

4.0 Audit Procedure for the MetOne SASS Speciation Sampler



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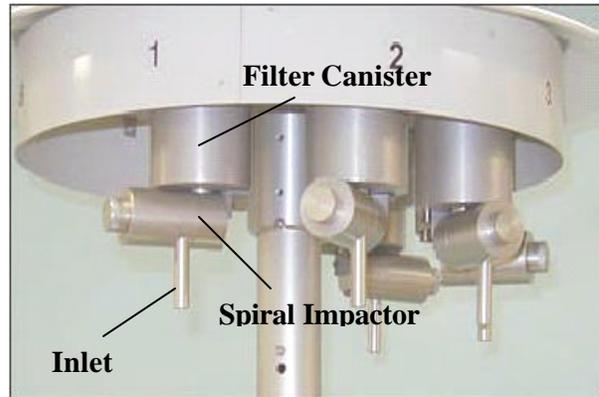


4.1 Background

The Met One SASS chemical speciation sampler was developed in order to collect samples for the chemical and gravimetric analysis of $PM_{2.5}$ ambient air particulate matter. These particles are comprised of sulfates, nitrates, organic carbon, soot-like carbon and metals.

The MetOne SASS utilizes five independent channels (the Met One Super SASS utilizes eight independent channels) with spiral impactors attached directly to the filter cartridges that are arrayed in a raised carousel.

Each canister has its own $PM_{2.5}$ inlet, denuder ring and tandem 47mm Federal Reference Method/Monitor (FRM) filter holders. The canisters are mounted in a wind aspirated radiation shield that maintains sampler temperature close to ambient. Inlets point downward and sample flow rate is 6.7 to 7.0 L/min per canister. The $PM_{2.5}$ separation is produced by a sharp cut cyclone (SCC) that removes both solid and liquid coarse particles with equal efficiency without the use of impaction grease or oil.



The field audit of this sampler includes the determination of the accuracy of the total flow rate reading for channels 1, 2, and 3 under normal operating conditions (nominally 6.7 Liters/min), ambient and filter temperature readings, and the barometric pressure reading as compared to those measured with a NIST traceable audit device (that must be recalibrated on an annual basis). Prior to performing an audit, verify that the annual calibration and maintenance procedures have been performed according to the required frequencies specified in Section 16 of the STN QAPP.

4.2 Calibration Equipment

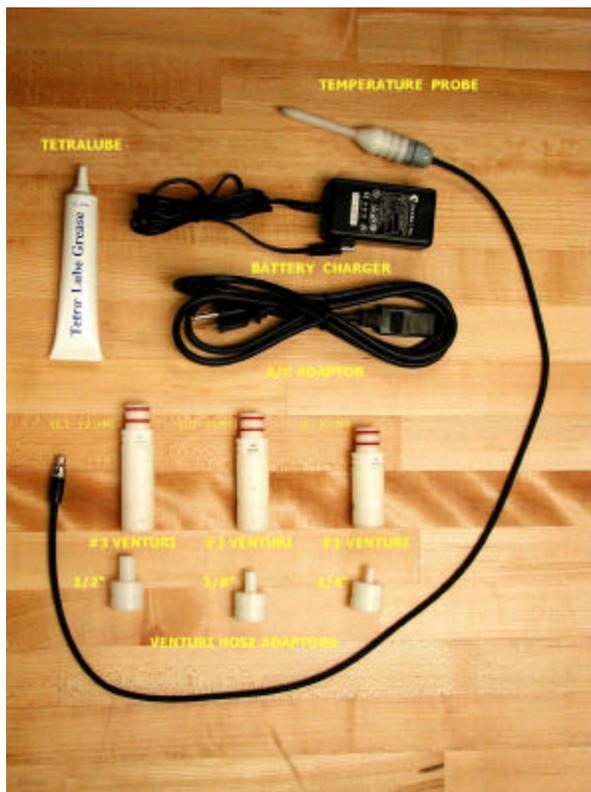
A TriCAL Laboratory/Field Audit Calibrator (Figure 4-1), and an audit sample canister with a sharp cut cyclone (SCC) inlet are necessary for conducting audits of the MetOne SASS. (Figure 4-3)



Figure 4 -1: TriCAL calibration unit.



Figure 4 -2: Calibration equipment.



The TriCAL's ancillary equipment are illustrated in Figure 4-2. The audit sample canister, Sharp Cut Cyclone (SCC) inlet, and its components are illustrated in Figure 4-3. The sharp cut cyclone removes particles larger than $2.5\mu\text{m}$ - aerodynamic diameter - and a denuder is used to remove nitric acid or other interfering gases.

It is important to ensure that the equipment is in thermal equilibrium with the ambient environment of the sampler. It is recommended that the TriCAL be set out (of its carrying case) for an hour prior to any tests being conducted. If the unit experiences temperature variances greater than 5° during its use, it should be rebooted.

Battery capacity should be in excess of 10% (this ensures that at least one hour of power is available). If this is not the case, the battery in the TriCAL unit shall be charged prior to use. Before using the TriCAL audit device, the auditor must check the calibration tag on the instrument. If the instrument is out of calibration, **do not use**. Use one that is in calibration.



Figure 4 -3: Exploded view of audit sample canister.



4.3 Audit Procedure for Met One SASS

Upon arrival at the site location, the auditor must fill in all information listed below on the Performance Audit Worksheet (Attachment 1). This worksheet will also be used to record other required information throughout the audit procedure/process.

Note: Leak and flow check audits will only be performed on channels 1, 2, and 3.

1. location of the sampler;
2. date of audit;
3. auditor (s) and agency affiliation;
4. operator (s) and agency affiliation;
5. sampler model and serial number (SN);
6. SASS or sampler calibration due date;
7. reference model, calibration date, and serial number.
8. location sampler operating agency, sampler operator's name, auditor's name.

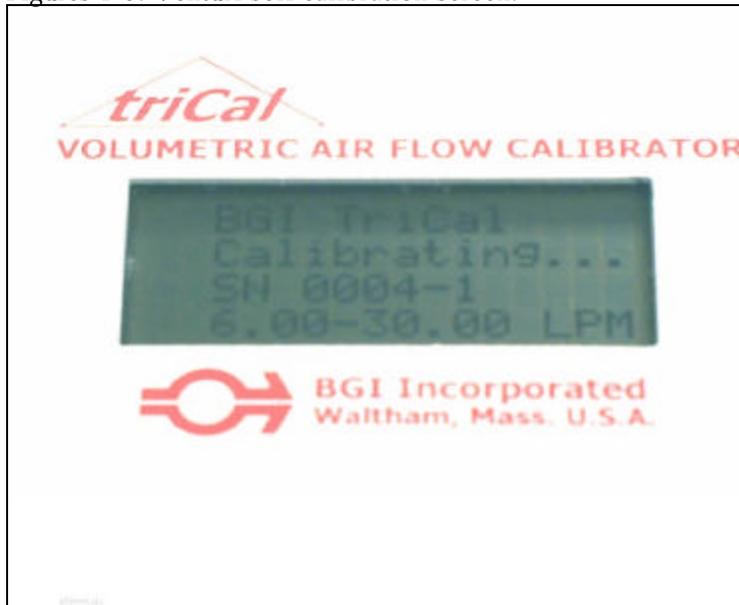
Unpack the TriCAL and turn it on by pressing the on/off switch. The menu will prompt the user to insert venturi #1, #2, or #3. The venturi that will be used is determined by the flow rate of the air sampler being audited. After a venturi has been inserted the TriCAL will perform a self-calibration of the venturi (Figure 4-4 and 4-5).



Figure 4 -4: Inserting venturi into TriCAL.

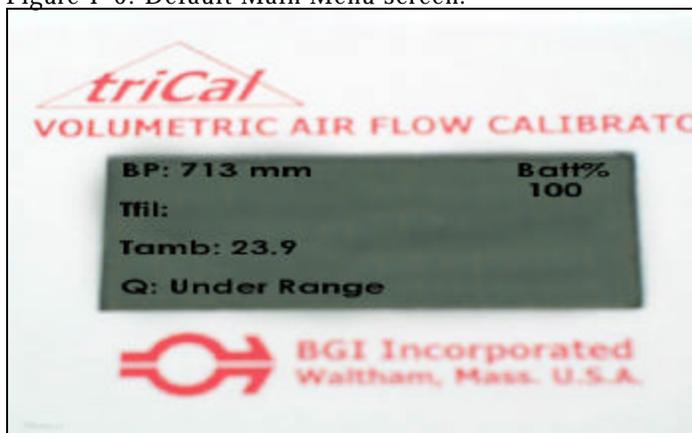


Figure 4 -5: Venturi self-calibration screen.



Once the venturi has been calibrated, the TriCAL will default to the Main Menu displaying barometric pressure, battery capacity, temperature, and flowrate (Figure 4-6).

Figure 4 -6: Default Main Menu screen.



Attach the temperature probe to the TriCAL. A value for the T_{fil} will then be displayed. (T_{amb} is the internal temperature sensor of the TriCAL, T_{fil} is the external temperature reading of the temperature probe.) Next, attach the tygon tubing to the venturi hose adapter, then attach the hose adapter to the venturi. (Figures 4-7 and 4-8) (**Note: The correct venturi hose adapter is determined by the size of the venturi that was inserted into the TriCAL.**)

Figures 4-7 & 4-8: Inserting temperature probe and venturi hose adapter.



The data required for the next five sections (*Clock Test, Leak Test, Flow Test, Temperature, Pressure Test*) can be obtained from the Main Menu (Figure 49) of the Control Box through a series of keystrokes listed later in this section.

4.3.1 Clock Test

From the Main Menu screen (Figure 49) select the Setup menu (Figure 4-10), then select *clock* (or F3). From the clock screen (Figure 4-11), record the air sampler's displayed time as the SASS time on the Met One Performance Audit Worksheet. Record the NIST traceable reference clock time this is another external device such as an atomic wristwatch/clock. The time difference shall be calculated, on the worksheet, and determined to be either a Pass/Fail status.

Figure 4-9: Main Screen/Menu

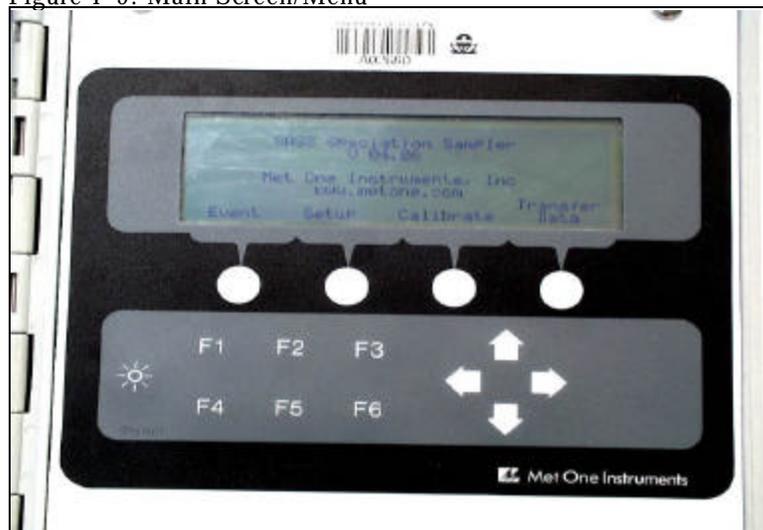


Figure 4 -10: Setup Menu



Figure 4 -11: Clock screen



4.3.2 Leak Test

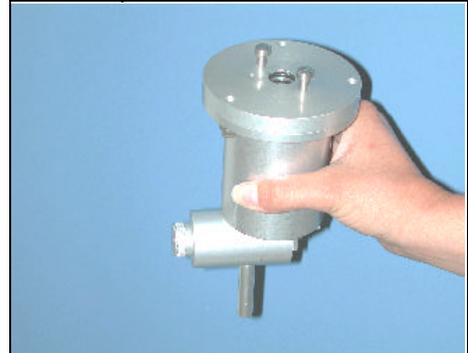
Lower the bottom shield by removing the pin, which is located at the base of the sample head. This is required to have access to the sample filter canisters. (Figures 4-12 and 4-13)

Figures 4-12 & 4-13: Canister exposure.



Attach the flow rate audit canister with attached spiral impactor assembly to SASS Channel #1. (Figures 4-14 through Figure 4-16)

Figures 4-14 & 4-15: View of the Canister Assembly Block and SCC Inlet.



Figures 4-16: Canister installation.



From the Main Menu (Figure 4-9) select the Calibration Menu, at the Calibration menu (Figure 4-17), select the System Test Menu (F1). (Figure 4-18.) From this menu the user is able to turn on the pump by selecting the *Pump* key. Once the pump begins to run, a new menu pops up and asks the user to stop the pump (by pressing *Cancel*) or continue sampling (by pressing *Continue*). (Figure 4-19.) The user must press Continue to perform the leak and flow checks. Once this is done, the screen reverts back to the System Test Menu which allows the user to view the flow rates for each system channel. Ensure that the *Leak* option is selected to *On* by pressing the *Leak* key, from the System Test Menu. The user is now ready to perform the leak check.

Figure 4 -17: Calibration Menu.



Figure 4 -18: System Test Menu.

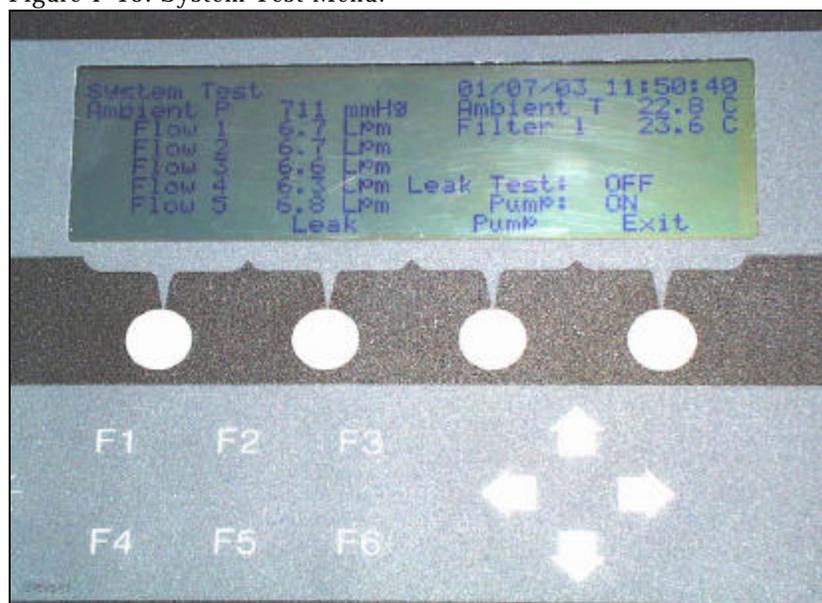
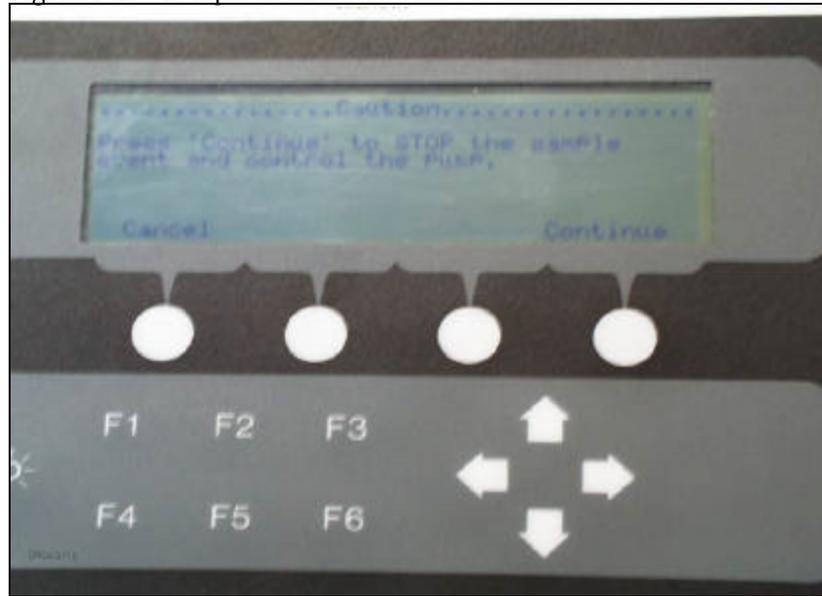


Figure 4 -19: Pump Screen.



Using either a cap/plug or finger, tightly seal the inlet of the SCC so that no air can pass up through the nozzle (Figure 4-20). Allow the system to stabilize at a constant flow rate for several minutes. Record the leak flow rate for channel #1, from the System Test Menu, on the Performance Audit Worksheet. The flow rate indicated should be 0.0 L/min, which indicates that there is no leak in the flow system.

Figure 4 -20: Leak check by capping inlet.



Move the audit filter canister and impactor to the next two consecutive channel positions (channels 2 & 3) in succession to perform leak checks. Record the leak flow rate for each channel on the Performance Audit Worksheet. **Note: It is not necessary to stop the pump or change the menus to conduct leak and flow checks between each channel.**



4.3.3 Flow Test

Move the audit filter canister and impactor assembly back to channel #1. Ensure that the SCC inlet is open, and attach the 4' hose to the venturi hose adapter (which attaches to the flow audit device - TriCAL). (Figure 4-21) Next, attach the opposite end of the hose to the filter canister impactor inlet (Figure 4-22). Allow the flow to stabilize and record, on the Performance Audit Worksheet, the displayed Met One sample flow rate for channel #1, and the flow rate displayed on the flow audit device.

Figure 4 -21: Venturi hose audit adapter.



Figure 4 -22: Flow audit device connected to SCC inlet.



Without stopping the pump, repeat the above procedures for channels 2 and 3. Record the sampler and audit device flow rates for each channel.

When the flow audit is completed, select *Exit* from the System Test menu to shut off the pump. The screen will then default back to the Calibration Menu. At the Calibration Menu, press the *Exit* key the screen defaults back to the Main Menu. Remove the canister assembly from the air sampler, stow and repack for the next audit.



4.3.4 Filter Temperature

Ensure that the temperature probe is attached to the TriCAL and that it has been allowed to equilibrate (Figure 4-7). From the Main Menu, press the *Event* key this will take the user into the Event Menu (Figure 4-23). At the Event Menu, press the *Current Event Status* key (F1), this takes the user into the Current Event Menu (Figure 4-24). Insert the TriCAL temperature probe into the open sample orifice of channel #1 (Figure 4-25). Record the filter temperature for channel #1, from the Current Event Menu (which is located at the upper right hand corner of the screen), and the displayed temperature reading from the TriCAL.

Note: Filter temperature audit only requires temperature readings for channel #1.

Figure 4 -23: Event Menu

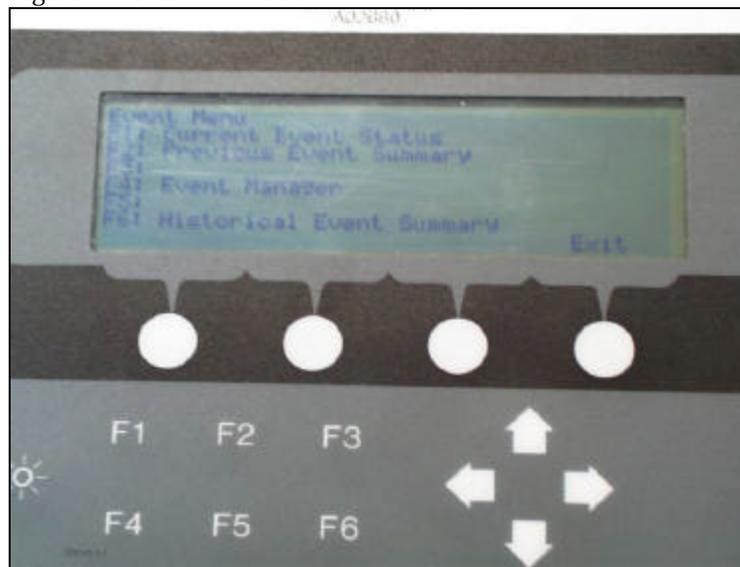


Figure 4 -24: Current Event Menu

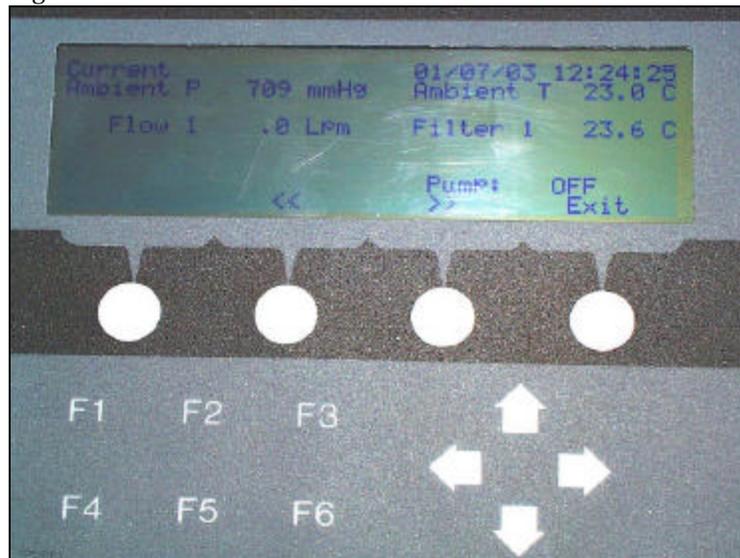


Figure 4 -25: Filter temperature audit.



4.3.5 Ambient Temperature

Carefully insert the temperature probe into the gill screen of the SASS ambient temperature sensor, avoiding contact with the sides of the gill screen, and direct sunlight (Figure 4-26). **Note: Contact with a gill screen that has been exposed to direct sunlight may result in non-representative/erroneous readings due to possible elevated temperatures of the gill screen.** Allow the TriCAL temperature reading to stabilize. Record the air sampler ambient temperature (from the Current Event Menu) and the TriCAL ambient temperature.

Figure 4 -26: Ambient temperature audit.



4.3.6 Ambient Pressure Test

Record the ambient barometric pressures from the TriCAL and the SASS (which is found in the upper right hand corner of the Current Event screen).

Once the ambient pressures have been recorded the audit procedure is completed. Restore the air sampler to its original condition ensuring that the Control Box is returned to the Main Menu and replace any routine samples to their original positions. Return all the audit instrumentation to their cases.

4.4 Other

Record any applicable observations on the back of the Performance Audit Worksheet. This may include information such as the following:

1. obvious vandalism;
2. known power outages/failures;
3. any interrupted sample events;
4. inclement weather conditions;
5. and any other pertinent information that might have adverse impacts on data generation/collection.



Attachment 1: Audit Performance Worksheet

Location _____

Date _____

Audit Information

Auditor(s)	<input type="text"/>	Affiliation	<input type="text"/>	Collocated? Yes	<input type="text"/>
Operator	<input type="text"/>	Affiliation	<input type="text"/>		
Sampler Model	<input type="text"/>	Sampler SN	<input type="text"/>		<input type="text"/>
Last Cal Date	<input type="text"/>				
Ref. Mdl	<input type="text"/>				
Calibration Date	<input type="text"/>				
Ref. SN	<input type="text"/>				

Clock Test	Time		Minutes	Criteria > 5 min.	
	Ref Std	SASS	Difference	Pass	Fail
	<input type="text"/>				

Leak Test	L/min	Criteria > 80 cc/min	
		Pass	Fail
Channel 1	<input type="text"/>	<input type="text"/>	<input type="text"/>
Channel 2	<input type="text"/>	<input type="text"/>	<input type="text"/>
Channel 3	<input type="text"/>	<input type="text"/>	<input type="text"/>

Flow Test	L/min			Criteria > 10%	
	Ref Std	SASS	% Difference	Pass	Fail
Channel 1	<input type="text"/>				
Channel 2	<input type="text"/>				
Channel 3	<input type="text"/>				

Temperature	Degrees C			Criteria > 2.0 deg.		
	Test	Ref Std	SASS	Difference	Pass	Fail
Ambient		<input type="text"/>				
Filter		<input type="text"/>				

Pressure Test	mm Hg			Criteria > 10 mm hg	
	Ref Std	SASS	Difference	Pass	Fail
	<input type="text"/>				

