Particulate Matter 2.5 Speciation QA Plan

Section II

Operator Responsibilities

1.0 General Information

1.1 Introduction

1.2 Specifications

1.3 Technical Description

2.0 SuperSASS Assembly

2.1 Tripod

2.2 Head Assembly

2.3 Control Unit

2.4 Temperature Sensor

2.5 Pump Box

2.6 Channel Cables

2.7 System Ground

3.0 Initial Setup and Operation of the SuperSASS Sampler

3.1 Canister Assembly and SCC Installation

3.2 Operational Checkout of System

3.2.1 Leak Check of System

4.0 System Calibration and Check

4.1 Temperature

4.1.1 One-Point Temperature Calibration

4.2 Pressure

4.2.1 Two-Point Pressure Calibration

4.3 Flow Check and Calibration

5.0 Programming of System

5.1 Setting Date and Time

5.1.1 Setting Default Elapsed Time for Tests

5.1.2 Event Manager

5.1.3 Setting the Site ID Value

5.1.4 Clear All Event History

6.0 Running the Sampler

6.1 Shipping/Receiving of Canisters

6.2 Installing Canisters

6.3 Programming Sample Event

6.4 Filter Retrieval

6.4.1 Example of Shipping/Sampling Schedule

6.4.2 Filling Out the Custody and Field Data Sheet

6.4.3 Data Download

6.4.4 Exporting Data

6.4.5 Sending Data to Headquarters

7.0 Troubleshooting and Maintenance

7.1 System Cleaning

7.1.1 Denuder Replacement

7.1.2 System Inspection

ATTACHMENTS

ATTACHMENT 1- Troubleshooting Guide

ATTACHMENT 2- Software Troubleshooting Guide

ATTACHMENT 3- Calibrations, Checks, and Audits Schedule

AMBIENT PM 2.5 CHEMICAL SPECIATION SAMPLER
MET ONE MODEL SUPERSASS

1.0 General Information

1.1 Introduction

Met One Instruments developed the SuperSASS (Speciation Air Sampler System) chemical sampler under contract from the United States Environmental Protection Agency (USEPA) for the purpose of collecting samples for the chemical and gravimetric analysis of ambient air PM2.5 particles (airborne particles with diameters smaller than 2.5 micrometers (μm)). These particles are comprised of sulfates, nitrates, organic carbon, soot-like carbon and metals.

1.2 Specifications

The SuperSASS accommodates eight (8) sampling canisters used in groups of up to four, each with active flow control. Each individual canister has its own PM2.5 sharp cut cyclone (SCC) inlet, denuder ring and tandem 47 mm FRM filter holders. As such, each canister contains all necessary components for excluding particles above 2.5 μm, for removing interfering gases, and for collecting ambient fine particles.

The canisters are mounted in a wind aspirated radiation shield that maintains sampler temperature close to ambient. Inlets are approximately 72 inches above the ground. The sample flow rate is controlled at 6.7 L/min per canister depending on filter media and denuder material pressures.

The PM2.5 separation is produced by the SCC, which removes both solid and liquid coarse particles with equal efficiency without the use of impaction grease or oil. Particle penetration through the SCC mimics the PM2.5 cutoff curve of the WINS impactor as defined by the USEPA. The denuders are multi-cell configured, 25mm in length, and are housed in a 47mm O.D. aluminum sleeve. The nitric acid denuder is made of aluminum with 350 parallel, hexagonal channels, and is coated with Magnesium Oxide.

The filter size used in the sample canister is 47 mm O.D. Each canister can hold either one or two filters in tandem. The collection media used for each canister varies, depending on the types of analysis to be performed. The FRM designed cassettes are used with the speciation filters.

The SuperSASS contains a solar and heat radiation shield that is designed to maintain the samples at near ambient temperature. The temperatures for both the sample filter and the ambient air are logged throughout the sampling period. The filter temperature is measured immediately downstream of the filter media in each canister.

The SuperSASS is standard with four active volumetric flow controllers. Each sampling line has a check valve to shut off the flow if the sampling line is not used, or for performing a dynamic field leak check. Volumetric flow rate measurement is made independently for each of the active flow channels, displayed instantaneously and logged with five-minute averages. Flow rate errors are flagged both on the display and in the data logger. Volumetric flows are measured and recorded with four independent electronic mass flow sensors. The mass flow sensors in conjunction with ambient temperature and barometric pressure readings are used by the control unit microprocessor to calculate the actual volumetric flow. This provides site-specific flow measurements so no correction is needed for true volumetric readings.

Routine maintenance can be done in the field. Sampling canisters are transported to the EPA contract laboratory for inspection, cleaning and changing of sampling substrates. Every element of the sampler that is contacted by the sampled air stream ahead of the filter, including the inlet can be cleaned with each sample change. This approach eliminates possible contamination problems.

1.3 Technical Description

The SuperSASS sampler is shown in Figure 1. 1. There are eight possible canister positions mounted within the solar radiation shield, each being selectively controlled to collect particles smaller than 2.5µm. Canisters may be equipped with a diffusion denuder ahead of the filter to remove selected gaseous compounds. The SuperSASS was designed with individual SCC inlets. This approach minimizes the chance for contamination and significantly reduces the required field maintenance of the unit,

A set of eight (8) solenoid valves is used to select which of the canisters are used during each test sequence. Vacuum lines for each orifice leads to an electronic mass flow monitor. The lines are then connected to a common manifold. A vacuum line from the manifold leads to the pump, which is housed in a fan-ventilated box.

Figure 1.1 Assembled SuperSASS Sampler

2.0 SUPERSASS ASSEMBLY

2.1 Tripod

The SuperSASS tripod comes as an assembled item. The 3 ringed pins from the tripod leg brackets are removed and the legs folded down. The pins are then reinserted to hold the legs in position. Holes are provided in the tripod feet and commercial hardware can be used to anchor the tripod to the sampling site. Due to lack of cable length, running from the pump box to the tripod, it will be necessary to place the tripod as close to the FRM platform as possible.

2.2 Head Assembly

The head assembly is mounting on the tripod and contains eight sampling channels. The bottom portion of the head is lowered in order to access the sampling channels. While holding the lower shield, pull out the securing pin and slide down the mast until it comes to rest on top of the control unit. This allows canisters to be installed or retrieved and calibrations and checks to be performed. When finished, raise shield back up the mast and align with the setscrews in order to maintain the proper orientation. Place securing pin back into mast. The setscrews of the head assembly hold the head in place and should not be loosened.

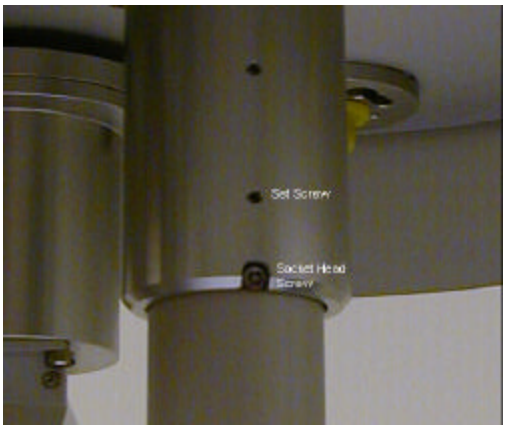


Figure 2.1 Head Assembly Mounting Screws

Figure 2.2 Head Assembly

2.3 Control Unit

The control unit is secured to the mast using two metal U-Bolt hardware clamps. Proper orientation of the control box is with the hinged side of the box facing the left (from the front) and in the middle of two legs of the tripod. See Figure 2.3 for mounting details.

Figure 2.3 Control Unit and Temperature Sensor Assembly

2.4 Temperature Sensor

The sensor is mounted just above the control box, about 3 inches above the lower control unit U-Bolt, facing the opposite direction (see Figure 2.3). The sensor is mounted using the one U-Bolt and two 7/16" nuts with washers that have been provided. The sensor should be mounted on the mast with the flat top plate facing up and the cable connector facing the ground.

Attach the cable and connector to the ambient temperature sensor from the pump control box. The cable is labeled Amb. Temp. (8838-6). It is impossible to misconnect the cable since the connections are keyed.

2.5 Pump Box

The dual diaphragm AC vacuum pump is contained in its own environmental shelter isolated from the SuperSASS to prevent vibration, noise, heat and any potential of exhaust contamination. The vacuum pump is a dual head Thomas Co.™ diaphragm vacuum pump mounted with four bolts through the bottom of the cabinet.

The pump box contains a filter screen under the pump and an aspiration fan on the side. Heat is exhausted from the box by pulling ambient air in the base and through the fan and exhausting on the right. The pump will be located in a position that is close to the base of the tripod. The pump box ideally will be secured to the existing FRM platform, given there is ample room to keep the minimum 1-meter distance intake to intake from the FRM sampler. If securing to the existing platform is not possible, a smaller version of the platform will be constructed specifically for the pump box

alone. The platform should be a minimum of 12" x 18", and should be approximately 1.5 to 2 feet high. This will increase the accessibility of the pump box by the technicians to perform routine maintenance. The pump box can be mounted using ¼" bolts or lag screws to the platform. The pump box will ultimately be located as close to the tripod as possible.

The pump box contains three cables. One is the 110VAC 60 HZ power cable, which is connected to the AC grounded service. The second is a signal cable with a screw type connector that attaches to the ambient temperature sensor. The third cable from the bottom of the pump box (labeled 8833) connects to the center connector on the bottom of the control unit. Once this cable is inserted rotate the outer ring on the front of the connector to lock it in place on the control unit. A multi-pin connector on the side of the pump box connects to a multi-conductor cable that runs down the center of the mast from the sampling head assembly (gray cable, 8896).

Although the SuperSASS allows for eight (8) sampling channels, only the first three will be used. The upper shield of the assembly head has labeled channels, 1 through 8. Channels 1, 2 and 3 will be used primarily for sampling. Although the remaining five channels will not be used on a regular basis, they may be used during long holiday seasons such as Thanksgiving and Christmas, or any other special circumstances, which may arise. Regardless, all eight channels will be calibrated upon setup and then annually. Only the 1, 2 and 3 channels will be verified monthly and audited quarterly. In the event it becomes necessary to use the any of the other channels, a verification of temperature, pressure and flow should be performed prior to sampling.

There are only four flow controllers for the SuperSASS. The same four are used for all eight channels. The sampler will run channels 1 through 4 simultaneously or channels 5 through 8 simultaneously. This means that, if for some reason one channel in the first group of four are not functioning properly, then the corresponding channel in the last group of four will also not function properly. For example, if channel 3 is not functioning properly, neither will channel 7. Only applies for flow. Filter temp is independent.

2.6 Channel Cables

Each channel has its own individually identified cable that runs down the center of the mast. Connect all eight cables to the corresponding position on the pump box (cable #1 connects to valve #1, etc.). A Quick-Disconnect valve on the side of the pump box connects each cable. Secure the cables to the tripod leg with tie wraps or electrical tape.

2.7 System Ground

The SuperSASS is equipped with a heavy green/yellow ground cable that should be connected to a nearby earth ground rod. It is recommended that one leg of the tripod also be grounded to the same earth ground used to ground the pump box.

3.0 Initial Setup and Operation of the SuperSASS Sampler

3.1 Canister Assembly and SCC Installation

In order to check the operation of the SuperSASS, test filters must be loaded into the canisters that will be used for the system check. Remove the two yellow caps from both ends of the canister. The canisters are secured with three socket head cap screws, ¼" -20 x 5/9" lg. Unscrew all three using a long Allen wrench. Once the screws have been removed, lift the upper portion of the canister to expose the two filter cassettes and the denuder sleeve. Place 47mm Teflon filters into each cassette and place back onto the canister bottom. Referring to Figure 3.1, replace the contents of the canister in the appropriate order, with filter surfaces facing away from the screws. After all contents have been replaced, lower the upper portion of the canister back onto the bottom portion, and secure with the three screws.

The fixed shoulder screw at the top of the sample canister will hold the SCC in place. Do not loosen or remove this screw. Referring to Figure 3.1, insert the SCC into the sample canister and twist so that the bracket slides under the shoulder screw. A light coating of silicone grease can be applied to the two O-rings on the SCC for easier installation. The sample canister is now complete and ready to be used in the systems check.

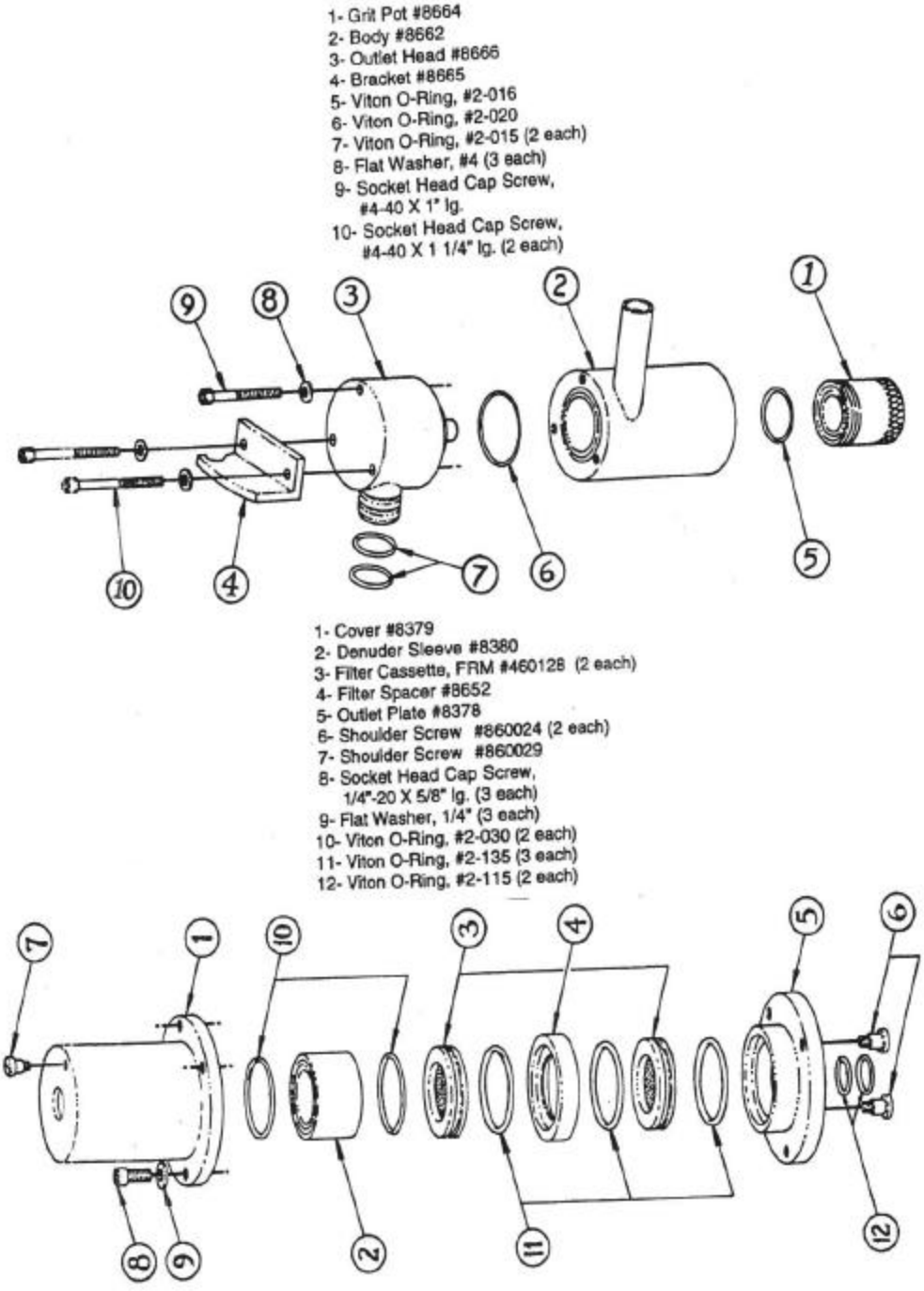


Figure 3.1 Sharp Cut Cyclone (SCC) and Canister Assembly

3.2 Operational Checkout of System

The ECB has checked and verified the operation of the SuperSASS sampler. The operator will perform an operational check of the system and a calibration before sampling begins. Before the system check can begin, sample canisters must be loaded into each sampling channel to be used. Each operator will have three canisters for use in verifications, audits and calibrations. For yearly calibrations, it will be necessary to calibrate each of the eight channels. Therefore, the procedures will have to be performed three different times. Channels 1-3, channels 4-6, and finally channels 7 and 8. For monthly and quarterly checks only channels 1-3 will be checked. Each canister has a pair of mounting shoulder bolt posts and a vacuum connection with O-rings. Insert the posts into the inlet assembly and twist to the right until locked into position. Each canister has an alignment mark that should be pointing out and away from the tripod mast. The mark should approximately align with the channel number above the canister. A light coating of silicone grease can be used on the canister O-rings for easier installation.

Once the SuperSASS has been powered, the pump fan in the pump box should be detected operating and the LCD display of the Control unit should illuminate. There is no on/off switch. The Control unit's main screen menu will be displayed as below in Figure 3.2. The LCD display can be adjusted according to brightness by pressing the * key on the Control Unit keypad. Continued pressure on the key will lighten or darken the LCD display.

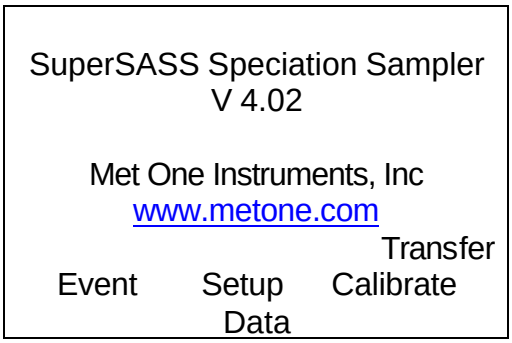


Figure 3.2 Main Screen Display

3.2.1 Leak Check of System

While pump is operating and flow values are being displayed on the screen of the control unit, use a yellow plastic cap and block off the inlet tube of the SCC of canister # 1. The flow value for canister #1 should drop to 0.0 or 0. 1 LPM, indicating that there are no leaks in the components of the first canister. Continue this procedure for each of the eight channels, using the

"Cans" button to toggle the screen of the control unit between the first four channels and the last four channels. Any channel reading higher than 0. 1 LPM indicates that there is a leak in that portion of the system. Refer to the troubleshooting and maintenance information in this QA plan.

4.0 System Calibration and Check

Using a set of NIST traceable standards for volumetric flow, barometric pressure and temperature, the SuperSASS can be easily calibrated using the calibration screens in the control unit. Annual calibrations and monthly checks are to be done using one set of NIST traceable devices (for flow, temperature and pressure) while audits are to be performed quarterly using a different set of traceable devices.

From the main menu, select the "Calibrate" key. The following utility menu will be displayed.

```
Calibrate Menu
F1: System Test
F2: Flow Calibration
F3: Temperature Calibration
F4: Pressure Calibration
F5:
F6:
                                Exit
```

Calibrate Menu

4.1 Temperature

Select the F3 key from the calibration menu. This will bring up the Temperature Calibration screen. Use the arrow keys to select the correct temperature in the upper left-hand comer of the screen. The screen should be in the "Ambient Temperature Calibration" mode.

```
(0) Ambient Temperature Calibration

SASS    Pt    Save    Reference
23.6     1    -30.0    -30.0    Save (F1)
         2    50.0     50.0     Save (F4)



Calibrate                  Default    Exit
```

Display Screen for Temperature Calibration Menu

The number in parenthesis in the upper left-hand corner of the screen represents the current temperature being displayed. (0) represents ambient temperature while the filter temperatures are denoted 1 through 8, depending on which channel is being viewed at the time. By placing the cursor in the parenthesis position, you can scroll through all temperature options.

Compare the SuperSASS temperature reading to that of a NIST traceable reference temperature device. Place the reference device near the temperature sensor of the SuperSASS, and allow time to stabilize. The readings should compare at ± 2° C of one another to satisfy verification limits. If readings do not compare within this tolerance, follow the instructions to perform the one-point temperature calibration. After calibrating, recheck to insure that the values now fall within the tolerance. Press “Exit” when finished.

4.1.1 One-Point Temperature Calibration

Using a NIST traceable reference temperature device, obtain a stable temperature reading next to the SuperSASS temperature sensor. Place the cursor in the position of the “Reference” value for Pt 1. Using the arrow keys, enter the value measured by the reference device. Press F1 to save the value. After saving the value press the “Calibrate” key. The ambient temperature has now been calibrated.

Using the arrow keys, move the cursor back to the parenthesis position and change to “Filter Temperature Calibration”. Perform the same one-point calibration on all eight channels, placing the reference probe up near the channel opening. These calibrations will be performed yearly, unless values fall outside of the tolerance during any monthly verification. In that instance, or when a major repair has been performed or the sampler has been moved, calibration will be required.

4.2 Pressure

Select F4 from the "Calibrate Menu". This screen shows the current barometric pressure observed by the SuperSASS. It is necessary to have a NIST traceable reference device. The reading from the reference and the SuperSASS should be within ± 10 mmHg of the reference pressure device. If at any time the value should fall outside of this tolerance, or if the sampler has had a major repair or been moved, a two-point calibration will be required.

4.2.1 Two-Point Pressure Calibration

From the Utility Menu press F4 for the Pressure Calibration Menu. Comparing the SuperSASS pressure measurement with a reference barometer can make a preliminary check. If the SuperSASS does not compare to within ± 10 mmHg, calibration is necessary.

Pressure Calibration				
SASS	Pt	Save	Reference	
760	1	600	600 mmHg	Save (F1)
	2	800	800 mmHg	Save (F4)
Calibrate			Default	Exit

Display Screen for Pressure Calibration Menu

A pressure calibration requires a NIST traceable reference pressure device, a syringe, some tubing and a tee. Refer to Figure 4.1 for the pressure test setup. Refer to Figure 4.2 for location of the pressure test port. The cover of the pump box must be removed to reach the pressure test port.

Figure 4.1 Pressure Test Setup

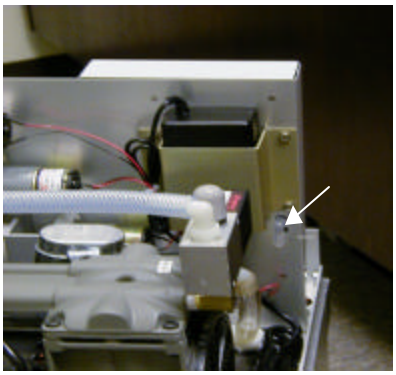


Figure 4.2 Pressure Test Port

Connect the syringe to the tubing shortest in length and the long tubing to the pressure test port of the SuperSASS. The syringe is used to change the pressure inside the tubing from below ambient to above ambient. Verify that the syringe is able to adjust the pressure to 600 and 800 mmHg. Adjust the length of tubing to provide the necessary adjustment.

Follow the procedure outlined below to calibrate for pressure.

- Set the simulated pressure value to 600 mmHg as measured from the reference pressure sensor. When the measurement is stable, enter the value measured from the reference by moving the cursor to the top

reference window position and entering the value. When completed press F1 to save value.

- Now set the simulated pressure value to 800 mmHg as measured from the reference sensor. When the measurement is stable, enter the value measured from the reference by moving the cursor to the second reference window position and entering the value. When completed press F4 to save value.
- Now press the “Calibrate” key and the new values will be saved in the memory of the control unit.
- Re-check the pressure to the reference pressure device and verify that the values are within the ± 10 mmHg tolerance. If test fails after two times, a new pressure sensor may be required. If a new sensor is installed set the replacement sensor using the “Default” menu selection. This will return to the original measurement factors.

Remove the test setup and log results in the e-logbook.

4.3 Flow Verification and Calibration

Press F2 from the calibration menu. This will display the "Volumetric Flow Calibration” screen. It is necessary to have a NIST traceable reference flow device, along with the adapter for the SCC inlet. Follow the sequence below to check and/or calibrate. If only a check is required, then no values will be entered into the SuperSASS. The check values must fall within ± 0.67 LPM of the reference standard. If outside of this tolerance a calibration must be performed. Simply entering the measured value from the check and pressing the calibrate key will set the SuperSASS to the correct flow rate value if calibration is required. Only the first four channels will be calibrated (1 through 4). This calibration reflects the last four channels as well. There are only four flow controllers on the SuperSASS.

- Attach the reference device to the inlet of the SCC on canister #1 and turn on the pump by pressing "Pump".
- Select channel #1 on the menu screen (only one channel can be calibrated at a time), using the up/down arrow keys. Allow the flow to reach a stable reading, and record the measurement from the reference flow standard.
- Use the following equation, along with the calibrated values for the given reference flow standard from AirMetrics, to calculate the volumetric flow of the SuperSASS.

$$Q_{act} = m_{flo} \times \sqrt{\frac{\Delta H \; x \; T_{act}}{P_{act}}} + b_{flo}$$

- Compare the calculated value of the reference standard with that of the SuperSASS. All measured flows should be within ± 0.67 LPM of the reference standard. If any value is in excess of this tolerance, entering the value of the reference in the "Reference" position and then hitting the "Calibrate" key can calibrate the channel. This will enter in the correctly measured value for that channel.

Use this same procedure for all other channels that require calibration. Calibration is required if the sampler has had a major repair or if it has been moved. Record all changes to the system in the e-logbook.

The primary channels, {1,2,3}, that will be used on a routine basis will be checked monthly. All other channels will be calibrated and verified annually, unless it becomes necessary that they be used. Long holidays and special scheduling circumstances may require the use of other channels.

5.0 Programming of System

5.1 Setting Date and Time

From the main menu, select the "Setup" button. Once selected the "Setup Menu" will be displayed. From this menu press F3. Using the left and right arrow keys, move the cursor to the MM/DD/YY or the HH:mm:ss position. Using the up and down arrow keys, enter the correct date and time. Once completed, press the "Set" key and the newly entered values will be saved. Press "Exit" to return to Setup Menu.

Conduct date and time checks monthly. Samplers will not be using daylight savings time. Use Eastern Standard Time. Record these checks in the e-logbook.

5.1.1 Setting Default Elapsed Time for Tests

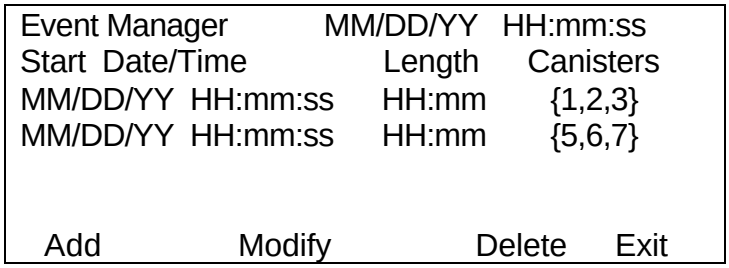
From the Setup Menu press the F2 key to advance to the "Sample Event Defaults" screen. This is used to set up the default value that is used for the total elapsed time for each run during the operation and collection of sample material. This also allows for a default set of canisters to be selected.

From the "Sample Event Defaults" screen use the left and right arrow keys to move the cursor to the HH or mm position that needs to be changed. Use the up and down arrow keys to change the value. Each sample run will total 24 hours. Once completed press the "Save" key.

The factory default setting for the canister set is {1, 2, 3}. These are the three channels that will be used for sampling on a routine basis. In the event these are not the current canisters selected, use the up and down arrow keys to correct. Once completed press the "Save" key. Press "Exit".

5.1.2 Event Manager

From the Setup Menu press F1 to display the "Event Manager" screen. This screen allows for sequential programming of the SuperSASS. Although sequential sampling is available the system will only be using the first three channels for testing.



Event Manager Display Screen

5.1.3 Setting the Site ID Value

From the "Setup Menu" press the F4 key to display the "ID Setup" screen. The value displayed is the serial number for the control unit. This value should be changed to reflect the county code for the site on which it is located. There will be one sampler at each of the following six sites. Enter the corresponding three digit county code followed by a zero to fill the fourth position. After entering the correct code, press "Save". Press "Exit" to get back to the main menu.

Cherry Grove-**0330**	Hickory-**0350**	Raleigh-**1830**
Greensboro EB-**0810**	Lenoir CC-**1070**	Fayetteville-**0510**

5.1.4 Clear all Event History

From the main menu press the “Setup” key to go to the Setup Menu. Press F5 to clear all event history. This is only necessary after the initial setup of the sampler has been completed.

6.0 Running the Sampler

6.1 Shipping/Receiving of Canisters

Sampling canisters will not be opened or altered in any way by the operator. Research Triangle Institute (RTI) will be the contract laboratory for the PM 2.5 Speciation Program. All canisters, loaded with filters and denuders, will be supplied to the operators by RTI. RTI will ship an assortment of canisters to the operators with specific instructions on sampling. Each canister will be labeled with channel sampling position and a bar code. The sharp cut cyclones (SCC) will not be supplied by RTI. Each operator will have a minimum of three (3) cyclones, which will be used for sampling and regular calibrations and checks.

The canisters will be shipped to and from RTI in large coolers. Inside of these coolers will be a gray bin, which will contain three sampling canisters. The gray bin is labeled with a bar code that corresponds to the bar codes on the individual canisters. It is important to place the sampling canisters back into their corresponding bin. Sampling canisters, their paperwork and bin should all be placed back into the shipping cooler in which they were received when preparing to ship samples back to RTI.

RTI will send designated canisters for field blanks and trip blanks. There will be one set of trip blanks every 30 days (one per channel). There will be one set of field blanks every 10 sampling days (one per channel). Upon visiting the site to set up the next run, the field blanks will be installed into the designated channels for a few minutes and then removed. **Do not turn pump on for blanks**. Blanks will then be placed back into their shipping container and sent back to RTI on the scheduled shipping day. Trip blanks will be taken to the site but not opened.

6.2 Installing Canisters

Lower the bottom portion of the head assembly and let come to rest above the control unit. All canisters will be received with plastic yellow end caps. These caps provide a barrier for possible contamination prior to and after sampling. Remove the bottom end cap and insert the canister in its designated channel position. Once the canister has been installed remove the second end cap and insert the SCC. It is important that the SCC not be installed on the canister until the canister is in position on the sampling head. Retain the end caps for post sampling transport. Raise the bottom portion of the sampling head and secure in place.

6.3 Programming Sample Event

Once canisters have been loaded in their appropriate sampling position it is necessary to program the sampler. From the main menu screen press "Event". Then press F4 for "Event Manager". This screen will display the start date/time, length of run and canisters selected to run. The event manager will keep a total of 24 post events archived in a circular manner where the oldest will be overwritten by the newest addition. Upon initial setup of the sampler there will be no events posted.

Press "Add". This screen allows you to enter the start date and length of run time. It also allows for the selection of the group of canisters that will be running. Using the arrow keys, scroll through the menu to enter the necessary information. All samples will run for a period of twenty-four hours, beginning at midnight (00:00), on the designated sampling date. After entering sampling information press "Add" to save the information. Press "Exit" when completed.

6.4 Filter Retrieval

Operators will make every effort to pick up samples on the EPA schedule. In instances where this is not possible, samples will be retrieved from the sites following the FRM schedule of no later than 96 hours after sampling. Samples are to be kept at $\leq 4^{\circ}$ C after retrieval from site. RTI will provide large coolers and packing ice for shipment of samples. The coolers must reach RTI at a temperature of $\leq 4^{\circ}$ C.

Lower the bottom portion of the sampling head and allow it to come to rest above the control unit. Before removing the canisters, locate the plastic yellow end caps that were removed upon canister installation. While canister is still in position on the sampling head, remove the SCC and cap the canister with a yellow end cap. Now remove the canister and plug the other end with the second end cap. Place the canister in the transport cooler.

It is necessary to remove the grit cap from the SCC and dump out any particles that may have collected during sampling. If necessary, wipe the SCC with a kim wipe to remove any remaining debris. It may also be necessary to wipe off the solar radiation shield upon visible inspection, especially in the summer months when the pollen may be high, but at least once a month. If dirt or dust is allowed to collect on the shield, the effectiveness of the reflective surface can be reduced and can cause the temperature to rise inside the shield. The design is to maintain the temperature differential between ambient and sample to within 3° C.

6.4.1 Example of Shipping/Sampling Schedule

The following schedule is an example of RTI's routine shipping and receiving schedule. Every effort will be made to meet these sampling and shipping requirements. In the event that a sample cannot be installed for an upcoming sampling event, the modules will be marked as blanks and returned to RTI on the designated shipping day.

If filters do not get shipped out on their designated day, for whatever reason, simply wait until the next business day to ship them out, but DO NOT SHIP ON FRIDAYS. RTI does not want this to be a common occurrence, but are willing to accommodate the occasional late shipment.

1-Day-In-6 Sampling Schedule							
Module Activity	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
	9/9	9/10	9/11	9/12	9/13	9/14	9/15
Ship from RTI					3		
Rec'd by State						3	
Sampling	-	6,1FB	-	-	-	-	-
Ship from State					6,1FB		
Rec'd by RTI						6,1FB	
						Shipping Day	

1-Day-In-6 Sampling Schedule							
Module Activity	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
	9/16	9/17	9/18	9/19	9/20	9/21	9/22
Ship from RTI		5					
Rec'd by State			5				
Sampling	3	-	-	-	-	-	5
Ship from State					3		
Rec'd by RTI						3	
		Shipping Day			Shipping Day		

Sampling days are shaded on the schedule and have a number in the Sampling (under Module Activity) row. Each number in the schedule represents a set of canisters to be used for a scheduled sampling event. The set number will be used to track the activity of that set of canisters through the schedule. For example, each operator's canister set 3 will be shipped from RTI on September 13, 2001, received by the State on September 14th, used for sampling on September 16th, shipped back to RTI

by the State on September 20th, and received back at RTI on September 21st.

Legend: FB = Field Blank, TB = Trip Blank, (Example: 2TB = canister set #2 is used as a Trip Blank for that sampling event.)

6.4.2 Filling Out the Custody and Field Data Sheet

A copy of the PM 2.5 STN Custody and Field Data Form is printed below. Research Triangle Institute (RTI) will provide a data sheet for each canister. The data sheet provides specific sampling information as to site, sampling date and channel number. The canisters are bar coded and color coded for easy identification and installation. It is important that the right canister be sampled using the correct channel. If for some reason a different channel is used, this should be noted on the data sheet.

Part A, number 2, should be signed by the operator who receives the canisters from shipping. The operator that takes the canisters to the site for installation will sign number 3. The site operator upon setup will fill in part B, numbers 7 and 8. Part C will be filled in by RTI.

Part D. of the data sheet is to be filled out by the operator upon retrieval of the sample from the site. Information such as start date and time, end date and time, and retrieval date and time should be logged. The steps below should be used to fill in the necessary information on part E. of the data sheet.

1. Press “Event” from the main menu.

2. Press F2 for the “Previous Event Summary” in order to view the most recent sampling event.

3. The “Status” of the sampling event is displayed as Finished, and the start/stop date and time will be displayed.

4. Along the bottom of the screen will be arrows pointing left and right (<<, >>). Use the left arrow key (<<) to scroll through the menus. Press (<<) key once to bring up the “Power Interruptions” screen. If any interruptions occurred, note in the comment section of the data sheet.

5. Press (<<) key again to display the “Flow Warnings” screen. If any warnings, note in comment section.

6. Scroll to the next screen, which displays the warnings for elapsed time and the change in filter temperature. If any warnings, note in the "ΔT Flag" section.

7. Next go to the "Filter dT Summary" screen. No information from this screen will be recorded.

8. Press (<<) key to display the "Min/Max Summary" screen. Record the min and max values for ambient temperature, min and max values for filter temperature and min and max values for barometric pressure. Use the arrow keys to scroll through the filter number to view temperatures for all three channels.

9. Press (<<) key to display the "CV Summary" screen. Record the average CV % in the "Avg. flow CV" section of the data sheet. Record the average flow (mean) in the "Avg. Flow (L/min)" section of the data sheet.

10. Press(<<) key to display the "Volume Summary" screen. Record the average ambient temperature, average barometric pressure, average filter temperature and sample volume values for each channel.

11. Press (<<) key to display the "5-Minute Values" screen. No information will be recorded from this screen.

12. The last screen to be displayed is the "Current Conditions" screen. No information will be recorded from this screen.

13. Log the time/date of retrieval.

14. Run time is always 24 hours unless otherwise indicated on the "Power Interruptions" or "Warnings Summary" screens.

BAR CODE GOES HERE Custody/Data Form No.	**$PM_{2.5}$ STN CUSTODY AND FIELD DATA FORM**	White – return to lab Yellow – site retains Pink – lab retains

A. CUSTODY RECORD (Name, Date)

1. Laboratory, Out RTI Signs Date 00/00/00
3. Site, Out _____ Date _____
2. Site, In _____ Date _____
4. Lab, In _____ Date _____

B. SITE AND SAMPLER INFORMATION

1. Site AIRS Code _____
5. Site Name _____
2. Sampler S/N _____
6. Intended date of use _____
3. Sampler Type _____
7. Date of sampler set-up _____
4. Sampler POC _____
8. Operator's name _____

C. SAMPLER CHANNEL COMPONENTS

Channel Number	Component ID No.	Component Description
1	kept at site	SASS cyclone
1	I1234568	SASS cassette (Teflon filter) (GREEN)
2	kept at site	SASS cyclone
2	I1234570	SASS cassette (MgO denuder, nylon filter) (RED)
3	kept at site	SASS cyclone
3	I1234572	SASS cassette (quartz filter) (ORANGE)

D. START, END, AND RETRIEVAL TIMES

Channel No.	Start date	Start time	End date	End time	Retrieval date	Retrieval time
1	3	3	3	3	13	13
2	3	3	3	3	13	13
3	3	3	3	3	13	13

E. SAMPLER CHANNEL INFORMATION (Post-Sampling)

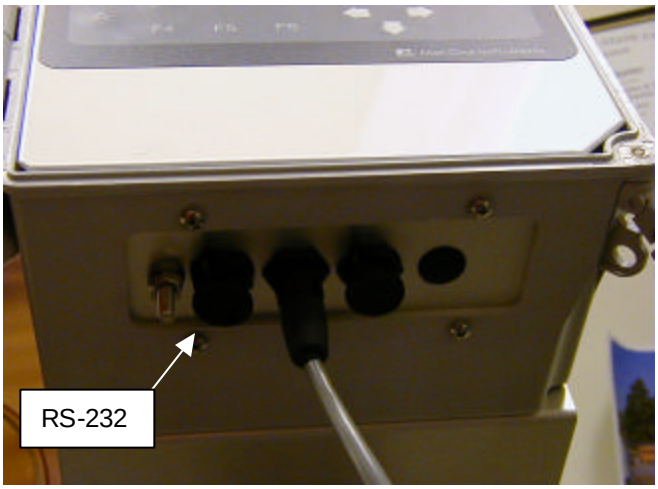
Channel No.	Run Time	Run Time, Flag	Sample Volume (m3)	Avg. flow (L/min)	Avg. flow CV (L/min)	Avg. ambient T (°C)	Max. ambient T (°C)	Min. ambient T (°C)
1	14	6	10	9	9	10	8	8
2	14	6	10	9	9	10	8	8
3	14	6	10	9	9	10	8	8

Channel No.	AT Flag	Avg. Filter T (°C)	Max. Filter T (°C)	Min. Filter T (°C)	Avg. BP (mm Hg)	Max. BP (mm Hg)	Min. BP (mm Hg)
1	6	10	8	8	10	8	8
2	6	10	8	8	10	8	8
3	6	10	8	8	10	8	8

After form is complete, detach the yellow copy and send to headquarters for future data verification. Make a copy of the yellow form for the region to keep before sending to headquarters.

6.4.3 Data Download

After a sampling event and after the data sheet has been filled in with the necessary sampling information, the data must be downloaded from the control unit. Located under the control unit, the most left-hand circular connection is for the RS-232 cable. It is a four pin circular connector with a 9-pin RS-232 female (DE-9F) type connection at the other end. Connect the circular connection to the control unit, and the 9-pin connector to the laptop PC.



Control Unit RS-232 Connection

Use a laptop PC and the SASSComm AQ Software version 4.0.1 (or higher), supplied with the system, to collect the data.

The software will be loaded onto the laptop PC's. There are two disks containing the SassCommAQ software. To install, insert Disk #1 into the disk drive. Click on the Windows <Start> button and then <Run>. Type in A:\Setup, then press <Enter>. Follow the instructions on the screen.

After software installation is complete click on the SASSComm icon to open. This will bring up the Files/Reports Menu of the software. Press the "Retrieve Data" button and the computer will begin to download the data from the previous sampling event. The software will ask if you want to download only the event data. The response to this should be no. You want to download all of the data, including the five-minute interval data. If there is

an error waking the data logger, try the process again. If the software still does not respond properly, refer to Attachment 2 of this SOP for possible causes. If still unable to download data contact the ECB for further assistance.

Once the data has downloaded, the grids on each menu will fill in with data information. There is a "Warnings" menu, "Data Log" menu, and an "Event Summary" menu.

6.4.4 Exporting Data

Once the download is complete, go back to the "Files/Reports" menu and click the "Export" button. You will be prompted to pick the file that you wish to export. The file name is based on the site ID and the start time and the date of the event. The 00 Hour, 00 Minute and 00 Second refers to the start time of the event.

Typical file name: 0330_2001_09_28_00_00_00.BIN Binary Data File

This breaks down as:

0330 Site ID (Cherry Grove) 2001 Year 09 Month 28 Day 00 Hour 00 Minute 00 Second

Once exported, the file is automatically formatted and labeled with all collected information for each test summary. In addition the five-minute interval data is also reported for the entire test interval.

The downloaded interval data will not accompany the canisters when returned back to RTI for analysis. The download files will be sent via email to headquarters for future data verification.

6.4.5 Sending Data to Headquarters

COC Form: Make certain that all copies of the chain of custody (COC) form are legible and all are complete before sending to Headquarters. Annotate as completely as possible all unusual site or sampling events on the COC form. Use an additional sheet (not the back) if more space is needed. Send the yellow copy of the COC form to Headquarters. This copy should be sent to Mary Clark on the same day the module is sent back to RTI.

Data Download: Download the data from the samplers at least once a week, preferably after each run, to insure that data is not overwritten. The sampler will begin to overwrite all data after one week.

The download files should be e-mailed to Mary Clark at Headquarters at least once every two weeks. (Mary.Clark@ncmail.net)

7.0 Troubleshooting and Maintenance

Very little maintenance is required for the operation of the SuperSASS Sampler System. Most maintenance involves inspection and cleaning of components for damage or wear, as well as the regularly performed checks and calibrations by the operators. All maintenance and troubleshooting activities should be recorded in the site logbook.

In the event a sampler fails to operate properly after repeated attempts, the ECB should collect the sampler from the site for further troubleshooting. Operators will inform the ECB of such occasions.

7.1 System Cleaning

Each time the system canisters are replaced, or as deemed necessary, the solar radiation shield of the sampler head should be cleaned with a wet cloth. Buildup on the shield can reduce the effectiveness of the reflective surface and cause the temperature to rise inside the shield.
The pump housing should be inspected and cleaned at least every quarter by removing the four screws on the corners and lifting the cover up and out of the way. Using a brush, or a compressed air source, clean the insides of the enclosure, particularly the screen located below the pump assembly. When completed, reattach the pump box cover and re-secure the four screws.

The control box and cables should be inspected for damage or dirt/dust accumulation. The control panel should only be cleaned with a damp cloth, and no liquids should be allowed to enter the electronic package.

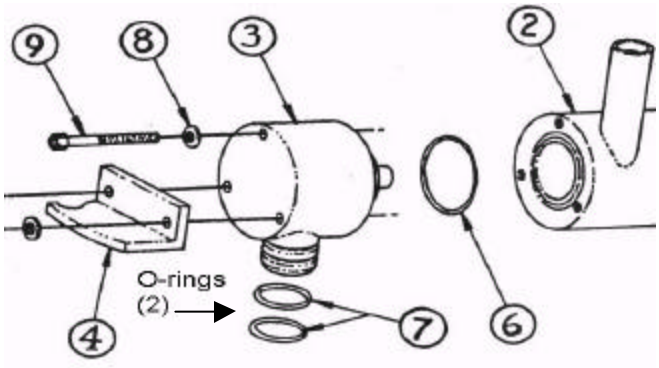
7.1.1 Denuder Replacement

The MgO denuder will need replacement approximately every three months of operation, or as required by the US-EPA. The third party contract laboratory performing the chemical analysis of the filters replaces the denuders. The third party vendor is replacing filters and denuders in each canister. The operator is not to open the sampling canisters that have been received from RTI.

7.1.2 System Inspection

The various components of the system should be inspected for wear, damage, and changes in previous operation. Most inspections rely on visual checks during normal operation of the system.

Each time a canister is removed, check the O-rings of the canisters and those on the SCC. RTI will be replacing canister O-rings as necessary. The operator will replace the SCC O-rings as necessary. The diagram below shows the three O-rings (6&7) to be replaced on the SCC. Each time the cyclones are removed, unscrew the grit cap and dump out any dirt that may have collected as part of a routine maintenance program.



O-Rings of the SCC (6) & (7)

ATTACHMENT 1

Troubleshooting Guide

Out of specification (±10 % of transfer standard)	1. Completely remove flow rate measurement adapter; reconnect and perform flow rate check again. 2. Perform Leak test 3. Check flow rate at three points to determine if flow rate problem with slope. 4. Recalibrate flow rate
Leak outside acceptable tolerance	1. Completely remove flow rate measurement adapter; reconnect and perform leak test again. 2. Inspect all seals and O-rings; replace as necessary and perform leak test again. 3. Check sampler with different leak test device.
Consistently low flows during sample runs	1. Check programming of sampler flow rate. 2. Check flow with a flow rate verification filter and determine if actual flow is low.
Out of specification (±4° C of standard)	1. Recalibrate sensor; replace sensor.
Out of specification (±10 mmHg of standard)	1. Make certain pressure sensors are exposed to ambient air and are not in direct sunlight. 2. Call local airport or other source of ambient pressure data and compare that pressure to pressure data from monitor's sensor; pressure correction may be required. 3. Connect new pressure sensor.
Out of specification (±5 min)	1. Check programming; verify power outages 2. Reset
Sample did not run	1. Check programming 2. Try programming sample run to start while operator is at site; ensure the transport filter is in the unit.
Power Interruptions	1. Check line voltage
Liquid-crystal display pen on, but sample not working.	1. Check to see that plugs are in place and there are no loose connections.
Data did not transfer to laptop computer	1. Document key information on sample data sheet. Make sure problem is resolved before data may be overwritten.

ATTACHMENT 2

Software Troubleshooting Guide

Error	Possible Cause	Correction
Unable to open port	Wrong COM port selected	Select another COM port in the serial communications section under Controls.
	Multiple communication programs opened simultaneously.	Close other terminal programs that may be using the same COM port.
	COM port device driver conflict	Refer to Windows help to solve the conflict.
Error Waking Data Logger	RS232 cable not connected	Connect RS232 cable from SASS to COM port specified for communication
	Faulty RS232 cable	Check RS232 cable with a continuity meter. Pin 2 to 3, 3 to 2, and 5 to 5 should have continuity.
	Remote unit lost power	Check power to remote unit
	SASS Firmware version 3.0 or older	Make sure the SASS is in the top screen and try again
Run-time Error '70' Permission denied-during data retrieval	The current Export file is opened by another program	Close the program that has the export file open and retrieve data again

ATTACHMENT 3

Calibrations, Checks and Audits Schedule

Action To Be Performed	Frequency
Date/Time Check- compare date and time displayed on sampler to an accurately set watch.	Monthly. Use Eastern Standard Time.
Leak Check- follow procedures in Section 3.2.1 of this SOP.	Upon startup, then monthly. (Beginning of 1st and 3rd month of each quarter)
Temperature Check- follow procedures in Section 4.1 of this SOP.	Upon startup, then monthly. (Beginning of 1st and 3rd month of each quarter)
Pressure Check- follow procedure in Section 4.2 of this SOP.	Upon startup, then monthly. (Beginning of 1st and 3rd month of each quarter)
Flow Rate Check- follow procedure in Section 4.3 of this SOP.	Upon startup, then monthly. (Beginning of 1st and 3rd month of each quarter)
One-Point Temp. Calibration- follow procedure in Section 4.1.1 of this SOP.	Upon startup, then annually. Exceptions: whenever the temperature sensor is not within the tolerance of ± 2° C.
Two-Point Pressure Calibration- follow procedure in Section 4.2.1 of this SOP.	Upon startup, then annually. Exceptions: whenever the pressure sensor is not within the tolerance of ± 10 mmHg.
Flow Calibration- follow procedure in Section 4.3 of this SOP.	Upon startup, then annually. Exceptions: When flow is outside of tolerance ± 0.67 LPM
Audits (Temperature, Pressure and Flow)- Follow procedures in Section 4.0 of this SOP.	Beginning of second month of each quarter. Four audits per year.
Clean SCC Grit Cup- Unscrew the grit cup on the end of the SCC and remove any particles or debris.	Once per week.
Clean Solar Radiation Shield- wipe clean the upper portion of the white solar radiation shield.	As needed, but at least once per month.
Clean Interior Of Pump Box- remove pump box cover and remove dust and debris particles with an air source or brush. Clean the screen below the pump assembly.	Once per quarter.
Replace O-Rings- replace damaged or visibly worn o-rings of the SCC. See 7.1.2 for diagram of o-ring locations.	Only as needed.