



Air Pollution Control Division

Technical Services Program

APPENDIX PM6

Standard Operating Procedure for the Chemical Speciation Network (CSN) - SASS™ AND SUPERSASS™

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1.0 INTRODUCTION

In July 1997, the U.S. EPA promulgated a new National Ambient Air Quality Standard (NAAQS) for particulate matter with an aerodynamic diameter smaller than 2.5 microns, or PM_{2.5}. The original primary annual standard set for PM_{2.5} was 15 µg/m³ and the original primary 24-hour standard was 65 µg/m³. On October 17, 2006 the 24-hour PM_{2.5} NAAQS was revised to 35 µg/m³, 98th percentile, averaged over three years.. On December 14th 2012, the primary PM_{2.5} standard was revised to 12 µg/m³, annual mean averaged over 3 years. The primary standard final rule went into effect March 18th, 2013

Particle pollution - especially fine particles - contains microscopic solids or liquid droplets that are so small that they can get deep into the lungs and cause serious health problems. Numerous scientific studies have linked particle pollution exposure to a variety of problems, including:

- premature death in people with heart or lung disease,
- nonfatal heart attacks,
- irregular heartbeat,
- aggravated asthma,
- decreased lung function, and
- increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.

People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure. However, even if you are healthy, you may experience temporary symptoms from exposure to elevated levels of particle pollution.

Chemical speciation monitoring is intended to provide researchers with quantitative information about the chemical composition of PM_{2.5} and to help identify sources in source apportionment studies.

2.0 PURPOSE AND APPLICABILITY

This document is intended to instruct Colorado Air Pollution Control Division (APCD) and local agency operators to use the MetOne SASSTM and SuperSASSTM Chemical Speciation samplers. The specifications for the MetOne SASSTM and SuperSASSTM samplers and for obtaining valid measurements are contained in the MetOne Field Operation Manual (MetOne 2001). This document reviews the manufacturer guidelines, and QC protocol, and provides clarifications on the field methods and supplemental information in greater detail than can be provided in the formal regulatory requirements. Because this SOP is intended for method users, it emphasizes the operational aspects of the method, rather than the design and performance specifications for the sampler. The information provided here together with the instructions provided by the MetOne Field Operation Manual (MetOne 2001), have been used by the Colorado Air Pollution Control Division (APCD) to develop its own agency-specific standard operating procedure (SOP) for the MetOne SASSTM and SuperSASSTM samplers. The SASSTM and SuperSASSTM samplers are different only in the number of sample channels they contain. The SASS has five channels, while the SuperSASSTM sampler has eight sample channels. In the Colorado PM_{2.5} chemical speciation network both types of samplers are operated in an identical fashion and only the first two sample channels are used in each sampler. Thus, the terms SASSTM and SuperSASSTM samplers are used interchangeably throughout this document, except when a difference is specifically noted. Likewise, the term Speciation Trend Network (STN) is used to refer to both STN and Chemical Speciation Network (CSN) sites in this document and on laboratory and field forms, because all sites are treated the same way. STN actually

refers to a subset of the national CSN network. There are currently 53 national STN sites and 201 total sites within the national CSN network (including the STN sites). The one small difference is sampling frequency. The STN site is operated on a once every third day frequency while the supplemental CSN sites are operated on a once every sixth day frequency. Thus, there is no difference between a STN site and a supplemental speciation site, except in the designation of the site as a STN site. Currently, the only STN site in Colorado is the La Casa NCORE site located 4545 Navajo Street in Denver, CO. The supplemental speciation sites are currently located at the Alsup Elementary site in Commerce City, CO., and the Platteville Middle School site (PM_{2.5} transport site) in Platteville, CO. Sampling sites can be moved for many reasons and the current sites are just described here to better understand differences between STN and supplemental CSN sites.

This standard operating procedure (SOP) outlines procedures for field operations and quality control checks of the MetOne SASS™ and SuperSASS™ PM_{2.5} Chemical Speciation samplers. For more detailed information regarding operation of these samplers, refer to the MetOne SASS™ and SuperSASS™ Operators Manual.

3.0 ACRONYMS AND ABBREVIATIONS

Acronym or Form Name	Full Name or Definition
SASS™ Field Form	PM _{2.5} STN Custody and Field Data Form
Site Visit Sheet	PM _{2.5} STN Regular Maintenance and Sampler Verification Form
APCD	Air Pollution Control Division
P _a	Ambient Pressure
°C	Degrees Celsius or Centigrade
FTS	Flow Transfer Standard
IMPROVE	Interagency Monitoring of Protected Visual Environments
L _{pm}	Liters Per Minute
Na	Sodium
Nitrate	NO ₃
PM _{2.5}	Particulate matter with an aerodynamic diameter smaller than 2.5 microns
QC	Quality Control
RTI	Research Triangle Institute Laboratories
SCC	Sharp cut cyclone
SOP	Standard Operating Procedure
STN	Speciation Trend Network
T	Temperature in degrees C unless otherwise noted
T _a	Ambient temperature in degrees C (sampler display)
ΔT	A difference between ambient and filter temperature while sampling of > 5°C for > 30 minutes invalidates the sample
XRF	X-Ray Diffraction
Validity Form	Chemical Speciation Trends Network Field Sampling Null Value and Validity Coding Form

4.0 METHOD OVERVIEW

The Model SASS™ & SuperSASS™ PM_{2.5} Ambient Chemical Speciation Samplers: Field Operation Manual contains a complete description of the sampling method, sampler specifications and a thorough technical description of the samplers, the integrated SASS™ canister (sample module), the sharp cut cyclone (SCC), and other associated parts. Refer to the Field Operation Manual for specific details. Basically, the SASS™ and SuperSASS™ samplers draw ambient air through a size selective inlet (i.e., the SCC) that removes particles larger than 2.5 microns in aerodynamic diameter and deposits the fine particles or PM_{2.5} on 47 mm filters, which are analyzed by an EPA contract laboratory. The SASS™ and SuperSASS™ use volumetric active flow control to keep the sample flow rate relatively constant at 6.7 LPM in each of the sample module flow trains currently used for PM_{2.5} chemical speciation sampling (channels 1 & 2). It is important to note (in the event that a different channel needs to be used temporarily), that Channels 4 and 5 in the SASS™ and 4 and 8 in the SuperSASS™ use critical orifices at 6.9 LPM instead of volumetric active flow control. The critical orifice channels are not used in the Chemical Speciation sampling and should not be used as back-up channels. Each of the sample modules is color coded and labeled with a number to correspond with the SASS™ and SuperSASS™ channels, which are also numbered but not color-coded. See Figure 4-1, showing the sample module configuration. The first sample module is color coded green and labeled “1” to match up with Channel 1 on the samplers. Module 1 samples for total mass on a Teflon filter and is analyzed for metals by x-ray diffraction (XRF). Channel 2 is color coded yellow and labeled “2” and is analyzed for anions (negatively charged ions): Nitrate (NO₃) and Sulfate (SO₄), and cations (positively charged ions): Ammonium (NH₄), Potassium (K), and Sodium (Na) on a nylon filter. Denuders are used inside the sample modules to remove interfering gases.

Note: As of April 2009 carbon species are now sampled on a separate instrument, a URG3000N. This configuration allows for an analysis comparable to that performed in the IMPROVE monitoring program. The SOP for the URG3000N is covered elsewhere in this QAPP.

5.0 PRECAUTIONS

Read and thoroughly understand the operator’s manual before beginning field operations. The flow rate and temperature calibrations of the sampler must be checked and, if necessary, adjusted to specifications prior to taking the first sample. Consult the operator’s manual for calibration instructions.

Use only the sampling modules, sent from the laboratory, for the designated sampler and location. Be certain the correct sample module is in the correct sampler flow train on the samplers. Each sample module is color coded and labeled with a number (1 and 2).

Exercise great care in placement and handling of sampling modules to avoid contamination. The SCC must be attached to the inlet of the sampling module before sampling.

6.0 EQUIPMENT AND SUPPLIES

Note: For a complete list of consumable supplies needed for the operation and maintenance of the SASS™ and SuperSASS™ instruments refer to the manufacturer’s operator manual.

Forms

Have a PM_{2.5} STN Custody and Field Data Form (SASS™ Field Form) (see Figure EOD-1) for the particular sampler, for the particular sampling day, with you when visiting the site. Also, bring the Chemical Speciation Trends Network Field Sampling Null Value and Validity Coding Form (Validity

Form) (see Figure EOD-2). These forms are provided with sample modules from the support laboratory, which is currently Research Triangle Institute Laboratories (RTI).

Have a STN Regular Maintenance and Sampler Verification Form (Site Visit Form) (see Figure EOD-2).

Tools and Sampler

MetOne SASS™ or Super SASS™ chemical speciation sampler, accessories, and any tools needed.

Samples and Field Blanks

SASS™ sample modules, pre-loaded with filters and denuders for two channels. Also, bring field blank and/or trip blank sample modules as scheduled, typically one field blank for every ten samples and one trip blank per month. All these items will be supplied from the support laboratory.

Cut Point Cyclones

Sharp cut cyclone (SCC) for each sampling module. These will be kept at the sampling site and are labeled to correspond to a single sample channel position (1 or 2 as described above in the Method Overview section) and dedicate the cyclone to use with this channel.

Module Transport Supplies

Transport cooler with frozen ice substitutes, and a min/max thermometer to ensure the samples are kept chilled at less than 4 °C.

Shipping Supplies

Shipping coolers, frozen ice substitutes, and overnight labels for shipment of sampling modules and reports to the analytical support laboratory. The support laboratory will supply all shipping supplies.

7.0 SAMPLER OPERATING PROCEDURES

Record information about the sample, the field blank, or the trip blank on an individual PM_{2.5} STN Custody and Field Data Form (SASS™ Field Form) (Figure EOD-1). Note any null value or validity flags on the Validity Form. Be extremely careful when applying null codes as the support laboratory will not analyze the sample if there is a null code noted on the form. Always call the APCD to discuss potential null codes before marking a null code on the Validity Form. It may be more appropriate to just mark a validity flag and have the sample analyzed, rather than invalidating the sample with a null code.

7.1 Filter Sample Module Handling

The field operator will encounter filter sample modules for several different species. Each filter module is used to analyze different species types of PM_{2.5}. Modules consist of an aluminum housing, which contains sampling cassette(s) holding a filter, and denuders that remove interfering gases. There are modules for routine sampling (every third day or every sixth day), field blanks (sent from the laboratory for use on every tenth sampling day), and trip blanks (sent every thirty sampling days except sites on the “Alternative Schedule”, which have a trip blank every two or three weeks). The Alternative Schedule is every third day sites, which have elected to not collect samples on weekends or holidays to meet the 48-hour filter collection condition. Whenever, there is a sample scheduled on a Friday and the following Monday, one of the days will be used as a sample and the other used as a trip blank. The La Casa NCORE STN site is on the Alternative Schedule. The support laboratory determines the Alternative Schedule for sampling.

It is highly recommended that sampling modules be removed from the sampler within 48 hours after the sampling period ends. For a one-in-three day schedule this will be necessary since the next sampling day's sample modules must be installed.

Once the sampled modules are removed, separate the SCC for reinstallation with the next set of sample modules, cap or cover the sample module openings, store the sample modules in the transport cooler with ice substitute, complete the SASS™ Field Form, and return the transport cooler with the sampled modules and the associated paperwork to the field office. *The sampled modules and paperwork must be properly packaged in a cooler, ready for pickup by Federal Express, within 96 hours after the sampling period ends. The support laboratory will provide specific directions for packaging and shipment and days for shipment.* Protect samples in the transport cooler, from direct sunlight and extreme heat during transport from the site to the field office; store them in the field sample refrigerators until just before packaging them in the cooler.

Days of the week for shipment will be arranged in coordination with the EPA STN liaison (DOPO) and the support laboratory. Do not ship on Fridays unless prior arrangements are made with the DOPO and the laboratory.

7.2 Denuder Handling

The support laboratory will change the denuder when it is due for replacement. The denuder is an integral part of the sampling module. It is located inside the sample modules, which should never be opened by field operators or the sample will be voided.

7.3 Sample Preparation and New Run Setup

Remove the protective plastic end caps from the sample module and protect them from contamination by placing them in a clean plastic bag and store for later use to seal the used sample modules for return to the laboratory. Attach a dedicated SCC to each sample module. Install loaded filter sample modules in predetermined (numbered) sampling channel locations according to the information given on the SASS™ Field Form sent from the support laboratory. Load field blank sample module(s) every 10 sampling days. Do not activate flow to field blank channel(s).

1. Press F2 key to Setup the Start/Stop times in the sampler.
2. During normal operations, the control unit of the SASS™/SuperSASS™ sampler retains all data needed to operate the sampler for the next regularly scheduled sample event. The date is the key information needed to allow later matching of the stored data with the analytical results.
3. Edit START Date/Time, and END Date/Time using the arrow keys. The STN network will collect 24-hour samples, beginning at midnight.
4. Select "SAVE" to save the programmed event.
5. Press F1 to review the programmed event and verify correct entry, and then select "EXIT".

New run setup

1. From the Main Screen select "Event"
2. From the Event Screen select F4- "Event Manager".

3. From the Event Manager Screen select “Add”.
4. A default date (the next day) will appear.
5. The “Start Date” is displayed as MM/DD/YY.
6. Use the left and right arrows on the arrow pad to move the cursor along the date line.
7. Once on the day section of the date, use the up and down arrows to adjust the day (pressing the up arrow moves to the next day, using the down arrow moves to the previous day). On occasion, both the month and day will need to be adjusted.
8. After the correct date is set, from the Event Manager Screen, select “Add” again.
9. From the Event Manager Screen select “Exit”
10. From the Event Screen select “Exit” to return to the Main Screen.

The monitor is now set to start sampling on the scheduled Start Date that was entered.

The operator must fill in the appropriate site and sampler information on the SASS™ Field Form, including, the date of sample set up, and operator name. The site name and intended date of use is pre-entered onto the SASS™ Field Form.

7.4 Exposed Sample Removal

Follow the instructions below to recover valid samples:

1. At the end of the sample run, lower the sampler’s lower radiation shield.
2. Rotate each canister counterclockwise to remove it from its sampling position.
3. Remove the cyclone.
4. Cap the sample module inlet and outlet with yellow end caps.
5. Place or store the cyclones in a safe location (e.g., transport cooler).
6. Reinstall SCC’s on the new, unexposed sample modules for the next sampling run. At least every 30 days of use, clean the SCC’s by opening the grit cup and gently tapping the cup upside down on a clean solid surface. Then blow clean compressed or canned air through each hole of the SCC until it is visually clean.
7. Inspect the o-rings on the SCC. If the o-rings are cracked or damaged replace them.
8. Place each filter sample module into a zip-lock style bag and then place it in the transport cooler.
9. Complete all paperwork.
10. Clean the area around the sample head; wipe connections with a clean cloth or paper towel.

11. Install a new filter sample module by aligning screws in slots and rotate it counterclockwise to secure. Take care to properly match the SASS™ sample module to the correct sampler inlet.

7.5 Data Retrieval

At the end of the sample run record the end date/time, sample retrieval date/time, specified post-sampling information, and free-form comments on the SASS™ Field Form. **Please double-check entries and write clearly!**

1. From the Main Screen select “Event”.
2. From the Event Screen, select F2- “Previous Event Summary”
3. Use the control keys under the displayed arrows to move thru all of the screens that contain data that is required on the Field Data Sheet. (The record information is displayed in a different order than the fields on the Field Data Sheet.)
4. Fill out the Field Data Sheet COMPLETELY.
5. There should be no empty fields on the Field Data Sheet. If there is redundant information for channel 2 then draw an arrow down the columns on the Field Data Sheet indicating that the information for channel 2 is the same as it is for channel 1 (i.e., Start dates and times; End dates and times; Retrieval dates and times; Run Time; Run Time Flag; Avg. (average), min, max ambient temperatures (ambient T); ΔT Flag (see Note below); filter temperatures (Filter T), and barometric pressure (BP). Any empty fields on the SASS™ Field Form will be entered as “NO DATA” by the Lab and possibly lead to inaccurate flags on the sample.
6. When done, From the Previous Event Summary screen, select “Exit”.
- 7) From the Event Screen, select “Exit” to return to the Main Screen.

Note: The ΔT Flag indicates that there was a difference in temperature between the ambient temperature sensor and the filter temperature sensor while sampling, which was greater than 5° C for more than 30 minutes in a row. This can invalidate the sample. The operator should call the APCD as soon as possible if the ΔT Flag is shown.

If instructed by APCD, download the sampler data from RS232 port to laptop computer or to MetOne data transfer module. Retain data disk file for later use in data validation. Do not ship it to the support laboratory.

7.6 Historical Event Data Collection:

Occasionally, sampling event data is lost. However, it can be retrieved from the SASS™ or SuperSASS™ sampler if it has not yet been over written. To retrieve historical event data follow the directions below:

1. From the **Main Screen** select “Event”.
2. From the **Event Screen** select F5- “Historical Data”
3. The “Start Date” of the most recent sample will be displayed.

4. Use the down arrow on the arrow pad to move through the start dates of the historical records.
5. Once the desired date is found, use the control keys under the displayed arrows to move through all of the screens that contain the needed data.
6. When done, from the **Historical Data Summary Screen**, select “Exit” to return to the Event screen.
7. From the **Event Screen**, select “Exit” again to return to the Main screen.

7.7 Field Blank Filters

Field blank filters, loaded into sample modules, will be shipped from the laboratory. They will have a separate STN Custody and Field Data Form (SASS™ Field Form) with them. The field blanks are to be used during the same time interval as the routine sample modules. Follow the procedures below to obtain valid field blanks:

1. Visit the sampling site at the regularly scheduled time for setting up a new sampler run.
2. Install the field blank modules (and sharp-cut cyclones) in the channel locations as indicated by the SASS™ Field Form.
3. After a few minutes, remove the field blank modules from the sampler, detach the cyclones, cap the sample modules, and return them to their spot in the transport cooler.
4. Proceed to install the routine sample modules according to the schedule.
5. Complete and sign the SASS™ Field Form for the field blank modules and ship them back to the laboratory, in their own shipping cooler and Blue Ice packs, at the earliest possible time, avoiding Fridays and holidays as stated below in the Packing and Shipping Coolers section.

7.8 Trip Blank Filters

Trip blank filters, loaded into sample modules, will be shipped from the laboratory. They will have a separate SASS™ Field Form with them. They are to be used during the same time interval as the routine sample modules. Follow the procedures below to obtain valid trip blanks:

1. These trip blank modules should be carried to the site but left in the transport cooler. They should not be installed in the sampler.
2. Complete and sign the SASS™ Field Form for the trip blank modules and ship them back, in their own cooler, to the laboratory at the same time as the routine samples are shipped.

7.9 Packing and Shipping Coolers:

Coolers should be packed up within an hour prior to the scheduled pickup whenever possible. Do not mail out coolers on Fridays or the day before a holiday as the cooler will sit on the lab's dock and the ice packs will thaw compromising the samples.

Prior to packing check to make sure the paperwork on the Field Data Sheets and the Validity Forms are COMPLETELY and CORRECTLY filled in. Then, separate the Yellow copies of the Field Data Sheets and the Validity Forms and paper clip the forms together and send them to APCD at least once a month. The current address is:

APCD-TS-B1
Colorado Dept. of Health and Environment
4300 Cherry Creek Dr. South
Denver, CO 80246-1530

1. Verify that the bin number on the Field Data Sheet matches the number inside the shipping cooler.
2. Verify that the module numbers match the module number on the Field Data Sheet.
3. Place the modules inside the large plastic bag then in the cooler.
4. Fill plastic bag inside the cooler with the Blue Ice packs that came with the modules and shipping cooler. There should be a total of about eight (8) Blue Ice packs used per cooler. Note: if the Blue Ice packs should thaw, they may leak. Each ice pack is inside a small zip-locked bag. Place the ice packs/bags around and on top of the sample modules to keep them cold.
5. Seal the large plastic bag containing the three sample modules and the Blue Ice packs using the provided twist tie.
6. Place the styrofoam insulation cooler piece on top of the bag containing the sample modules and ice.
7. Place the COMPLETED Field Data Sheet, Field Sampling Null Value and Coding Form and the rest of the paperwork, inside the large zip locked bag provided, on top of the styrofoam insulation piece.
8. Close the shipping box and seal the cooler box lid using strapping tape.
9. Stick the new overnight delivery address label (addressed to RTI), on top of the cooler box in its plastic bag and tape the edges with strapping tape or clear tape if necessary to prevent it from coming loose.

7.10 Storing the Blue Ice Packs:

The temperature of the freezer where the Blue Ice packs are stored should be below 20 degrees F (-6°C). The Blue Ice packs should be stored in the freezer for at least 24 hours before using.

8.0 SAMPLER MAINTENANCE AND VERIFICATION PROCEDURES

Certain quality control checks must be conducted at the time of sampler startup and at monthly or quarterly intervals thereafter. Carry out these checks before making any adjustments to the sampler. Record information about the site, the sampler, and the results of scheduled or special (unscheduled) quality control checks on the PM_{2.5} STN Regular Maintenance and Sampler Verification Form (Site Visit Form), Figure EOD-3. This report form originates at APCD and is sent to the field sites at regular intervals. The dates and the scheduled maintenance or QA/QC procedures are listed at the bottom of the Site Visit Form. The site operator should keep the original on file and send a copy to the APCD. Do not send the Site Visit Form to the support laboratory, but return it to APCD. Any actions taken to service or calibrate the speciation sampler after the check must be recorded on the Site Visit Form and in detail in the field operator's notebook.

8.1 Equipment

The following equipment is needed to complete the field audit:

- Certified NIST traceable thermometer
- Certified NIST traceable barometer
- Certified NIST traceable flow transfer standard
- Certified timepiece
- Leak check audit adapter

8.2 Verifications

Note: perform regular verifications upon instrument installation, after performing a calibration, and every four weeks as per APCD schedule.

8.2.1 Date and Time Checks

Conduct these checks monthly or whenever daylight savings time changes occur. Compare the date and time displayed on the sampler to the known date and to an accurately set watch or cell phone. Record data and time information on the Site Visit Form (see Figure EOD-3).

8.2.2 Monthly Leak Check

Performed upon startup, prior to every calibration, and every four weeks as per APCD schedule.

1. Place the "leak check module" containing the appropriate filter cassette/denuder for each channel and attach a SCC on the channel to be leak-checked. Use this "leak check module" assembly for leak checks and flow rate checks only. The sample module must contain the type of filter (and denuder, if included in the sample module) normally used at this sampling channel location as described in the Method Overview section.
2. Press F3 key, and select "PUMP ON".
3. Plug the Sample Inlet (e.g., Channel 1) with a cap.

4. Note the displayed flow in LPM (L/min). The indicated flow rate should drop to 0.1 L/min or less. If it does not, check for leaks and repeat the procedure until the leak check is completed successfully.
5. Repeat for all channels in use.
6. Select “PUMP OFF” to stop the pump, and press “EXIT” to return to the main menu.
7. Release the vacuum slowly to avoid damaging the leak check filter.

8.2.3 Every 4-Week Ambient Temperature Verification

Performed upon startup, after every calibration, and every four weeks as per APCD verification schedule.

1. Compare the ambient temperature readout from the sampler display screen with the reading from a certified transfer standard thermometer.
2. Note the temperature values on the Site Visit Form (see Figure EOD-3).
3. If the temperature readings differ by more than $\pm 4^{\circ}\text{C}$, notify APCD. APCD may perform a multipoint calibration of the sensor or replace the faulty sensor.

8.2.4 Every 4-Week Ambient Pressure Verification

Perform upon startup, after every calibration, and every four weeks as per APCD schedule.

1. Compare the ambient barometric pressure readout from the sampler display screen with the reading from a certified transfer standard barometer.
2. Note the ambient barometric pressure values on the Site Visit Form (see Figure EOD-3).
3. If the pressure readings differ by more than ± 10 mm Hg notify APCD. APCD may perform a multipoint calibration of the sensor or replace the faulty sensor.

8.2.5 Every 4-Week Flow Rate Verification

Perform flow rate verification upon startup, after calibration, and every four weeks as per the schedule provided by APCD.

1. Use same “leak check” module assembly called for in monthly Leak Check Procedure.
2. Connect an external flow audit device to the cyclone sample inlet (e.g., Channel 1). Use a low-pressure drop certified flow transfer standard.
3. Press the F3 key, and select “PUMP ON”.
4. Compare the flow rate measured by the external flow device with displayed value. (The sampler is preset at 6.7 L/min for each channel used for chemical speciation sampling). If the flow deviation exceeds $\pm 4\%$ (± 0.27 L/min) notify APCD for technical support.

5. Repeat the procedure for all flow channels in use.

8.3 Sampler Maintenance and Troubleshooting

1. Clean the cyclone inlets prior to every sampling run using a can of compressed air and dust-free wipes.
2. Clean the solar radiation shield with wet cloth as required.
3. If flow rate falls off, or is variable, the unit may need factory servicing of the pump or of the active flow controllers/critical orifice flow controllers.
4. Check O-rings for wear or damage at least every four weeks.
5. Make a comment on the SASS™ Field Form (see Figure 2) to the laboratory of problems with sample module assemblies.
6. Record all maintenance and troubleshooting activities on the Site Visit Form (see Figure 4).
7. On the SASS™ Field Form (Figure 2), note any special conditions of the environment or sampler that may affect the sample weight or analysis (e.g. forest fires in area).

8.3.1 Troubleshooting

Figure 8-1 offers a quick reference for the most common problems experienced by field operators. Should any of these occur the operators, after notifying APCD, may be asked to perform some of the task(s) in the 'Action' column.

Figure 8-1 Troubleshooting Table for the SASS and SuperSASS.

PROBLEMS	ACTION
Damaged Modules	Notify APCD, arrangements will be made with the contract lab for replacements.
Flow out of specification (more than $\pm 10\%$ from design flow rate of 6.67 lpm)	<ol style="list-style-type: none"> 1. Perform leak check 2. Completely remove flow rate measurement adapter, reconnect and perform flow verification again. 3. Notify APCD
Leak outside of accepted tolerance	<ol style="list-style-type: none"> 1. Remove and refit the module and SCC and try leak test again. If it fails again, go to step 2. 2. Examine the hoses from the pump box through the inlet for cracks or leaks, including the o-rings on the module and SCC. Try leak test again. 3. If it fails again, call APCD.
Consistently low flows during sample runs	<ol style="list-style-type: none"> 1. Check the programmed sampler flow rate. Reset if not 6.7 LPM. 2. Call APCD.
Ambient Temperature out of specification ($\pm 4^\circ\text{C}$ of standard)	<ol style="list-style-type: none"> 1. Recalibrate the temperature sensor. 2. Call APCD
Ambient pressure out of specification ($\pm 10\text{mm Hg}$ of standard)	<ol style="list-style-type: none"> 1. Make sure the ambient pressure sensors in the pump box are open to the air (no obstructions or dirt) and out of direct sunlight. 2. Compare NIST traceable barometer or local airport pressure reading to the instrument and adjust if necessary. 3. Call APCD.
Clock out of specification (± 10 minutes of standard)	<ol style="list-style-type: none"> 1. Check sampler programming and power outages. 2. Calibrate the clock if needed. 3. Call APCD.
Sample scheduled but not collected	<ol style="list-style-type: none"> 1. Check sample programming. 2. Call APCD.
Power interruptions	<ol style="list-style-type: none"> 1. Check and reset sampler clock if needed. 2. Call APCD.
LCD display on but sampler not responding to key inputs	<ol style="list-style-type: none"> 1. Check for loose connections in plugs to LCD at the control box. 2. Call APCD.
Data transfer failed	Call APCD.

9.0 SAMPLER CALIBRATION PROCEDURES

The calibration procedure performed in the field for the SASS and Super SASS instruments is performed in the following order:

- Ambient Temperature Sensor Calibration,
- Ambient Pressure Sensor Calibration,
- Multiple point, multiple channel flow Calibration.

As with all instrument calibrations APCD utilizes a set of NIST traceable standards that are independent of the verification and audit standards. The SASS Unit (or SuperSASS unit) can be easily calibrated using the calibration screens in the Control Unit. From the main screen menu select the “Calibrate” key. This action will display the Utility Menu Screen.

9.1 Temperature Calibration

Before beginning it will be necessary to have a reference temperature measurement device that has a calibration traceable to NIST or other approved calibration authority. The temperature calibration is done using two temperatures points. One good reference point for the ambient temperature sensor measurement is “ice-point” (0° C/ 32° F), the second being some elevated temperature above 20°C. During the summer, the local ambient air may provide a suitable second temperature for calibration. The ice-point or ice-bath consists of a slurry of distilled water and ice chips that has been stirred to produce a 0° C temperature bath as measured with the reference thermometer. A wide mouth thermos bottle works well for the temperature tests.

1. From the Utility Menu Screen select the F3 key to display the Temperature Calibration Screen. Additional details on the various menu selections can be found in Section 4.4 of the Model SASS™ & SuperSASS™ Field Operation Manual.
2. From the calibration menu use the arrow keys to move the cursor to the upper left hand selection and choose the “ambient temperature” measurement.
3. The indication under the SASS™ menu item indicates the current ambient temperature, and this will be used to determine if the system needs to have the temperature calibration changed.
4. Remove the ambient temperature probe from the sampler’s radiation shield by removing the three hexagonal nuts that hold the ring in place under the shield.
5. Using the ice-point bath with the reference thermometer, immerse the sensor portion of the ambient temperature probe into the ice mixture; allow enough time for the temperature to stabilize (about 10 minutes).
6. The temperature sensor should be within 2°C of the reference thermometer.
7. Using a second thermos bottle with a warm water mixture of approximately 30°C (the operator may use ambient temperature if the current value is greater than 20°C) immerse the temperature probe and compare the reference thermometer in the bath with the measured value indicated for SASS Ambient Temperature. The temperature should be within 2°C of the reference thermometer.
8. If both measurements are within the temperature tolerance then it is not necessary to calibrate the ambient temperature probe. If the temperature is in excess of the tolerance then use the following procedure to reset the calibration of the ambient temperature probe.
9. Insert the probe in the ice bath with the reference thermometer, and allow several minutes for the temperature measurements to stabilize (about 10 minutes). It is best to stir the bath while both probes are in the ice mixture.
10. When the temperatures of both probes are stable, enter the value measured from the reference thermometer in the top reference window.

11. When completed press **F1** to save this reference temperature value, note the values on the PM_{2.5} STN Regular Maintenance and Sampler Verification Form (Site Visit Form – Figure EOD-3).
12. Insert the probe in the heated water mixture and allow time for the probe and the reference thermometer to stabilize (about 10 minutes).
13. When the probes are stable, enter the value measured from the reference thermometer in the second reference window.
14. Press **F4** to save this reference temperature value, note both values on the Site Visit Form.
15. Press the “Calibrate” key and the new values will be saved in memory of the control unit. This procedure has calibrated the temperature probe to the reference thermometer.
16. Re-run the temperature checks previously outlined and verify that at the two measurement points the temperatures are within the 2°C tolerance. If they are not, then rerun the calibration test one more time.
17. If it fails the test a second, time, there is the possibility that the temperature probe is damaged, and will need to be replaced. If a new probe is installed, be sure to set the replacement probe using the “Default” menu selection. This will return to the original measurement factors.

This same procedure can also be used for the filter temperature measurement, except that the temperature check uses only the local ambient temperature as a single reference point.

1. From the temperature menu, use the arrow keys to change the value from 0 to 1 which will now display the indicated “Filter” Temperature.
2. Insert a temperature probe into the open hole.
3. Allow about 10 minutes for the temperatures to stabilize.
4. Compare the reference thermometer with the filter temperature screen. They should be within 2°C. If the difference is greater, use the procedure to reset the temperature of the filter thermocouple to the reference temperature outlined in steps 10 – 17 above. Except that the upper temperature is based on a reference thermometer placed near the filter temperature probe located above the canister.
5. If this is a SASS™ instrument, continue this same procedure for the remaining 4 filter temperature probes. If this is a SuperSASS™ instrument, continue this same procedure for the remaining 7 filter temperature probes.

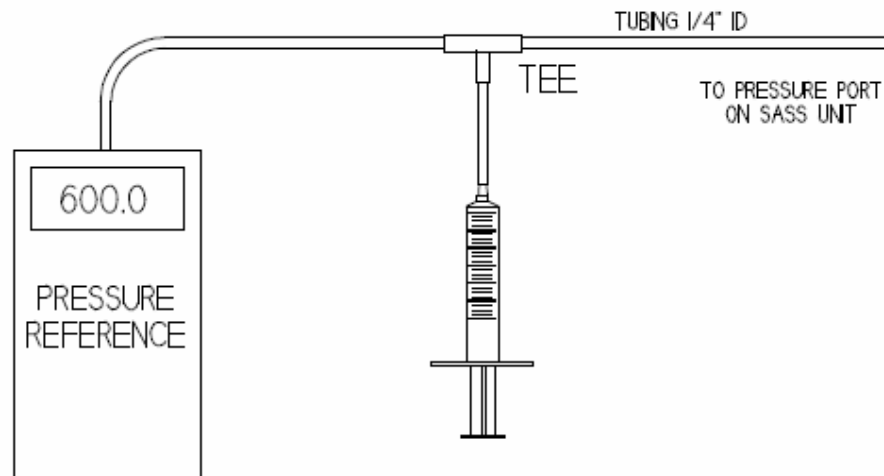
9.2 Barometric Pressure Calibration

1. From the Utility Menu Screen select the **F4** key on the control unit keyboard. This will bring up the Volumetric Flow Calibration Screen. Additional details on the various menu selections can be found in Section 4.4 of the Operator’s Manual.
2. The barometric pressure indicated for the SASS™ should be within ±10 mm Hg of the reference pressure device. If the measurement is in excess of this value, then it may be

necessary to recalibrate the sensor in the SASS™ using a two-point barometric pressure measurement.

3. To perform a calibration, two pressure measurement points will be necessary. This can be accomplished by using a syringe (or a clamp), some tubing, a tee, and the precision reference pressure device (such as a manometer). See Figure 9-1 for detail of pressure test setup.
4. Connect from the pressure test point to a tee connector using some tubing. One side of the tee goes to the pressure measurement device and the other to the syringe. The size syringe required is dependent upon the length (total air volume) of tubing used to make this test apparatus. The syringe is used to change the pressure inside the tubing.
5. Adjust the syringe in and out to change the simulated test pressure measured by the reference device and transferred to the sensor inside the SASS. Two typical readings would be ± 100 mmHg from ambient.
6. First, verify that the syringe is able to adjust the simulated barometric pressure by ± 100 mmHg.
7. Adjust the size of the syringe or the lengths of tubing to provide the necessary adjustments.

Figure 9-1 - Pressure Test Setup



8. Once set begin the following sequence to calibrate the internal barometer to the reference standard.
9. Set the simulated barometric pressure value to approximate 100 mmHg below ambient, as measured from the reference pressure sensor.
10. When the measurement is stable, enter the value measured from the reference in the top reference window. When completed press **F1** to save this value.

11. Note the results of the SASS™ pressure reading and the manometer reading on the calibration or Site Visit Form (see Figure EOD-3).
12. Set the simulated barometric pressure value to approximately 100 mmHg above ambient, as measured from the reference sensor.
13. When the measurement is stable, enter the value measured from the reference in the second reference window. When completed press **F4** to save this value.
14. Note the results on the Site Visit Form.
15. Press the “Calibrate” key and the new values will be saved in memory of the control unit. This procedure calibrated the pressure sensor in the pump box to the reference barometric pressure.
16. Re-run the pressure checks previously outlined and verify that the new measurement is within the ± 10 mmHg tolerance. If they are not, then rerun the calibration test one more time.
17. If it fails the test a second, time, there is the possibility that the pressure sensor is damaged, and will need to be replaced. If a new sensor is installed, be sure to set the replacement sensor using the “Default” menu selection. This will return to the original measurement factors.
18. Remove the test apparatus and log the results on the Site Visit Form.

9.3 Flow Calibration

1. From the Utility Menu Screen, select the **F2** key on the control unit keyboard. This will bring up the Volumetric Flow Calibration Screen. Additional details on the various menu selections can be found in Section 4.4 of the SASS™ Operator’s Manual.
2. Using a flow transfer standard (FTS) test device, and any adapter that might be necessary to adapt to size of the input tube of the SCC, measure the flow at each of the canisters. The SCC inlet adapter part number 8959 can be used.
3. Using the Up/Down key select each of the flow line positions. The SASS™ has 5 flow monitors while the SuperSASS™ has 4 flow lines. In the SuperSASS™ these same four lines are also used by the second set of 4 sample canisters. These keys are used to change the channel being monitored.
4. Channels 1,2,and 3 should be within ± 0.67 LPM or $\pm 10\%$ of the reference standard. Channels 4&5 of the SASS™ should be within ± 0.69 LPM or $\pm 10\%$. 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.
5. Pressing the “Calibrate key” will enter in the correctly measured value for that channel. Use this same procedure for any other channels that may require recalibration.
6. Record all flow changes on the Site Visit Form (see Figure EOD-3).

10.0 QUALITY ASSURANCE AND QUALITY CONTROL

Quality assurance (QA) and quality control (QC) are two terms commonly discussed, but often confused. Quality assurance refers to the overall process of ensuring that the data collected meet previously stated measurement quality objectives (MQOs). Quality control covers specific procedures established for obtaining and maintaining data collection within those limits.

Speciation Trends Network’s samplers in Colorado are operated under EPA’s “[Quality Assurance Project Plan, Chemical Speciation of PM2.5 Filter Samples](#)”, prepared by RTI January 2014 (Called the EPA CSN QAPP in the rest of this document for short).

10.1 Quality Assurance - Audit Procedure

The APCD has adopted EPA’s “[Quality Assurance Project Plan, Chemical Speciation of PM2.5 Filter Samples](#)” for all STN and SPM samplers in Colorado. Absent from EPA QAPP are detailed audit procedures for all STN samplers. EPA requires all persons auditing STN samplers to be certified by EPA. During EPA’s auditor certification training, auditors are provided with auditing procedures via a document titled: “[Audit Procedure for the MetOne SASS and SuperSASS Speciation Sampler](#)” which can be found in Appendix SASS. Also see Appendix QA1 of the CDPHE/APCD/TSP QAPP “Stand Alone Audit Procedures” SOP for more information.

10.1.1 Other

Record any applicable observations on the comments section of the Performance Audit Worksheet or on the TSA form. This may include information such as the following:

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

10.1.2 Follow-up actions

1. The auditor should prepare a completed Performance Audit Worksheet including any findings recorded during the TSA interview and inspection in the “Findings” text box. The findings should be divided into “Significant” and “General.”
2. Within two weeks following a site audit, a draft audit report should be submitted to the site operator and the EPA OAQPS PM2.5 Speciation Network QA Lead.
3. The site operator will be given two weeks to respond for the purpose of ensuring there are no erroneously recorded data that led to a false significant finding. Erroneous data entry should be corrected if there is a high level of confidence that accurate audit data can be recovered from the written versions of the Performance Audit Worksheet and TSA form.
4. Disputed findings of any parameter or condition that were not the result of erroneous data entry should be identified for the interim final report.
5. Within 6 weeks after an audit has concluded and two weeks after the operators response period, an Interim final report will be prepared and forwarded to the Site operator, the SLT’s monitoring program manager, the EPA Speciation Network National Program Manager, the EPA Regional Delivery Order Project Officer, and the appropriate Regional Monitoring Program contact and QA Contact. Interim final reports will be posted on EPA’s AMTIC on the Speciation Monitoring QA Webpage.

6. Monitoring site owners are expected to correct significant findings within 60 days following issuance of the interim final report. Safety findings should be corrected immediately. Remedies for significant findings should be patterned after those stated in the National PM2.5 Chemical Speciation Network guidance document and Field QAPP. (Note this document will be revised by the fall of 2006.)
7. If necessary, a final actions update will be added to the interim final 90 days following the 60 day remediation period, and the resulting report will stand as the “Final Audit Report”

Audit reports for each audit are to be uploaded to an EPA website following the actual field audit. After the findings have been summarized, the audit report is archived within the J:Drive on APCD’s Local Area Network (LAN) at J:QAAuditPrograms/CSN SASSaudits. Once the audit is saved to the LAN it can be uploaded to <https://airqa.rti.org/>. Uploading the audit report is simple by following the directions on the website. Only EPA approved auditors are allowed to upload reports to this repository. A user name and password must be entered before uploading can take place and can be attained from EPA at the website after a request is made and approved. Audit Reports for the Speciation Network will be summarized in a National QA Audit report at the end of the calendar year.

10.2 Quality Control

As stated earlier, quality control (QC) refers to procedures established for collecting data within pre-specified tolerance limits. Almost all QC procedures have already been covered under specific topics throughout this document. Documentation and standard operating procedures, however, are discussed below because they apply to many topics.

10.2.1 Documentation

Documentation is important for all measurements. Certification paperwork for all quality control and quality assurance practices are rigorously maintained for each standard and analyzer.

APCD takes special care to prepare and preserve backup copies of all data, including calibration data. All data and supporting documentation should be held for a minimum of five years.

10.2.2 System of Quality Control

Currently an APCD staff person services on a 4-week event schedule. For more information regarding what tasks are routinely performed during these events, refer to Section 8 in this SOP.

11.0 REFERENCES

1. EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Volume II, Ambient Air Quality Monitoring Program. EPA-454/B-13-003, May 2013.
<http://www.epa.gov/ttnamti1/files/ambient/pm25/qa/QA-Handbook-Vol-II.pdf>
2. Model SASS & SuperSASS PM_{2.5} Ambient Chemical Speciation Samplers: Field Operation Manual. Document No. SASS-9800 Rev. G. December 27, 2001.
<http://www.epa.gov/ttn/amtic/files/spectraining/MetOneSASSFOM.pdf>
3. U.S. Environmental Protection Agency, Quality Assurance Project Plan: Chemical Speciation of PM_{2.5} Filter Samples. RTI/0212053/01QA. EPA Contract No. EP-D-09-010. January 27, 2014.
<http://www.epa.gov/ttnamti1/files/ambient/pm25/spec/qapp.pdf>.

Figure EOD-1 PM_{2.5} STN Custody and Field Data Form (SASS Field Form)

 Q124175K		PM 2.5 STN CUSTODY AND FIELD DATA FORM		o. White (return to lab) c. Yellow (site retains) c. Pink (lab)				
A. CUSTODY RECORD (Name, Date)			Bin ID: B15115		Set: 5			
1. Laboratory, Out <u>Pafio 07/12/06</u>		3. Site, Out _____						
2. Site, In _____		4. Lab, In _____						
B. SITE AND SAMPLER INFORMATION								
1. Site AIRS Code <u>080010006</u>		5. Site Name <u>Commerce City</u>						
2. Sampler S/N _____		6. Intended date of us <u>Sunday, July 16, 2006</u>						
3. Sampler Type <u>SASS</u>		7. Date of Sampler set-up _____						
4. Sampler PO <u>5</u>		8. Operator's name _____						
C. SAMPLER CHANNEL COMPONENT								
Channel No.	Component ID No.	Component Description						
1	Kept at Site	SASS cyclone						
1	I2928T	SASS cassette (Teflon filter) (GREEN)						
2	Kept at Site	SASS cyclone						
2	I2929U	SASS cassette (MgO denuder, nylon filter) (RED)						
3	Kept at Site	SASS cyclone						
3	I2930N	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								
2								
3								
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								
2								
3								
Channel No.	Δ T 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								
2								
3								
F. Comments _____ _____ _____								

Figure EOD-2. STN Field Sampling Validity Form

**Chemical Speciation Trends Network
Field Sampling Null Value and Validity Coding Form**

c. White (return to lab)
c. yellow (site retains)
c. pink (lab)

Chain of Custody Sampling Request ID Q128388 B Sampling Date 12-10-06

Date Received in SHAL _____

Instructions to Field Sampling Operator: For the sampling event identified by the Chain of Custody Sampling Request ID indicated above please circle all applicable flags in the tables below. If no flags apply to this sampling event, please check the box below the tables.

Table A. Null Value Codes

* selection of any flag in this table will invalidate sample

FLAG	DESCRIPTION
AA	SAMPLE PRESSURE OUT OF LIMITS
AB	TECHNICIAN UNAVAILABLE
AC	CONSTRUCTION/REPAIRS IN AREA
AD	SHELTER STORM DAMAGE
AF	SCHEDULED BUT NOT COLLECTED
AG	SAMPLE TIME OUT OF LIMITS
AH	SAMPLE FLOW RATE OUT OF LIMITS
AI	INSUFFICIENT DATA (CAN'T CALCULATE)
AJ	FILTER DAMAGE
AK	FILTER LEAK
AL	VOIDED BY OPERATOR
AM	MISCELLANEOUS VOID
AN	MACHINE MALFUNCTION
AO	BAD WEATHER
AP	VANDALISM
AQ	COLLECTION ERROR
AU	MONITORING WAIVED
AV	POWER FAILURE (POWR)
AW	WILDLIFE DAMAGE
BA	MAINTENANCE/ROUTINE REPAIRS
BB	UNABLE TO REACH SITE
BE	BUILDING/SITE REPAIR

Table B. Validity Flags

* samples marked with any of these flags will be analyzed and reported with flags noted

FLAG	DESCRIPTION
A	HIGH WINDS
C	VOLCANIC ERUPTIONS
D	SANDBLASTING
E	FOREST FIRE
F	STRUCTURAL FIRE
H	CHEMICAL SPILLS & INDUST. ACCIDENTS
I	UNUSUAL TRAFFIC CONGESTION
J	CONSTRUCTION/DEMOLITION
K	AGRICULTURAL TILLING
L	HIGHWAY CONSTRUCTION
M	REROUTING OF TRAFFIC
N	SANDING/SALTING OF STREETS
O	INFREQUENT LARGE GATHERINGS
P	ROOFING OPERATIONS
Q	PRESCRIBED BURNING
R	CLEAN UP AFTER A MAJOR DISASTER
S	SEISMIC ACTIVITY
U	SAHARA DUST
W	FLOW RATE AVERAGE OUT OF SPEC.
X	FILTER TEMPERATURE DIFFERENCE OUT OF SPEC.
Y	ELAPSED SAMPLE TIME OUT OF SPEC.

No flags assigned to this sampling event.


Signature _____

Date _____

Figure EOD-3. PM_{2.5} STN Site Visit Form

COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT

Air Pollution Control Division - Technical Services Program
 PM_{2.5} STN Regular Maintenance/Sampler Verification Form



SITE/SAMPLER DATA Site Visit

Site Name: Commerce City STN Sampler Model: MetOne SASS Sampler S/N: A1158
 AIRS ID: 08-001-0008

	#1	#2	#3	#4	#5	#6	#7	#8	#9	#10
Operator										
Date										
Time										
Vis. Insp										
INSPECTION										
Inst. Mode										
Inst. Condition										
Chan1 Flow										
Chan2 Flow										
Chan3 Flow										
Temp. (T _a)										
Pres. (P _a)										
FTS S/N: IA177 FTS m = 0.2148 FTS b = 0.1481 Therm. S/N: 350042 Bar S/N: P/retel26754										

Four Week Instrument Verification										
Chan. #	Leak Rate OK?	Clock		Ambient Pres.		Amb. Temp.		FTS Pres	Channel Flow	
		Current	Standard	Current	Standard	Current	Standard		Inst.	Std.
1										
2										
3										

Visit #	Time	Describe Action Due/Action Taken	Time On	Initials

TIME PERIOD: 06.13.06 to 07.10.06

LIST OF SCHEDULED EVENTS/ SCHEDULED DATES:
Scheduled Events: # 1 7-wk verification, 1st Stage Inlet Cleaning

SCHEDULED DATE: 06.13.06

Comments:
