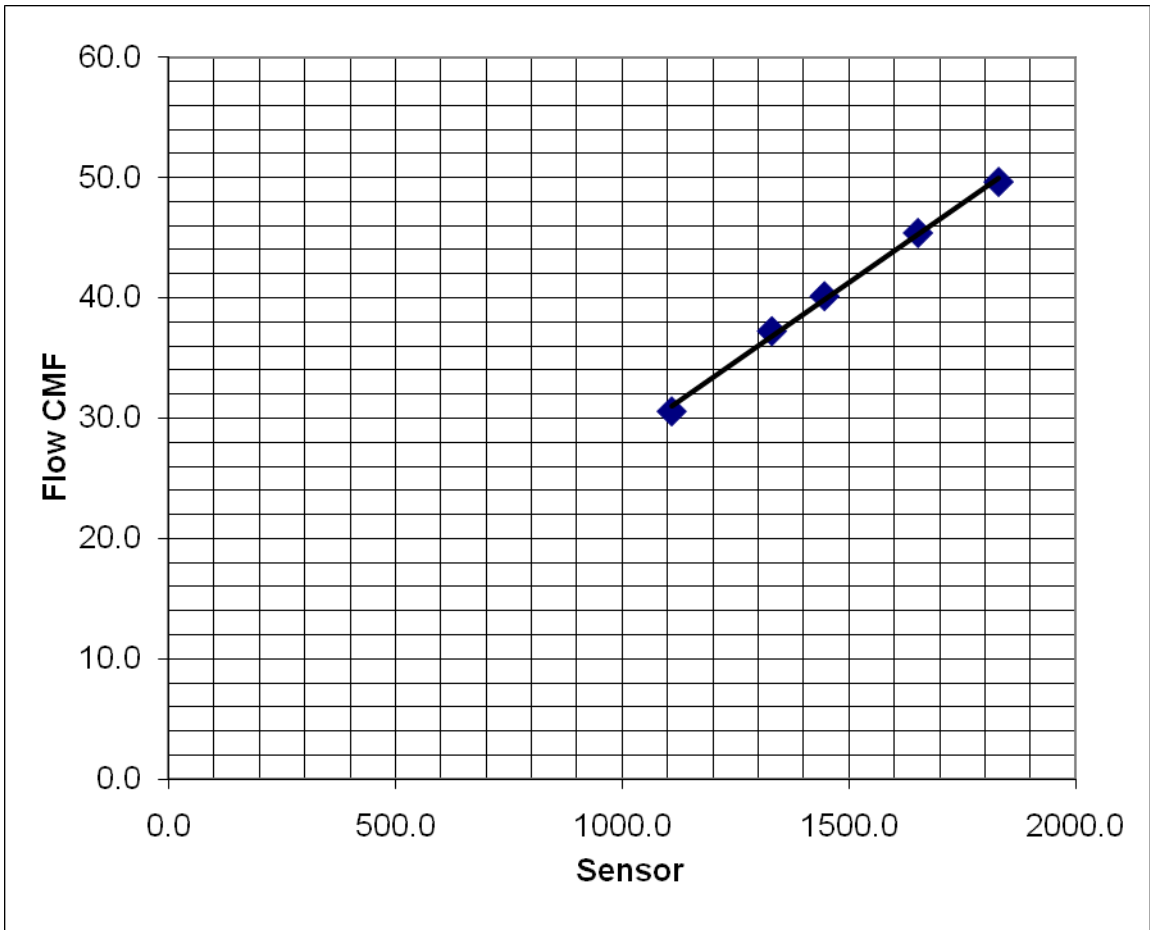
Station NO.:	33155	Station Location:	Norco		Date:	1/12/2009					
Sampler ID:	1570			Altitude Correction Factor:		0.974		Temp Conversion:	62	F	
									16.67	C	
Calibration Technician:	Sawyer			VRC Calibration Date:		10/16/09					
				VRC Property No.:		3213					
Press (Pa)	746.2	mmhg	Temp. Ambient:	23	c	296	k				
			Winter Ts[a]	14.7	c	287.7	k	Seasonal Flow Settings:			
			Spring Ts[a]	18.61	c	291.61	k		1.140023	M3 (standard)	
			Summer Ts[a]	24	c	297	k	Winter	40.25959	SCFM	
			fall Ts[a]	17	c	290	k				
Calibration Orifice Actual Slope:		1.060324	Intercept:	-0.02641	Correlation	1.0000			1.124738	M3 (standard)	
								Spring	39.71977	SCFM	
Calibration Orifice Std. Slope:		2.704181	Intercept:	-0.06604	Correlation	1.0000					
			(Sensor))						1.104326	M3 (standard)	
AS IS CAL.	3.6	1.151926	1.138452	39.0	40.7	40.2	2%	Summer	38.99893	SCFM	
	H2O"	M3 (act)	M3 (std)	Sensor	CFM (act)	CFM (std)					
	2	0.864937	0.854771	1110.0	30.5	30.2			1.130982	M3 (standard)	
	3	1.05373	1.041388	1331.0	37.2	36.8		Fall	39.94029	SCFM	
	3.5	1.136162	1.122871	1447.0	40.1	39.7					
	4.5	1.284952	1.269946	1653.0	45.4	44.8					
	5.4	1.405217	1.388825	1831.0	49.6	49.0					
				(Setting)							
As Left	3.5	1.136162	1.122871	40.0	40.1	39.7	0%	*			

Actual		
Set Point:	40 SCFM	40.1 CFM
Slope:	37.9331	
Int.	-64.7942	
Corr.	0.9987	

TRUE

REMARKS: No seasonal set point adjust until summer

Calibration Spreadsheet
Figure 2
(Page 1)



Typical Flow Calibration Curve
Figure 2
(Page 2)

2.3 Operational Procedures

The following should provide the user with steps necessary to perform normal instrument sampling:

Required Materials

- ✓ Quartz sample filters as obtained from the AQMD laboratory.
- ✓ Cassette holder.
- ✓ Sample filter envelope
- ✓ Sample filter log

2.4 Sample Setup

The keypad buttons and the corresponding functions in this menu are:

1 Monitor

2 Calibration

3 Reset Parameters

4 Timer

- ✓ If sample needs to collected from a previous run go to procedure for "Collecting Sample"
- ✓ Press "1" to go to the "Monitor" screen.
- ✓ Take note of the flow setpoint. It should match the calibrated seasonal setpoint as per the calibration card. The instrument flow setpoint is adjusted as dictated by the average seasonal temperatures of the location. Seasons are defined as follows:
    - Winter (Jan, Feb, March)
    - Spring (April, May, June)
    - Summer (July, Aug, Sep)
    - Fall (Oct, Nov, Dec)
- ✓ Place a quartz filter in the cassette holder and loosely tightening brass nuts install on instrument. Turn hi-vol on and tighten brass nuts then secure four fasteners to form an airtight seal.
- ✓ Close sampler head and secure with latches taking note that each latch is properly adjusted and snug.

- ✓ Press “3” from the “Main Menu”(Figure 3) to enter the “Reset Parameters” screen.(Figure 4) This is where the totalizer and elapsed timer can be reset to zero.
- ✓ The following screen prompts the user to enter a password. The factory pre-set password for the RESET functions is 250.
- ✓ Enter 250 using the keypad and press OK (or ESC to return to Main Menu). Press the RESET button from the following screen (figure 2) to reset the totalizer and elapsed timer to zero (or ESC to return to Main Menu without resetting). Press OK to return to the Main Menu.

Figure 3

Figure 4

Timer Screen (set up sample run)

- ✓ Press “4” from the “Main Menu” to enter the Timer screen as shown in figure 5.
- ✓ Press the corresponding key to select the appropriate day of the week you wish to program. To select Tuesday press 3.

The top of the screen displays the current day (DDD), date (MM/DD) and time (HH:MM). The bottom of the screen will show the sample program.

- ✓ Enter the start time (“ON”) hour of 00:00 by pressing “enter” twice.
- ✓ Enter the finish time (“OFF”) by entering 23:59.
- ✓ Press “enter” and “OK”
- ✓ Make sure the “timer switch” is in the down position.

Figure 5

2.5 Collecting Sample

1. Open sample head
2. Remove filter cassette assembly.
3. Taking care to avoid touching the sample filter as possible, fold filter in half and place in a folded cardstock sheet.
4. Insert cardstock and filter in provided sample envelopes. Envelopes and cardstock are provided by the laboratory.
5. Note the total flow volume and sample time on the sample envelope.(figure 7)
6. Note the all the relevant information on the monthly data sheet. (figure 9)
7. Enter any unusual conditions or observations in the “Remarks” section of the sample envelope.
8. After downloading data, (Section 2.5) enter in all spaces on the operator’s side of the field envelope.
9. Samples should be transported to the lab as soon as possible.

2.6 Downloading Data

Note: Data downloads for the SSI units are managed by Unitronics software. This software allows the user to connect to the unit by means of a serial cable and download relevant sampling data. The database and sampler profile are stored in an ".ulp" file.

Required Materials

- ✓ Laptop computer with Unitronics software installed, configured, and equipped with serial connection

1. Open the appropriate ".ulp" file
2. Click the icon "Run Project". (Running Man)
3. Click the icon "Force Call" (Button on left) to force a download.
4. Open the excel files from the folder defined in step 12 in the setup instructions.
5. The format of the generated excel files is as shown in the table below:
6. All downloaded data should be transmitted to the shared drive preferably every two weeks. The file location is "E:\ASTD\AM Operations Data\SSI Sample Run Data".

Flow History

Row No	Date	Time	Flow Rate	Total Flow
	DDMM	HHMM	CFM	CF

Start Stop Time

Row No	Date	Time
Start	DDMM	HHMM
Stop	DDMM	HHMM

Summary Table

The generated Excel file will include a summary table similar to Figure 6 below

- ✓ The operator should review the run data and determine if there were any irregularities.
- ✓ If the sample run looks good, enter the yellow shaded flow data from the summary table on the sample envelope.

Note: There should be no obvious flow excursions and the sampler should have recorded at least 23 hours of sample time. In addition the average flow should not be more than 10% from the calibration set point. If either of these conditions exist the sample may have to be declared invalid and the sampler should be investigated possible malfunction.

- ✓ Manually enter the blue shaded fields.

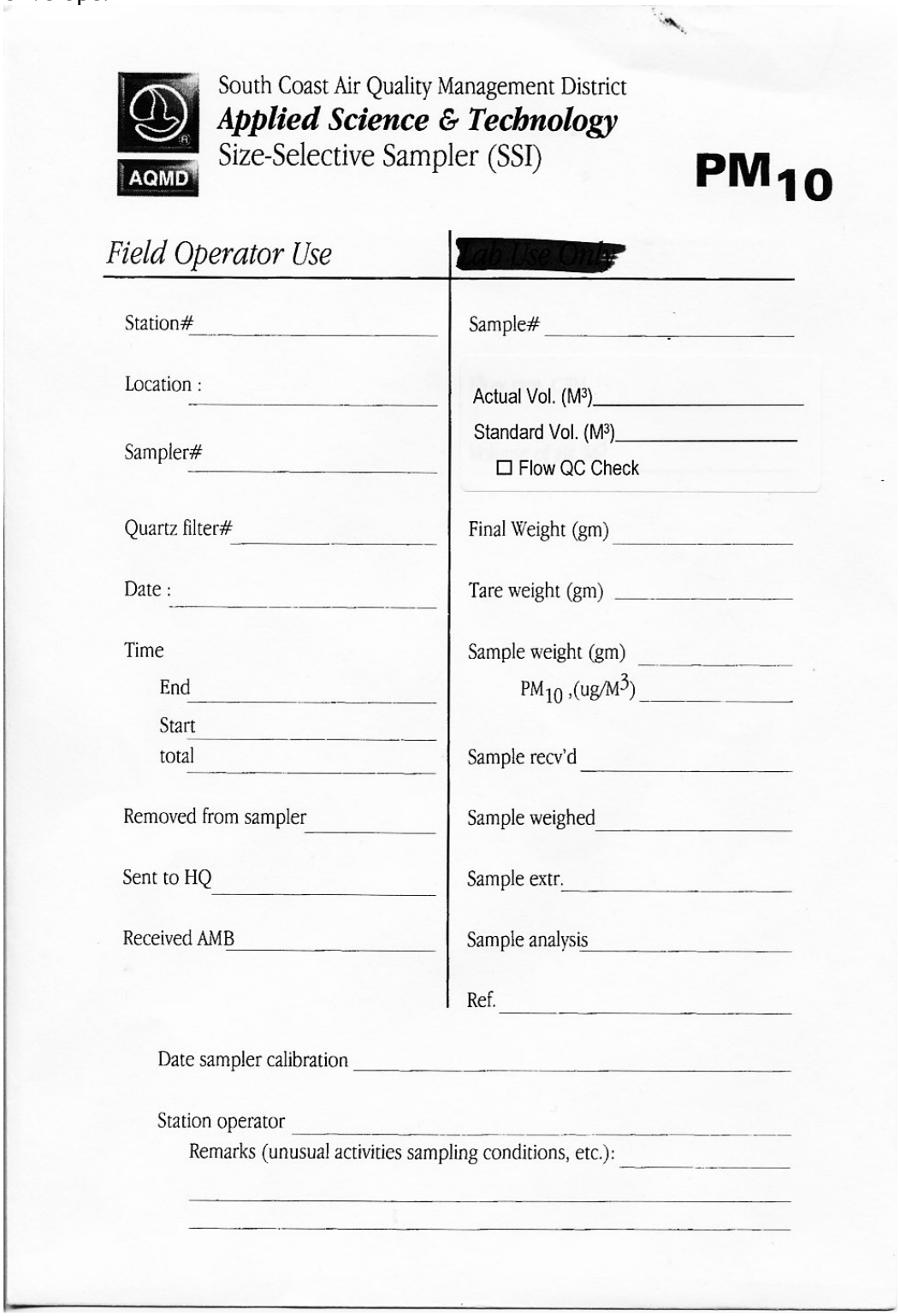
Summary

Total Flow	57138.3	SCF	
	1688.92	M^3 (actual)	* 0.958 Factor
	1617.99	M^3 (standard)	
Sampler:	4991		Run Date
Filter Number	Q7070979		4/19/2009
Site:	FONT		
Total Volume	57138.3	SCF	
Last Minute Run (Row)	1438	Minutes	
Average Flow	39.73	SCF/Min	(Total Volume / Time)
Mean Indicated Flow	40.0	SCF/Min	(F9-F1435)
Std Dev	0.05		
% CV	0.13		

Downloaded Summary Sheet
Figure 6

3.0 Sample Chain of Custody

This is an example of the SSI/PM10 sample envelope:



South Coast Air Quality Management District
Applied Science & Technology
Size-Selective Sampler (SSI)

PM10

Field Operator Use	[redacted]
Station#	Sample#
Location :	Actual Vol. (M^3)
Sampler#	Standard Vol. (M^3)
	☐ Flow QC Check
Quartz filter#	Final Weight (gm)
Date :	Tare weight (gm)
Time	Sample weight (gm)
End	PM_{10} ,(ug/M^3)
Start	
total	Sample recv'd
Removed from sampler	Sample weighed
Sent to HQ	Sample extr.
Received AMB	Sample analysis
	Ref.

Date sampler calibration

Station operator

Remarks (unusual activities sampling conditions, etc.):

Figure 7

4.0 Quality Control

4.1 Monthly Flow Check:

Materials needed for flow check

- ✓ Flow check orifice device
- ✓ Calibrated traceable thermometer
- ✓ Calibrated traceable barometer
- ✓ Flow check spreadsheet

1. Set up flow check using same procedure as outline in the flow calibration section(sec. 2.2 steps 1-4).
2. Turn "continuous" switch to "on" position.
3. After flow has stabilized, (~5 minutes) note magnehelic, thermometer, and atmospheric readings on flow check spreadsheet (Figure 8)

Design flow and QC flow will be calculated by the spreadsheet. Flow errors in excess of 7% are considered to be at warning level and should be reported the Senior AQIS. Error values in excess of 10% constitute a failure and could constitute reasons for data invalidation. These should also be reported to the Senior AQIS for a possible work order request to AM Repair. All flow checks should be entered into the flow check log at the station.

SSI Sampler Flow Check

Station NO.:	33144	**Station Location:**	Rubidoux-A		**Date:**	9/3/2009				
									Temp Converson	
Sampler ID:	4941			**Altitude Correction Factor:**		0.969				
									F	90
Calibration Technician:		Lila Enriquez		**VRC Calibration Date:**		**1/2/09**			**C**	32.2
					VRC Property No.:		**1239**			
Press (Pa)	736	**mmhg**	**Temp. Ambient:**	30.7	**c**	303.7	**k**			
			Ts[a]	NA	**c**	NA	**k**			
Calibration Orifice Actual Slope:		1.197767	**Intercept:**	0.040655	**Correlation**	-				
Calibration Orifice Std. Slope:		3.054708	**Intercept:**	0.101124	**Correlation:**	-				

	H2O"	M^3 (act)	M^3 (std)	CFM (act)	CFM (std)	SCFM (ind)	Set Pt.
AS IS CAL.	**4.25**	**1.071677**	**1.017505**	**37.8**	**35.9**	37.0	37.0

Design Flow Error	**-5.4%**
QC Check Error	**3.0%**

>7% report to Senior

Figure 8
Sampler Flow Check
Data Sheet

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

MAKE/MODEL ---------- HIGH VOLUME SAMPLER/or SSI

Location ----------
Location no. ----------
Control no. ----------
Operating Set Point ----------
Date SSI head cleaned ----------

Month/Year ----------
Specialist ----------
Reviewed By/Date ----------
= ---------- CFM
Due Date --------

Sample Date	Initial Flow CFM	Final Flow CFM	Filter Number	Initial Elapsed Time	Final Elapsed Time	Total Time
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						

Calibration Date ---------- Calibration Due Date ---------- FORM #8 1/87

Figure 9
Monthly Sampler Data Sheet

Site Name: **LAXH**

	Year	2006	2007	2008	Average
Month					
1		57.1	54.2	54.3	55.2
2		56.4	56.3	54.7	55.8
3		53	58.1	57.5	56.2
Avg		**55.5**	**56.2**	**55.5**	**55.7**
4		57.3	57.9	59.7	58.3
5		61.7	60.1	60.8	60.9
6		63.6	63.1	65.1	63.9
Avg		**60.9**	**60.4**	**61.9**	**61.0**
7		70.7	57.8	66.8	65.1
8		68.1	68.6	68.3	68.3
9		66	66	66.8	66.3
Avg		**68.3**	**64.1**	**67.3**	**66.6**
10		63.6	63.8	66	64.5
11		61.9	59.7	62.2	61.3
12		56.5	54.5	54.2	55.1
Avg					**60.9**
Average					
Average		**61.3**	**60.0**	**61.4**	

← Winter

← Spring

← Summer

← Fall

Figure 10
Example of Average Seasonal Temperature Data

Figure 11
Variable Orifice Hi Volume Air Flow Calibrator

4.2 Equipment Maintenance

Note: The following procedure should be performed every 3 months for a 1/3 sampler and 6 months for a 1/6 sampler.

Materials needed for system cleaning

- ✓ Lint-free cloth
- ✓ Mild detergent
- ✓ Soft brushes (optional)
- ✓ Water (optional)

1. Remove the inlet hood by removing the four screws which hold the hood to the PM10 SSI housing.
2. Clean the interior surface for the hood and upper acceleration nozzle plate with a non-scratching brush or lintless cloth. Special attention should be paid to the lip of the acceleration nozzle plate where dust tends to build up.
3. Clean plate and re-coat with silicon spray.
4. Clean the first stage and second stage fractionators, acceleration nozzles and vent tubes with a clean, lintless cloth or brush. If necessary, use a small vacuum cleaner to remove dirt.
5. Inspect the joint seals and screw holes where the acceleration nozzles are attached to the acceleration nozzle plates and where the vent tubes are attached to the impaction plate. Inspect all on sampler. If seals are damaged or worn, contact your supervisor for instructions.

5.0 References

- Hi-Q HVP-4300AFC Operations Manual
- EPA Quality Assurance Handbook 2.11 Vol. II, Part II