

PART FOUR

PM_{2.5} Chemical Speciation Monitoring

Chapter 7
Part Four – PM_{2.5} Chemical Speciation Monitoring
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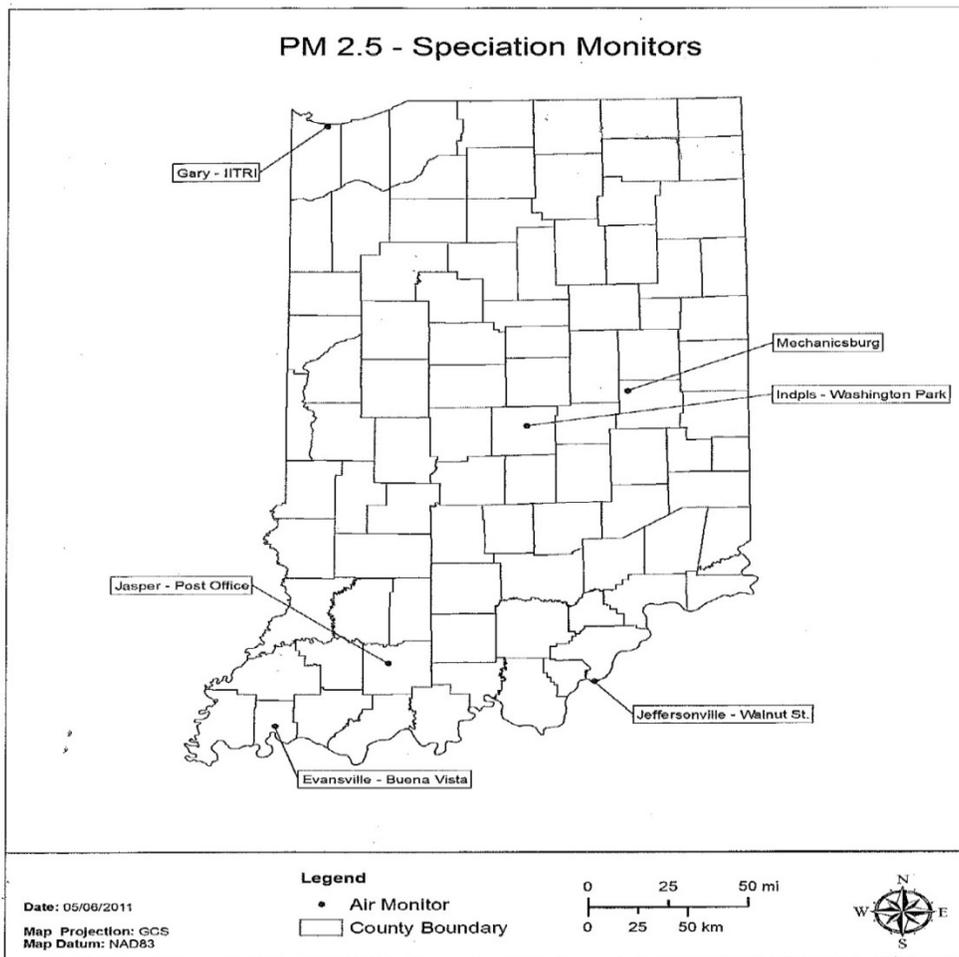
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PM_{2.5} Chemical Speciation Monitoring

1.0 Introduction

In accordance with Federal requirements outlined in 40 CFR Part 58, “Ambient Air Quality Surveillance for Particulate Matter”, Indiana is conducting chemical speciation monitoring at several locations statewide.

Figure 1
Speciation Monitors



Along with Toxics, Carbonyls, Ozone precursors and Meteorological data; PM_{2.5} chemical speciation is considered a *Non-Criteria* parameter.

However as part of the National Ambient Air Monitoring Stations (NAMS) network, chemical speciation sites help.

- Provide more specific data to define the correlation between particle concentration/composition and public health concerns
- Recognize national trends
- Identify source/receptor relationships and determine the effectiveness of emission control strategies
- Access air quality models and emission inventories
- Support future revisions to the NAAQS

The following sections of this part of Chapter 7 are intended to outline the monitoring, quality assurance (QA) and quality control (QC) practices associated with chemical speciation sampling. Since sample analysis is done contractually through the USEPA, laboratory practices and QA/QC procedures will not be addressed directly.

2.0 Network Description

Indiana's PM_{2.5} Chemical Speciation Monitoring Program falls into six categories of monitoring stations that measure criteria and non-criteria pollutants; National Core Multi-pollutant Monitoring Stations (NCore), State and Local Air Monitoring Stations (SLAMS), Special Purpose Monitoring (SPMS), Speciation Trends Network (STN), Photochemical Assessment Monitoring Stations (PAMS), and Supplemental Speciation Network (SSN).

- NCore sites have been established to provide data on several pollutants at lower detection limits than most other typical sites. The network consists of approximately 75 urban core sites located within major cities in the US
- SLAMS consists of a national network of approximately 3,500 monitoring sites whose size and distribution is largely determined by the needs of state and or local air pollution authorities
- SPMS are designed/intended for use by state and local agencies to collect supportive data for development of State Implementation Plans (SIPs) and/or other specific targeted studies such as: point source identification, control strategy effectiveness, etc. If data is used for SIP purposes, SPMS must meet all federal and state requirements for monitoring methodology and quality assurance
- STN consists of approximately 54 sites nationwide and are used to evaluate the long term *trends* of selected PM_{2.5} components. The network was developed to provide basic long-term data on the characterization of metals, ions, and the various carbon elements of PM_{2.5}
- PAMS were established to more effectively review and control the non-criteria pollutants that contribute to the formation of ozone (primarily VOCs and NO_x)

- SSN consists of approximately 200 additional sites for the multiple monitoring objectives mentioned in section 1.0 of this section; public health concerns, emission reduction strategies, assessment of air quality models, etc.

Collectively, the STN and supplemental speciation sites are referred to as the Chemical Speciation Network (CSN). A current listing of Indiana's CSN can be found at: <http://www.in.gov/idem/airquality/2389.htm>.

3.0 Monitoring Methodology

When analyzed, most PM_{2.5} can be expected to contain the following or a combination of the following components:

- Geological Material: airborne PM_{2.5} consists of approximately 5-15% of oxides of aluminum, silicon, calcium, titanium, iron, and other metal oxides. Proportions will vary regionally and are largely dependent on the geological and industrial makeup of the area
- Sulfate: the most common forms of sulfate found in mass PM_{2.5} samples are: ammonium sulfate, ammonium bisulfate and sulfuric acid.
- Nitrate: ammonium nitrate, ammonium bisulfate and ammonium nitrate
- Organic Carbon: particulate organic carbon consists of hundreds of separate compounds that contain more than 20 carbon atoms
- Elemental Carbon: most often called 'soot' contains pure, graphic carbon

Currently Indiana is using the Speciation Air Sampling System (SASS/SuperSASS) and the University Research Glassware (URG) 3000N for sample collection.

The SASS uses two separate filter media to collect the PM_{2.5} samples. Each medium is analyzed separately for different components:

- Teflon filter for gravimetric mass thirty three (33) trace metals, using Energy Dispersive X-ray Fluorescence
- Nylon filter for sulfates, nitrates, and three (3) cations (ammonium, potassium, and sodium), using Chromatography

The SASS uses a sharp cut cyclone (SCC) for particle separation. By design, cyclonic flow inlets use impellers to impart a circular motion to the air coming into the inlet. When the flow rate of the sampler is operating in range (6.7 liter per minute), the impellers and the centripetal force imparted to the particles in the air stream moves them toward the walls of a cylindrical tube. The particles reaching the wall of the tube either adhere to it (aided by an oil or greased coating) or they drop out of the air stream into a hopper at the bottom of the tube (grit cup). In order to maintain efficiency and prevent particle re-entrainment, the cyclone inlet must be cleaned at regular intervals, with the grit cap cleaned before each run.

Electronic systems in the sampler are designed to monitor and maintain the volumetric flow rate as well as record the elapsed sampling time, enabling the SASS to calculate the total sample volume in cubic meters (m^3). The support laboratory will report the sample data in micrograms per cubic meter ($\mu g/m$).

The SASS monitors and regulates the channel flow rates utilizing the component's microprocessor, software, mass flow controller, ambient temperature sensor and ambient barometric pressure sensor.

As in any monitoring program, it is recommended that site operators and support personnel, follow all Manufactures' recommended procedures for sampler set up and operation.

4.0 Siting Requirements

All PM_{2.5} Chemical Speciation Samplers must meet the siting requirements outlined in CFR 40, Part 58.

In general:

- Above all, sampling locations must be situated in secure areas minimizing the opportunity for vandalism and ensuring optimum operator safety. There must be adequate electricity and ease of accessibility in all weather conditions
Sites should be chosen where the collected PM_{2.5} mass will be representative of the monitored area. In circumstances where the above restrictions do not allow for breathing zone placement, micro scale samplers must be between two (2) and seven (7) meters above ground, and for middle or larger spatial scale locations the sampler inlet must be between two (2) and fifteen (15) meters above ground
- If located on a roof, there must be at least two (2) meters separation between walls, parapets, and penthouses with no furnace or incinerator flues nearby
- The distance the sampler inlet is from an obstacle (such as a building) should be at least two (2) times the height that the obstacle protrudes above the inlet
- There must be unrestricted airflow in an arc of at least 270° around the sampler and the predominant wind direction with the greatest expected PM_{2.5} concentration must be included in the 270° arc
- Samplers must be located at least twenty (20) meters from the drip line of the nearest trees
- Collocated samplers must be at least two (1) meter (2 meters if the flow is ≥ 200 Lpm) and not more than four (4) meters away from each other

5.0 Sample Collection – SASS

As mentioned earlier in this section, all laboratory activities involving SASS samples are done contractually through the USEPA.

SASS canisters preloaded with filters and denuders arrive via overland delivery to the main IDEM Air Monitoring Laboratory in Indianapolis and to regional offices throughout the state.

The sharp cut cyclones used on the individual canisters are the responsibility of the reporting organization.

Station operators and quality assurance personnel should have completed required safety training and thoroughly understand the Operations Manual.

5.1 Sampler Components

In general the components the SASS sampler include

- Color coded filter canister(s) *Canister #1 Green, Canister #2 Red*, equipped with:
 - sample inlet
 - denuder ring to remove nitric acid or other interfering gases
 - tandem 47mm FRM filter holders
 - 47mm filter media
- Color coded sampler air inlet with a Sharp Cut Cyclone (SCC) *#1 Green, #2 Red*
- Wind aspirated radiation shield
- Sampler control box
- Electrical system capable of meeting or exceeding design specifications
- Air pump
- Flow rate control system: capable of providing a constant design flow rate of 6.7 l/min to the sampler inlet at ambient conditions
- Flow rate measurement device capable of measuring the flow rate at the sampler inlet, within ± 2 percent, available for instantaneous display and updated every 30 seconds
- Ambient and filter temperature monitoring system
- Ambient barometric pressure monitoring system
- Timer: capable of measuring elapsed time to an accuracy within ± 2 minutes/1440 minutes
- Sampler head and tripod stand

5.2 Field Operations

5.2.1 Pre Sampling

During shipment from the support laboratory to the sampling locations, there are no requirements for temperature control. However, the sampling canisters should remain in their protective transport containers. Avoid exposure to excessive heat (avoid storing transport containers in direct sunlight or enclosed vehicles during the summer).

Upon receipt at the field office:

- The site operator should notate the date the sample arrives at the field office on the enclosed Custody and Field Data Form (CAFDF). See Form 1 at the end of Part 5
- Inspect the exterior of the shipment container notating any evident damage or contamination on the CAFDF

- Ensure that each identifying number printed on the CAFDF corresponds to an enclosed sample canister. Do not use any unidentified component and notify the support laboratory should there be discrepancies.
- Sign and date the custody portion of the CAFDF
- Keep all sample components together in an air conditioned secure area until transport to the sampling site
- Freeze the enclosed ice packs for use in transport back to the support laboratory. It is recommended that ice packs be frozen for at least three days at a temperature of -32 °C to ensure filters arrive at the support laboratory at or under 4 °C

Once the canisters are removed from their transport containers, extreme care should be taken to avoid potential contamination. They should remain capped until installation in the sampler and protected from exposure to dust, gases, or abrasion.

5.2.2 Sample Set Up

Along with the preloaded filter canisters, the operator should take the following along for sample set up:

- The PM_{2.5} STN CAFDF, provided by the support laboratory (See Form 1)
- Equipment for independent verification of routine sampler operation (date, time, temperature, pressure)
- Operations Manual
- Sharp cut cyclone (SCC) for each sampling canister(s) if they are not currently on site or if they are scheduled to be replaced
- Shipping coolers and frozen ice substitutes

5.2.3 Canister Installation

Following manufacturer's guidelines:

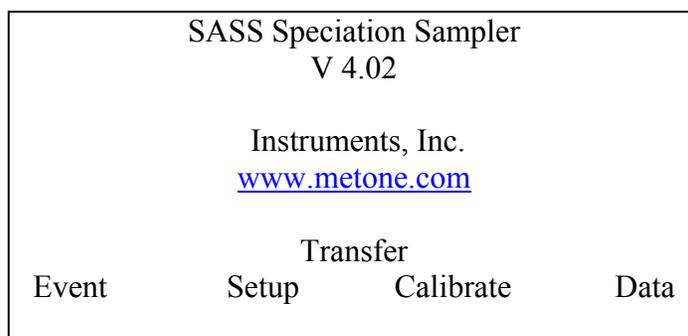
- Lower the radiation shield
- Insert the SCC into the bottom of the sample canister and rotate it until the plate on the cyclone locks into the lock screw on the canister. A small amount of silicone grease or similar lubricant on the O-rings will make the cyclone insertion easier. *From this point forward always keep the canister SCC side down to avoid contamination of the filter media*
- Remove the protective plug from the color coded canister and install it into the matching channel on the sampling head. Align the lock screws on the canister with the wider portion of the guides on the sample head. Push the canister upwards and rotate counterclockwise to secure the canister in place
- Once all of the canisters have been installed, raise the radiation shield and lock it in place

5.2.4 Configuration

Following manufacturer's guidelines:

- Open the control box and press any key to waken the screen
- Press the "SETUP" soft key

Figure 2
SASS Main Menu



- Press "F1" to activate the Event Manager

Figure 3
Event Manager

Event Manager	MM/DD/YY	HH:mm:ss:	
Start Date/Time	Length	Canisters	
MM/DD/YY	HH: mm:ss	HH: mm	{1,2,3}
MM/DD/YY	HH: mm:ss	HH: mm	{5,6,7}
Add	Modify	Delete	Exit

- Press "Add"
- Using the arrow keys, enter the desired sample date in the MM/DD/YY format
- Press "Add" to lock in the information
- Press "Exit" to return to the main menu

The SASS is now programmed and ready for the next sample run.

5.2.5 Sample/Data Retrieval - Manual

Chemical Speciation samples must be retrieved from the field within forty eight (48) hours after the completion of a run. Upon retrieval, through shipment to the support laboratory, the sample canisters must be refrigerated or stored in coolers with ice packs.

In addition to the sample canisters for the next run, the operator should take the following into the field:

- The PM_{2.5} STN CAFDF, provided by the support laboratory (See Form 1)
- Equipment for independent verification of routine sampler operation (date, time, temperature, pressure, flow)
- Operations Manual
- Shipping coolers and frozen ice substitutes

For consistency, it is recommended that data from the previous run be collected prior to canister pick-up/setup.

To complete the data retrieval, follow the steps described below:

- Open the sampler control box and press any key to waken the screen
- From the Main Menu (Figure 2), press “Event”

Figure 4
Operate Menu

Event Menu	
F1:	Current Event Status
F2:	Previous Event Summary
F3:	
F4:	Event Manager
F5:	
F6:	Historical Event Summary
	Exit

- Press “F1”

Figure 5
Status Menu

Status: Finished	MM/DD/YY	HH:mm:ss
06	Canister Set: (1,2,3)	
	Event Start: MM/DD/YY	HH:mm:ss
	Event Stop: MM/DD/YY	HH:mm:ss
	Event Length:	HH:mm:ss
	<<	>>
		Exit

- Record the run time information on the CAFDF
- Press “>>” to proceed to the Volume Summary Screen. This screen displays the volume data as well as the average values over the previous sampling event

Figure 6
Volume Summary Screen

Volume Summary			
MM/DD/YY	HH:mm:ss		
Ambient P	xxx mmHg	Ambient T	-xx.x C
Volume 1	x.xxx m3	Filter 1	- xx.s C
Volume 2	x.xxx m3		
Volume 3	x.xxx m3		
Volume 4	x.xxx m3		
Volume 5	x.xxx m3		
	<<	>>	Exit

- Record all required information on the CAFDF
- Press ">>" to proceed to the CV Summary Screen. This screen displays the CV values, Mean Values, and the Standard Deviation of the flow measurements taken during the previous sampling event

Figure 7
CV Summary Screen

CV Summary		MM/DD/YR	HH:mm:ss
	CV	Mean	Std Dev
Flow 1	%	Lpm	Lpm
Flow 2	%	Lpm	Lpm
Flow 3	%	Lpm	Lpm
Flow 4	%	Lpm	Lpm
Flow 5	%	Lpm	Lpm
	<<	>>	Exit

- Record all required information on the CAFDF
- Press “>>” to proceed to the Min/Max Summary Screen. This screen displays the various min/max values, for temperature and pressure that were recorded during the previous sampling event

Figure 8
Min/Max Summary Screen

Min/Max	MM/DD/YR	HH: mm:ss
Ambient	T Max	C
	Min	C
Filter 1	T Max	C
	Min	C
Ambient	P Max	mmHg
	Min	mmHg

- Record all required information on the CAFDF
- Press “>>” to proceed to the Flow Warnings Summary Screen. This screen indicates if there were any alarms or warnings during the previous sampling event related to flow measurement. A “Yes” value indicates an alarm occurred, the data and the time is stored on the screen.

Figure 9
Flow Warnings Summary Screen

Flow Warnings	MM/DD/YY	HH:mm:ss
	l/min	
Flow 1:	xx.x	MM/DD/YY HH:mm:ss
Flow 2:	xx.x	MM/DD/YY HH:mm:ss
Flow 3:	xx.x	MM/DD/YY HH:mm:ss
Flow 4:	xx.x	MM/DD/YY HH:mm:ss
Flow 5:	xx.x	MM/DD/YY HH:mm:ss
<<	>>	Exit

- Record any flow warnings on the CAFDF
- Press “>>” to proceed to the Power Interruptions Screen. This screen displays information on power interruptions that may have occurred during the previous sampling event

Figure 10
Power Interruptions Screen

Power Interruptions	MM/DD/YY	HH:mm:ss
1 MM/DD/Y HH:mm:ss	6 MM/DD?YY	HH: m:ss
2 MM/DD/Y HH:mm:ss	7 MM/DD?YY	HH: m:ss
3 MM/DD/Y HH:mm:ss	8 MM/DD?YY	HH: m:ss
4 MM/DD/Y HH:mm:ss	9 MM/DD?YY	HH: m:ss
5 MM/DD/Y HH:mm:ss	0 MM/DD?YY	HH: m:ss
<< >> Exit		

- Record any power interruptions on the CAFDF
- Press “Exit” to return to the Event Menu

5.2.6 Data Retrieval-Modular Download

Data is downloaded manually to the CAFDF after each sampling event and downloaded to a transfer module UX-961 once a month (usually at the same time as the routine verifications are performed.(Section 7.4). This download is done via the RS-232 port on the Control Box. Both manual and modular methods provide for immediate and archival storage of information.

- The RS-232 Connection is located under the control box. It is a four pin circular connector with a 9-pin RS-232 female connection on the other end
- A small transfer module UX 961 is used to collect the data form the SASS
- Once connected, select the “Transfer Data” button from the main control box screen. (See Figure 2). This will activate the transfer of data from the SASS to the module
- The module can be returned to station where the stored data can be transferred to a PC using SASS COM Software. This data is then available for report generation, review, etc.

5.2.7 Canister Retrieval

Once all the required information has been recorded on the CAFDF, or downloaded to the transfer module:

- Lower the radiation shield
- Disengage the spent sample canister(s) by rotating it clockwise until it is free from the lock screws on the sampler head
- Cap the sample port
- Keeping the canister SCC side down, carefully remove the SCC and cap the inlet port
- Place the canister upright into the specially cut Styrofoam support carrier in the shipping cooler supplied by the support laboratory
- Repeat this procedure until all canisters have been collected

5.2.8 SCC Cleaning

In order to prevent introduction of particulate matter from previous sampling onto filter media, the SCC(s) must be cleaned following each sample run. To do this in the field, simply:

- Remove the grit cup on the side of the SCC
- Invert the cup and dislodge any particulate by tapping it gently
- Swipe the grit cup with an alcohol wipe, cotton swab, or an air blast from a commercial compressed gas air duster product
- Replace the grit cup
- If any debris is observed on the inlet a more thorough cleaning may be required

The SCC is now ready for the next sample set up. See Section 5.2.2.

5.2.9 Logbooks

Logbooks are placed at each sampling site. All field logbooks are bound with numbered pages and are located in close proximity to the sampler. All actions affecting the operation of the sampler should be recorded such as:

- Sample Set-Up/Pick-up
- Monthly verifications (flow rate, temperature and pressure verifications, leak check)
- Quarterly quality assurance audits
- Routine maintenance (radiation shield cleaning, SCC replacement, motor change)
- Annual and non-routine calibrations

In addition to the site logbook, it is recommended that the IDEM standard operating procedure (SOP) and a copy of the SASS Field Operation Manual be kept on site.

5.3 Station Operation- Sample Shipment

Spent sampling canisters must be stored in a protective transport container and transported to the support laboratory/field office within 48 hours of the sample run. Situations that cause this time frame to be extended (Friday runs, Holidays, staff issues, extreme weather conditions, etc.), must be noted on the CAFDF.

The operator should retain the second page of the 3-page CAFDF and package the top copy in the shipping container. Package the canisters, ice packs and contact the shipping agent. Chain-of-custody seals on the shipping coolers or containers are not required.

6.0 Sample Collection – URG 3000N

In an effort to standardize the analyses of aerosol carbon concentration measurements for model evaluation and other data uses, the URG 3000N sampler has been phased into Indiana's PM_{2.5}

chemical speciation monitoring program. This type sampler is used for the collection of organic and elemental carbon (OC and EC) to more closely match the analytical method used by IMPROVE (Interagency Monitoring of Protected Visual Environments) thereby eliminating the use of the quartz filter channel in the SASS.

6.1 Sampler Components

In general the components of the URG 3000N sampler include:

- Module C sampling unit that collects samples
- Sample controller
- Pump and enclosure which also house the mass flow controller to provide active volumetric flow control. Optimum flow rate for this sampler is 22.0 l/min
- Stand
- Rain shield
- 36" inlet tube
- The particle separation system consisting of a screened inlet and cyclone capable of 50% efficiency in removing particles with an aerodynamic diameter $>2.5\mu\text{g}$
- Temperature and pressure sensors
- Compact flash memory card
- Applicable software

6.2 Field Operations

As with the SASS, filter cassettes for the URG are supplied to the station via overnight shipment from the support laboratory. CAFDF's will be included in the shipment container.

6.2.1 Pre Sampling

Filter cartridges used in the URG 3000N are supplied to the station via overnight shipment from the support laboratory. There are no requirements for temperature control. However, the sample cartridges should be protected from exposure to excessive heat/cold and protected from contamination or damage.

Upon receipt at the field office:

- The site operator should notate the date and time the sample arrives at the field location on the enclosed CAFDFs
- Inspect the exterior of the shipment container notating any evident damage or contamination on the CAFDF
- Ensure that each identifying number printed on the CAFDF corresponds to an enclosed sample cartridge. Do not use any unidentified component and notify the support laboratory should there be discrepancies
- Sign and date the custody portion of the CAFDF

- Keep all sample components together in an air conditioned secure area until transport to the sampling site
- Freeze the enclosed ice packs for use in transport back to the support laboratory. It is recommended that ice packs be frozen for at least three days at a temperature of -32 °C to ensure filters arrive at the support laboratory at or under 4 °C

Once the cartridges are removed from their transport containers, extreme care should be taken to avoid potential contamination. They should remain capped until installation in the sampler and protected from exposure to dust, gases, or abrasion.

6.2.2 Sample Set up/Filter Change

The Menu Mode on a URG sampler has a five screen Main Menu. This Main Menu can be accessed by pushing 'Enter'.

Authorized use only
Please enter code:

--

- Enter the four digit access code: 1123
- Select Operator when prompted

Choose Operator
Primary: 1 ABC
Backups: 2 – XXX #-YYY

F4 Edit

- The first Main Menu will allow for filter change operations

F1 = Filter Change
F2 = Set Date & Time
F3 = Alt. Sample Day
F4 = More Enter = Auto

- Press "F1"

Filter Change
YES to continue
NO to cancel

- Follow the directions as prompted to gather information for the previous sample run (flow, temperature, pressure, elapsed time)
- Next the operator will be prompted to replace the Compact Flash memory card

Replace controller's flash card

ENTER = Done

- Remove the old memory card and insert the new one
- The system will verify the placement of a new card and check for read errors

URG – 3000N
Sequential Particle
Speciation System

Checking Memory Card

Checking Memory Card
Card is OK

- Replace the exposed filter cartridge as prompted

New Filter Mod: [1]
Remove EXPOSED filter and
Insert NEW filter

Enter = Done

- Press the top red motor control button to raise the manifold
- Remove the exposed cassette cartridge
- Place the red cartridge caps on the filter modules to protect the filters from contamination
- Press "ENTER"
- Align the new cartridge and press the bottom red motor control button to lower the manifold

- Press “ENTER”
- You will be prompted to enter the filter ID #'s and Comp ID to store this data on the new memory card

Q Number (New)
Q_
ENTER = Done

Comp. ID Number (New)
I_
ENTER = Done

- Press “ENTER” to proceed. The sampler will read the temperature and pressure for the new filter and store this information on the Compact Flash memory card
- The Mass Flow Controller (MFC) will warm up for 5 minutes and the conduct a vacuum check
- If the vacuum check is satisfactory (>50 mmHg) press “ENTER” and the sampler will return to the AUTO MODE menu below:

11/18/08 06:26pm Wed
Next sample: 11/24/08
Sampler is OFF

- The filter change operation is now complete. Return all equipment and supplies including the spent filter cartridge and memory card to the station or field office

6.2.3 Logbooks

Logbooks are placed at each sampling site. All field logbooks are bound with numbered pages and are located in close proximity to the sampler. All actions affecting the operation of the sampler should be recorded such as:

- Sample Set-Up/Pick-up
- Monthly verifications (flow rate, temperature and pressure verifications, leak check)
- Quarterly quality assurance audits
- Routine maintenance (radiation shield cleaning, SCC replacement, motor change)
- Annual and non-routine calibrations

In addition to the site logbook, it is recommended that the IDEM standard operating procedure (SOP) and a copy of the URG 3000N Field Operation Manual be kept on site.

6.3 Station Operation - Sample Shipment

Spent sample cartridges must be stored in a protective transport container and transported to the support laboratory within 48 hours of run situations that cause this time frame to be extended (Friday runs, Holidays, staff issues, extreme weather conditions, etc.), must be noted on the CAFDF.

In the Chemical Speciation network, URG 3000N samplers are situated in locations that use the SASS. After packing the sampling modules (canisters) according to procedure, place the 9" x 12" sealable plastic shipping bag containing the URG filter cartridge, the completed CAFDF, and the memory card on top of the SASS canisters. The combined package can then be shipped to the support laboratory.

7.0 Quality Control

The procedures outlined below are part of the overall technical activities that measure the performance of the sample collection process. It has been mentioned previously that the analysis of collected PM_{2.5} speciation samples is done contractually by independent support laboratories, therefore the laboratory QA/QC activities will not be dealt with in this chapter.

In addition to the specific activities outlined below, the station operator or his or her supervisor must make every effort to keep the sampler(s) maintained, cleaned, and operated properly, to ensure the non-contaminated, timely shipment of scheduled samples.

7.1 Transfer Standards

Currently most transfer standards related to the QA/QC of PM_{2.5} chemical speciation samplers are certified in the IDEM Office of Air Quality's Quality Assurance Laboratory. It is the responsibility of the site operators and QA staff to ensure transfer standards being used are operating correctly and that their certification is current. The basic requirements for the certification/calibration of these transfer standards are explained below. Specific guidelines and procedures for certifications can be found in Chapter 6 of this manual.

7.1.1 Temperature Standards

Thermometers must be certified traceable to the OAQ/QAS Certification Facility's NIST-traceable thermometer or temperature probe. Mercury and organic fluid thermometers must be certified prior to use and annually thereafter. Electronic thermometers must be certified prior to use and annually thereafter.

7.1.2 Aneroid and Electronic Barometers

Aneroid and electronic barometers must be certified traceable to the OAQ/QAS certification facility's mercury barometer at station pressure annually. The transfer standard barometer must agree within $\pm 1.0\%$. Deviations greater than 1.0% require the barometer to be recalibrated (i.e. if primary standard barometric pressure reading = 740 mmHg then the limit is 740 ± 7.4 mmHg). Some models of barometers may be adjusted to the primary standard while other models may require a factory adjustment. Consult the instrument's manual for calibration procedures.

7.1.3 Flow Transfer Standard

Flow transfer standards (FTS), i.e. pressure drop-type, are required to be calibrated/recertified annually. Currently the FTS units used for SASS samplers are certified annually in the IDEM Quality Assurance lab along with an accompanying electronic manometer. The FTS units used for the URG 3000N samplers are recertified in the Quality Assurance Lab annually.

7.2 Routine Calibrations - SASS

7.2.1 Temperature Sensor Calibration

Temperature sensor calibrations are done on installation, annually, or any time verification fails. The following equipment is needed to perform a temperature sensor calibration on a SASS sampler:

- NIST traceable temperature standard.
- Precision Resistance Box

Photo 1
MetOne SASS Precision Control Box



Upon arrival:

- Open the Control Box and press any key to waken the screen
- From the Main Menu screen (Figure 2), press “Calibrate”. This will display the following Utility Menu Screen

**Figure 11
Calibration Menu Screen**

Calibrate Menu			
F:1	System Test		
F2:	Flow Calibration		
F3:	Temperature Calibration		
F4:	Pressure Calibration		
F5:			
F6:			
			Exit

- Press “F3” Temperature Calibration. This will display the Temperature Calibration Screen

**Figure 12
Temperature Calibration Menu Screen**

Temperature Calibration				
SASS	Pt	Save	Reference	
21.9	1	.0	-30.0	Save (F1)
	2	22.0	050.0 C	Save
(F2)				
Calibrate		Default		Exit

- Note the value under the SASS on the screen, this is the ambient temperature
- Remove the ambient temperature probe from the shield by removing the three hexagonal nuts that hold the ring in place. Remove the temp sensor from the cable
- Connect the Ambient Temp Cable to the top connector on the switched resistance box
- Disconnect the Sampling Head Cable from the Pump Box and connect the switched resistance box cable in its place
- Select the appropriate channel; 0 = Ambient, 1 = Filter 1, 2 = Filter 2, etc.
- Select -30°C on the switched resistance box. Allow the measurement to stabilize
- Press “F1” to to save the value
- Move to +50°C on the switched resistance box, Allow the measurement to stabilize

- Press “F4” to save the value
- Press the “CALIBRATE” button to store the results
- Move the temperature selector knob on the switched resistance box to +10°C
- If the displayed value is $>\pm 1^\circ\text{C}$ repeat the previous steps
- Repeat the steps for each temperature channel used
- Exit back to the MAIN MENU

7.2.2 Pressure Sensor Calibration

Pressure sensor calibrations are done on installation, annually, or any time verification fails. The following equipment is needed to perform a temperature sensor calibration on a SASS sampler:

- NIST-traceable pressure standard
- Syringe
- Tubing

Upon arrival:

- Open the Control Box and press any key to waken the screen
- From the Main Menu screen (Figure 2), press “Calibrate”. This will display the Calibrate Menu (Figure 12)
- Press “F4” Calibration Menu. This will display the Pressure Calibration Screen

Figure 13
Pressure Calibration Screen

Pressure Calibration				
SASS	Pt	Save	Reference	Save (F1)
730	1	0	000 mmHg	Save (F2)
	2	730	730	
Calibrate		Default		Exit

Compare the current SASS pressure measurement with a reference barometer. The pressure indicated for the SASS should be within ± 10 mmHg of the reference device. If not, it may be necessary to calibrate or replace the sensor in the SASS.

Pressure calibration procedure:

- To perform a calibration, two measurement points will be necessary (typically 600 and 800 mmHg). This can be accomplished by artificially changing the ambient pressure using a syringe and tubing

- Connect from the sampler's pressure test point to a tee. One side going to the reference device and one side going to the syringe
- Adjust the syringe in and out to change the simulated pressure measured by the reference barometer and transferred to the sampler's pressure sensor to 800 mmHg
- When the measurement is stable, enter the reference value in the top reference window of the Pressure Calibration screen (Figure 13)
- Press "F2" to save this value
- Next, adjust the simulated pressure to 800 mmHg as measured by the reference barometer
- When this measurement is stable, entered the reference value into the second reference window and Press "F4" to save this value
- Now press "Calibrate" and the new values will be stored into the memory control unit.
- This calibrates the pressure sensor in the pump box to the reference barometer
- Re-run the pressure check previously outlined to verify that the new measurement is within the ± 10 mmHg tolerance. If not, repeat the calibration procedure
- If the calibration fails a second verification, it may be necessary to install a new pressure sensor into the sampler
- Record all information on the applicable field sheet and logbook

7.2.3 Flow Rate Calibration

Flow rate calibrations are done on installation, annually, or if a verification fails. This applies to all channels individually. Prior to an annual calibration, temperature and pressure calibrations should be performed. Additionally, a flow audit should be completed prior to any calibration that may result in adjustments being made to any SASS system.

The following equipment will be needed to perform a flow rate calibration of the SASS sampler:

- NIST-traceable flow rate transfer standard (FTS, BIOS, Tri-Cal) and its certified electronic manometer
- Certified transfer standards for temperature and pressure
- A 'dummy' sample canister
- Flow rate adapter (#8959)
- Accurate time piece

Flow Rate Calibration Procedure

Upon arrival:

- Lower the radiation shield
- Remove and cap any active sample canisters in the SASS. Set aside
- From the Main Menu (Figure 2), press "Calibrate". This will display the following Utility Menu Screen

Figure 14
Calibration Menu Screen

Calibrate Menu	
F:1	System Test
F:2	Flow Calibration
F:3	Temperature Calibration
F:4	Pressure Calibration
F:5	
	Exit

- Press “F2” Flow Calibration. This action will display the Volumetric Flow Calibration screen

Figure 15
Volumetric Flow Calibration Screen

Volumetric Flow Calibration			
Chan	SASS	Ref	Type
(1)	0.	6.9 Lpm	10Lpm FS
Calibrate	Pump	Default	
Exit			

- Insert the ‘dummy’ canister and sampler’s SCC into sample Channel #1
- Attach the reference device to the inlet of the SCC
- Using the Up/Down key, select the channel number to be calibrated
- Press “Pump” to turn on the pump
- Allow time for flow rate stabilization
- Calculate the percent difference between the SASS flow rate displayed on the screen and the reference flow rate. If the difference is $> \pm 2.0$ adjustment is required to correct flow. Using the Up/Down key, enter the value of the reference flow and press “Calibrate”. This will enter in the correctly measured flow rate value for that channel
- Record all values and notate all actions in the site logbook
- Repeat the above for all active sampling channels
- Replace the active sample canisters and SCCs
- Raise and secure the radiation screen
- Press “Exit” twice to return to the Main Menu and verify the start date and time of the next sampling sequence

7.3 Routine Calibrations – URG 3000N

Temperature, pressure and flow rate calibrations are done on installation, annually, or any time a routine verification fails.

Prior to any calibration, the operator must confirm the reference standards used are certified as NIST-traceable and are in good working order. Consult manufacture procedure regarding the length of time an individual standard requires to stabilize to ambient conditions.

7.3.1 Temperature Calibration

From the Auto Mode:

- Press “ENTER” to move to the Authentication screen
- Enter “1123” to proceed to the Choose Operator screen
- Choose “1, 2, or 3” to reach the Main Menu screen
- Press “F4” to proceed to the second Main Menu screen below:

F1 = Calibration F2 = Maintenance F3 = Audit F4 = More ENTER = Auto

- Press “F1” for the next screen

F1 = Temp. Calibration F2 = BP Calibration F3 = Flow Calibration ENTER = back
--

- Locate the ambient temperature sensor located at the base of the inlet tee
- Slowly loosen and remove the sensor plug exposing the probe to ambient conditions
- Place the reference thermometer alongside the sampler sensor and allow them both to equilibrate
- Minimize any interference from wind, sunlight, or precipitation
- Press “F1” to proceed to the temp. calibration screen below

Raw Offset C F 1457 0 20.0 68.0 SPACE = Calibrate ENTER = Back
--

- Press SPACE”. The following screen will appear

```
Raw Offset  C  F
1457 0 20.0  68.0
F1: +/-    F2:C/F
Ref. Temp (C):?
```

- Enter the reference temperature value
- Press “YES” to save the calibrated temperature to the Compact Flash memory card
- After a brief pause the sampler will return to the Calibration Menu
- Replace and secure the sampler’s temperature sensor

7.3.2 Pressure Calibration

- At the Calibration Menu, Press “F2” to proceed to the barometric pressure calibration screen

```
Raw Offset  BP
2753 0  639.4
SPACE = Calibrate
ENTER = Back
```

- Press “SPACE” to begin the barometric calibration. The following screen will appear

```
Raw Offset  BP
2753 0  639.4

Ref. BP (mmHg):
```

- Enter the reference pressure using the keypad. The screen below will appear

```
Calibration  BP:
639.4 mmHg
Raw = 2753  Offset 0
YES = Save  NO = Cancel
```

- Press “YES” to save the calibrated pressure to the Compact Flash memory card
- After a brief pause the sampler will return to the Calibration Menu

7.3.3 Flow Rate Calibration

Part One - Leak Check

Prior to conducting a flow rate calibration, a successful leak check must be performed. See Section 8.2 for the leak check procedure. Once a leak check has been completed, proceed with the flow calibration.

- Remove the inlet cap and place the flow audit adapter on top of the down tube. Note: An audit cartridge must be in place in the sample filter manifold
- At the calibration Menu, Press “F3” then press “ENTER”. The screens below will appear

Calibration Mod:{1}

NO = Back ENTER = Next

- Press “ENTER”

WARNING
A leak check should always
precede a calibration

- Note: there will be a brief pause before the following screen appears

WARNING
Continue with calibration?
NO = Back YES = Continue

- A successful leak check (<225 mmHg in 35 seconds) should have been conducted prior to this point so the calibration can continue
- Press “YES”
- The screen below (1st calibration point will appear)

Cal pt: 1 Mod:[1]

Flow set point: 19.8
ENTER = Next

Press “ENTER”. The following screen will appear

```
Cal pt: 1 Mod:[1}  
Connect Reference  
Flow meter Now!  
NO = Cancel ENTER = Next
```

- Press “ENTER” to continue
- The mass flow controller (MFC) will run for 5 minutes at the rate of 19.8 l/min. At the end of this period the following screen will appear

```
Cal pt: 1 Mod:[1}  
gain = 6.000 Off = 0.00  
Raw = 2800 Flow = 19.77  
NO = Cancel ENTER = Next
```

- Press “ENTER” to continue. The operator will be prompted to enter the reference standard’s flow rate in l/min

```
Cal pt: 1 Mod:[1}  
Gain = 6.000 Off = 0.00  
Raw = 2800 Flow = 19.77  
Ref. Flow (l/min):
```

- Follow the prompts to continue with the remaining calibration points of 22.0 l/min and 24.2 l/min
- After entering the reference flow rate for Calibration Point 3, the screen below appears showing the new Gain, Offset, and Correlation

```
Calib Results Mod:1  
Gain = 5.980 Off = 0.25  
Correlation = 1.000  
Save? YES/NO
```

- Press “YES”, to save the calibration results to the Compact Flash memory card
- Press “ENTER” to return to the Calibration Menu screen
- Press “ENTER” twice

This concludes the verification of the calibration and returns the sampler to operational mode.

7.4 Monthly Field Verification Requirements

Once each month the site operator must complete the following on each sampler in his or her PM_{2.5} chemical speciation network:

- Flow rate verification
- Ambient temperature verification
- Sample temperature verification
- Sample channel Leak Checks
- Date and Time verification

All information should be recorded on the PM_{2.5} Speciation worksheet (Forms 3&4 located at the end of Part 5) and notated in the site logbook.

If any of the above verifications fall outside allowable limits corrective action must be completed. See Table 2 at the end of this section for verification limits.

7.4.1 Met One SASS

Part One: Leak Check

- Open the control box and press any key to waken the screen
- Press “Event”
- Press “F1” Current Event Status
- Record current status (note: monthly verifications and QA audits should NOT be conducted during a sampling sequence)
- Press “Exit” twice
- Lower the radiation shield
- Remove the sample canisters and SCCs from the SASS Channels 1, 2 (1-4 for SuperSASS)
- Cap the canister’s sample port and set aside, keeping the canister in an upright position
- Attach an audit canister and the Channel #1 SCC to the inlet of Channel #1
- Press “Calibrate”
- Press “System Test”
- Press “Pump” and “Continue”
- The screen should return to the System Test menu

Figure 16
System Test Screen

System Test	MM/DD/YY	HH:mm:ss
Amb P 724 mmHg	Amb T	24.4 C
Flow 1 .0 l/min	Filter T	24.5 C
Flow 2	.0 l/min	
Flow 3	.0 l/min	
Flow 4	.0 l/min	
Flow 5	.0 l/min	Pump: ON
	Pump	Exit

- Allow pump to run for 5 to 10 minutes
- Press “Leak”. The leak test module turns off the motor control to the flow controller valves
- Tightly seal the inlet of the SCC using a cap or a non-gloved thumb
- Allow for stabilization and record the leak flow rate for Channel #1 from the system test menu screen on the Field Verification Form (note: the flow rate for Channel #1 should drop to ≤ 0.0 l/min)
- Without making changes to the operating status of the SASS (i.e. it is not necessary to turn the pump or leak check mode off when switching channels) repeat the leak check on the remaining in service channels using the dummy canister and the respective channel’s SCC
- When the leak flow value for all channels has been recorded, press “Leak”. This will turn off the leak check mode

Part 2: Flow Rate Check

- With the dummy canister in place on the last channel, attach a certified FTS Flow device (high flow) and adapter to the SCC
- Connect the electronic manometer that has been certified with that FTS
- Allow for complete stabilization of the flow then record the manometer reading and Channel flow rate
- Without making changes to the operating status of the SASS (i.e., it is not necessary to turn the pump off when switching channels), repeat the flow audit on the remaining channels
- After all channels have been completed press “Pump” and “Continue” to turn off the SASS pump
- Remove and stow the dummy canister, manometer and flow transfer standard
- Calculate the flow rate using the following equation:

$$Q_{act} = m * \sqrt{\frac{\Delta P * T_{amb}}{P_{amb}}} + b$$

Where:

Q_{act}	=	l/min
T_{amb}	=	°K
ΔP	=	H ₂ O
P_{amb}	=	ambient barometric pressure in atmospheres
m	=	the slope of the certified FTS
b	=	the intercept of the certified FTS

Part 3: Temperature and Pressure Verification

- Prior to replacing the ambient sample canisters and SCC's, insert the certified temperature probe into the sampling positions. For the SuperSASS, a measurement should be taken at each active location. Allow for equilibration. Record the standard temperature and the filter temperature value displayed on the upper right hand corner of the system test screen
- After these values have been recorded, replace the sample canisters to their original positions. Double check their placement, by verifying the color codes on the sample canisters, the sample inlets and the SCC.
- Raise and secure the radiation shield
- Place the probe of the temperature standard into the grill of the SASS temperature sensor. Avoid direct contact with the sides of the grill or direct contact with sunlight. Record the standard temperature and the ambient temperature value displayed on the upper right hand corner of the system test screen
- Read and record the pressure transfer standard value and the SASS pressure value located on the upper left hand corner of the system test screen
- Verify the date and time displayed on the system test screen
- Press "Exit" twice to return to the main menu screen
- Calculate the difference in degrees between the certified temperature standard values and the filter and ambient sensor values from the SASS
- Calculate the difference in mmHg between the certified pressure standard and the pressure sensor value from the SASS
- See Table 2 for limitations. Any parameter falling outside the outlined limits must be addressed as soon as possible to avoid sample interruption or data invalidation. Refer to the SASS Operators Manual for a complete trouble shooting guide
- Verify the sampler date and time with a verified independent source
- Close the control box

Table 1
Monthly PM_{2.5} Verification Limitations

Parameter	Limit	Corrective Action
Leak Check	0.0 or 0.1 Lpm	Determine the source of the leak (path between pump and sampler head, SCC, canister assembly or connection). It may be necessary to replace any contributing components.
Ambient Temperature	$\leq \pm 2.0$ degrees C	Recalibrate or replace the temperature sensor. Consult section 7.2.1 or the SASS Field Operation Manual for specific calibration procedures.
Filter Temperature	$\leq \pm 2.0$ degrees C	Recalibrate or replace the temperature sensor. Consult section 7.2.1 or the SASS Field Operation Manual for specific calibration procedures.
Ambient Pressure	$\leq \pm 10$ mmHg	Recalibrate or replace the ambient pressure sensor. Consult section 7.2.2 or the SASS Field Operation Manual for specific calibration procedures.
Flow Rate	$\leq \pm 5\%$	Recalibrate or replace the flow rate sensor unit. Consult section 7.2.3 or the SASS Filed Operation Manual for specific calibration procedures. Data valid up to $\pm 10\%$.

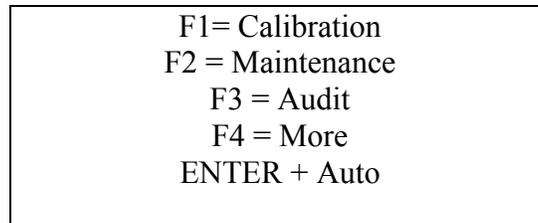
7.4.2 URG 3000N

Before beginning any of the processes outlined below, remove the sampler's filter cartridge and install an audit filter cartridge.

Part One: Leak Check

- Press "ENTER" to move to the Authentication screen
- Press "1123" to proceed to the Choose Operator screen
- Choose "1, 2, or 3" to reach the Main Menu screen
- Press "F4" to proceed to the Second Main Menu

Figure 17
Second Main Menu Screen



- Press “F3” for the Audit Menu screen
- From the Audit Menu, Press “F1” and then “ENTER” to begin the audit process
- Remove the inlet cap and install the flow audit adapter onto the down-tube, assuring it is in the open position
- Press “ENTER” when prompted
- Disconnect the vacuum line from the side of the housing and connect the open pump shut off valve
- Press “ENTER” when prompted
- Close the flow adapter and pump shut off valves as directed
- Press “ENTER” and the vacuum will begin to drop. When it reaches 380 mmHg a timer will measure the vacuum for 35 seconds
- After the 35 seconds, the results (PASSED or FAILED) will be displayed
- The acceptance criterion for the vacuum drop is 225 mmHg inside of 35 seconds. If the sampler fails the leak check, repeat the above procedure
- If the sampler fails to pass a second leak check attempt, consult Section 10 of the Operations Manual or contact URG@www.urgcorp.com
- Slowly open the shut off and flow adapter valves as directed
- Restore the sampler to normal operating conditions

Part 2: Monthly Temperature Verification

- From the Audit Menu, Press “F3”
- Locate the sampler’s ambient temperature probe
- Remove the plug, exposing the probe to ambient conditions
- Place the temperature transfer standard alongside the sampler probe
- Allow the temperatures to equilibrate
- When the results are stable, enter the reference temperature into the software as directed
- Save the verification results onto the memory card when requested
- The temperature should agree within ± 2 °C. If they do not, refer to the Operator Manual, conduct a non-routine temperature calibration, or contact URG for assistance
- After all information has been recorded, return the sampler to normal operating conditions

Part 3: Monthly Pressure Sensor Verification

- From the Audit Menu, Press “F4”
- Allow the pressure transfer standard to equilibrate
- Enter the reference pressure into the software as directed
- Save the verification results onto the memory card when requested
- The pressure should agree within ± 10 mmHg. If they do not, refer to the Operations Manual, conduct a non-routine pressure sensor calibration, or contact URG for assistance
- After all information has been recorded, return the sampler to normal operating conditions

Part 4: Monthly Flow Rate Verification

Note: prior to conducting the monthly flow rate verification, a leak check must be performed.

- Install the audit cartridge
- Remove the inlet cap and place the flow rate adapter and its certified flow transfer standard onto the down tube
- From the Audit Menu, Press “F2” and “Yes”
- The mass flow controller initiates and runs for 5 minutes @ the design flow rate of 22.0 Lpm.
- Press “ENTER” and use the keypad to enter the reference flow rate. This must be within $\pm 10\%$ for valid data. If $> 5\%$ notify the parameter specialist.
- Save the flow rate verification results to the memory card when prompted
- Disconnect the transfer standard and replace the sampler inlet
- Return the sampler to normal operating conditions.

7.5 Blanks

Sample blanks determine contamination from five basic sources:

- The sampling environment
- The analysis environment
- The reagents used in the analysis
- The apparatus used
- The operator/analysts handling the samples

7.5.1 Sample Blanks

Field blank filters, loaded into the sample canister, will be shipped from the support laboratory. They will have a separate STN Custody and CAFDF with them. They are used during the same sample time interval as the routine sampling canisters.

Visit the site at the regularly scheduled sample set up time. Install the field blank canister and SCC in the channel locations indicated by the CAFDF.

After a minute or two, remove the field blank canister from the sampler. Detach the SCC, replace the cap and return the sample blank to the shipping cooler and proceed with normal sample installation. Complete the CAFDF for the filed blanks and ship them back to the support laboratory at the same time as the routine samples.

8.0 Quality Assurance

The significant difference between Quality Control (QC) and Quality Assurance (QA) as discussed here is the introduction of independent personnel and equipment. Most often, monthly QC procedures are performed by the site operator using certified transfer standards for verification of: flow rate, temperature and pressure. Quarterly QA audits are done by staff other than the site operator, using different transfer standards to measure those same criteria (flow, temperature and pressure). Once each quarter an independent audit must be conducted on each Met One SASS/SuperSASS and URG 3000N in operation.

8.1 Quarterly Audit Procedures – Met One SASS

Part One: Leak Check

- Open the control box and press any key to awaken the screen
- Press “Event”
- Press “F1” Current Event Status
- Record current status (note: monthly verifications and QA audits should NOT be conducted during a sampling sequence)
- Press “Exit” twice
- Lower the radiation shield
- Remove the sample canisters and SCCs from the SASS/SuperSASS
- Cap the canister’s sample port and set aside, keeping the canister in an upright position
- Attach a quality assurance audit canister containing a Teflon filter and denuder ring and the Channel #1 SCC to the inlet of Channel #1
- Press “Calibrate”
- Press “System Test”
- Press “Pump” and “Continue”
- The screen should return to the System Test Menu (see Figure 16)
- Allow pump to run for 5 to 10 minutes
- Press “Leak”. The leak test module turns off the motor control to the flow controller valves
- Tightly seal the inlet of the SCC using a cap or a non-gloved thumb
- Allow for stabilization and record the leak flow rate for Channel #1 from the system test menu screen on the Field Verification Form (note: the flow rate for Channel #1 should drop to 0.0 l/min)
- Without making changes to the operating status of the SASS/SuperSASS (i.e. it is not necessary to turn the pump or leak check mode off when switching channels) repeat the leak check on the Channel #2 using an audit canister containing a Nylon filter and denuder ring and the SSC from Channel #2

- Repeat the previous steps for all active sampling channels
- When the leak flow value for all channels has been recorded, Press “Leak”. This will turn off the leak check mode

Part 2: Sample Flow Rate Audit

- With a quality assurance canister in place, attach a certified flow transfer standard (FTS) and adapter to the SCC on Channel #1
- Connect a water or electronic manometer to the FTS
- Allow for stabilization of the flow, then record the manometer reading and channel flow rate.
- Without making changes to the operating status of the SASS/SuperSASS repeat the flow audit on all active sampling channels using the corresponding quality assurance canister
- After all channels have been completed, Press “pump” and “continue” to turn off the SASS pump
- Remove and stow the audit canisters, adapter, manometer and FTS

Part 3: Temperature and Ambient Pressure Sensor Audits

- Prior to replacing the ambient sample canisters and SCCs, insert the certified temperature probe into the inlet of Channel #1. This is the location of the SASS sampler’s temperature sensor. Allow for stabilization. Record the standard temperature and the filter temperature value displayed on the upper right hand corner of the system test screen
- If auditing a SuperSASS, filter temperatures from all active sampling channels must be taken
- After these values have been recorded, replace the sample canisters to their original positions. Double check their placement by verifying the color codes on the sample canisters to the sample inlets and SCCs
- Raise and secure the radiation shield
- Place the probe of the temperature standard into the grill of the SASS/SuperSASS temperature sensor. Avoid direct contact with the sides of the grill or direct contact with sunlight. Allow for stabilization. When the temperature values are stable, record the temperature standard and the ambient temperature value from the SASS/SuperSASS displayed on the upper right hand corner of the system test screen
- Read and record the pressure standard value and the value on the SASS/SuperSASS, again, located in the upper right corner of the system test screen
- Verify the date and time displayed on the system test screen
- Press “EXIT” twice to return to the main menu screen
- Close the control box
- Calculate the flow rate % difference using the following equation:

$$Q_{act} = m * \sqrt{\frac{\Delta P * T_{amb}}{P_{amb}}} + b$$

Where:

Q_{act}	=	l/min
T_{amb}	=	°K
ΔP	=	H ₂ O
P_{amb}	=	ambient barometric pressure in atmospheres
m	=	the slope of the certified FTS
b	=	the intercept of the certified FTS

- Calculate the difference in degrees between the certified temperature standard and the filter and ambient temperatures from the SASS/SuperSASS
- Calculate the difference in mmHg between the certified pressure sensor and the pressure sensor value from the SASS/SuperSASS
- See Table 2 for limitations. Any parameter falling outside the outlined limits must be brought to the attention of the site operator or his or her supervisor for corrective action to be initiated
- Confirm the date and time with a verified independent source

8.2 Quarterly Audit Procedure – URG 3000N

Part One: Leak Check

- Press “ENTER” to move to the Authentication screen
- Press “1123” to proceed to the Choose Operation screen
- Choose “1, 2, or 3” to reach the Main Menu screen
- Press “F4” to proceed to the second Main Menu screen
- Press “F3” for the Audit Menu screen
- From the Audit Menu, Press “F1” then “ENTER” to begin the audit process
- Remove the inlet cap and install the flow audit adapter and leak check device onto the down tube, ensure the leak check device in the open position
- Press “ENTER” when prompted
- Disconnect the vacuum line from the side of the housing and connect the open pump shut off valve
- Press “Enter” when prompted
- Close the leak check device and the pump shut off valve when directed
- Press “ENTER” and the vacuum will drop. When it reaches 380 mmHg a time will measure the vacuum for 35 seconds
- After 35 seconds the results (PASSED or FAILED) will be displayed
- The acceptance criterion for vacuum drop is 225 mmHg inside of 35 seconds. If the sampler fails the leak check, repeat the above procedure
- If the sampler fails to pass a second leak check attempt, consult the [parameter](#) specialist
- Store the test results as directed and return the sample to normal operating conditions

Part 2: Temperature Audit

- From the Audit Menu Press “F3”
- Locate the sampler’s ambient temperature probe
- Remove the probe plug, exposing the sensor to ambient conditions
- Place the temperature transfer standard sensor alongside the sampler sensor
- Allow the temperatures to equilibrate
- When the results are stable, enter the reference temperature into the software as directed
- Save the audit results to the memory card when prompted
- The temperature should agree within ± 2 °C. If they do not, inform the parameter specialist
- After all information has been recorded, return the sampler to normal operating conditions

Part 3: Pressure Sensor Audit

- From the Audit Menu, Press “F4”
- Allow the pressure transfer standard to equilibrate
- Enter the reference pressure into the software as directed
- Save the audit result to the memory card when requested
- Record all information on the applicable field sheet
- The pressures should agree within ± 10 mmHg. If they do not, inform the parameter specialist
- After all information has been recorded, return the sampler to normal operating conditions.

Part 4: Flow Rate Audit

Note: prior to conducting a quarterly flow rate audit, a leak check must be performed.

- Install the audit cartridge
- Remove the inlet cap and place the flow rate adapter and a certified flow transfer standard (FTS) onto the down tube
- From the Audit Menu Press “F2”
- The mass flow controller initiates and runs for 5 minutes @ the design flow rate of 22.0 l/min
- Press “ENTER” and use the keypad to enter the reference flow rate
- Save the audit results to the memory card when prompted
- The reference and sampler flow rates must agree within $\pm 10\%$ for valid data. If they do not, inform the parameter specialist
- Record all information on the applicable field sheet
- After all information has been recorded, return the sampler to its normal operation conditions

9.0 Routine Maintenance

9.1 Met One SASS

The Met One SASS requires very little maintenance other than the regular checks and calibration activities. Most maintenance involves inspection of various components for damage or wear.

For example:

- The sampler pump should have the valves and diaphragms replaced annually
- The O-rings should be checked on a regular basis for signs of deterioration and replaced as necessary. Failure to identify O-ring deterioration may result in leak check or audit flow rate failures
- The solar radiation shield should be inspected after each sample run and cleaned as necessary with a damp cloth or a dilute soap and water solution. Accumulation of dirt can reduce the effectiveness of the reflective surface and cause the temperature to rise inside the shield
- The denuders should be replaced by the support laboratory approximately every three months
- The SCC's should be cleaned after each sample run

9.2 URG 3000N

As with the Met One SASS, the URG 3000N requires little in the matter of routine maintenance, however:

- The O-rings should be checked on a regular basis for signs of deterioration, lubricated with a light coat of vacuum grease if required, and or replaced as necessary
- Clean the interior of the Sample and Control modules monthly to remove bugs, dirt and water deposits
- Clean the sampler inlet surfaces
- Check all Tygon tubing and vacuum lines and replace as necessary
- Inspect electrical connections

10.0 Data Acquisition Requirements

This section addresses non-monitoring data that is associated with the PM_{2.5} Chemical Speciation Monitoring Program. This includes both outside data and historical monitoring data. IDEM uses non-monitoring data and historical monitoring data in a variety of ways. Use of information that fails to meet the necessary Data Quality Objectives (DQOs) for the PM_{2.5} Chemical Speciation Monitoring Program can lead to erroneous trend reports and regulatory decision errors. The policies and procedures described in this section apply both to data acquired from the Indiana Department of Environmental Management's monitoring program and to information previously acquired and/or acquired from an outside source (such as the support laboratory).

10.1 Non Direct Measurement Data

The PM_{2.5} Chemical Speciation Monitoring Program relies on data that is generated through field and laboratory operations; however, other significant data is obtained from sources outside the IDEM or from historical records.

Chemical and Physical Properties Data

Physical and chemical properties data and conversion constants are often required in the processing of raw data into reporting units. This type of information that has not already been specified in the monitoring regulations is obtained from nationally and internationally recognized sources. Other data sources may be used with the approval of the Air Monitoring QA Section Chief.

The following sources may be used:

- National Institute of Standards and Technology (NIST)
- ISO, IUPAC, ANSI, and other widely recognized national and international standards organizations
- U. S. Environmental Protection Agency (USEPA)
- The current edition of certain standard handbooks may be used without prior approval of the QA Section Chief. Two that are relevant to fine particulate monitoring are CRC Press Handbook of Chemistry and Physics and Lange's Handbook Sampler Operation and Manufacturer's Literature

Another important source of information needed for sampler operation is the manufacturer's literature. Operations and User manuals frequently provide numerical information and equations pertaining to specific equipment. Whenever possible, the field operators should compare physical and chemical constants in the Operations Manual to those given in the sources listed above. If discrepancies are found, Met One Instruments Inc. is contacted. If a change is indicated, IDEM contacts the USEPA.

Geographic Location

Another type of data that will commonly be used in conjunction with the PM_{2.5} Ambient Air Quality Monitoring Program is geographic information. For the current sites, IDEM uses a global positioning system (GPS) that meets the USEPA Located Data Policy of 25 meters accuracy. USGS maps were used as the primary means for locating and siting stations in the existing network.

Historical Monitoring Information of the IDEM

Ambient monitoring stations have been operated by an Indiana state agency since early 1970. Since 1986, the Indiana Department of Environmental Management has operated the stations.

Prior to 1986, monitoring was conducted by the Indiana State Board of Health, Air Pollution Control division. Historical monitoring data and summary information derived from this past data may be used in conjunction with current monitoring results to calculate and report trends in pollutant concentrations.

If calculating historical trends IDEM first verifies that historical data are fully comparable to current monitoring data. If different methodologies were used to gather the historical data, the biases and other inaccuracies are described in trends reports based on that data. Direct comparisons of speciated PM_{2.5} with historical TSP or PM₁₀ data will not be reported or used to estimate trends.

External Monitoring Databases

It is the policy of the IDEM that no data obtained from the Internet or databases from outside organizations shall be used in creating reportable data or published reports without the approval of the Air Monitoring Branch Chief. This policy is intended to ensure the use of high quality data in all IDEM Air Monitoring Publications.

Data from the USEPA AQS database may be used in published reports. Care is taken in reviewing/using any data that contains flags or data qualifiers. If data is flagged, such data will not be used unless it is clear that the data still meets critical QA/QC requirements.

U.S. Weather Service Data

Meteorological information is gathered from instruments operated by the IDEM Ambient Monitoring Section, the U.S. Weather Service, the National Park Service and various agencies within the state. Parameters include:

- Temperature
- Relative humidity
- Barometric pressure
- Rainfall
- Wind speed
- Wind direction

No changes to the way in which these data are collected are anticipated due to the addition of PM_{2.5} Chemical Speciation to the IDEM ambient air monitoring program.

Form 1
Custody and Field Data Form (CAFDF)

 Q163226U	PM 2.5 STN CUSTODY AND FIELD DATA FORM	c. White (return to lab) c. Yellow (site retained) c. Pink (lab)						
A. CUSTODY RECORD (Name, Date)		Bin ID: B2810H Set: 5y						
1. Laboratory, Out <u>Dubrye 9/10/08</u>		3. Site, Out _____						
2. Site, In <u>9/12/08</u>		4. Lab, In _____						
B. SITE AND SAMPLER INFORMATION								
1. Site AIRS Code <u>180890022</u>		5. Site Name <u>Gary litri</u>						
2. Sampler S/N <u>A4183</u>		6. Intended date of us <u>Sunday, September 21, 2008</u>						
3. Sampler Type <u>SASS</u>		7. Date of Sampler set-up <u>9/16/08</u>						
4. Sampler PO <u>5</u>		8. Operator's name <u>Scott Keller</u>						
C. SAMPLER CHANNEL COMPONENT								
Channel No.	Component ID No.	Component Description						
1	Kept at Site	SASS cyclone						
1	I7326S	SASS cassette (Teflon filter) (GREEN)						
2	Kept at Site	SASS cyclone						
2	I7326T	SASS cassette (MgO denuder, nylon filter) (RED)						
D. START, END, AND RETRIEVAL TIMES								
Channel No.	Start date	Start time	End date	End time	Retrieval date	Retrieval time		
1	9/21/08	00:00	9/22/08	00:00	9/22/08	9:15		
2	/	/	/	/	/	/		
E. SAMPLER CHANNEL INFORMATION (Post-Sampling)								
Channel No.	Run Time	Run Time, Flag	Sample Volume (m3)	Avg. flow (L/min)	Avg. flow CV (%)	Avg. ambient T (°C)	Max. ambient T (°C)	Min. ambient T (°C)
1	24:00		9.713	6.74	.7	19.5	26.9	13.9
2	/		9.719	6.75	.6	/	/	/
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		19.2	26.0	14.1	748	750	747	
2		/	/	/	/	/	/	
F. Comments _____ _____ _____								

Form 2
Custody and Field Data Form (CAFDF) URG

 Q163225T	PM 2.5 STN CUSTODY AND FIELD DATA FORM	e. White (return to lab) c. Yellow (site retains) c. Pink (lab)						
A. CUSTODY RECORD (Name, Date)		Bin ID: B2B10H Set: 5y						
1. Laboratory, Out <u>Atkins 9/16/08</u>	3. Site, Out _____							
2. Site, in _____	4. Lab, in _____							
B. SITE AND SAMPLER INFORMATION								
1. Site AIRS Code <u>180890022</u>	5. Site Name <u>Gary Itri</u>							
2. Sampler S/N <u>3N-B0223</u>	6. Intended date of us <u>Sunday, September 21, 2008</u>							
3. Sampler Type <u>URG 3000N</u>	7. Date of Sampler set-up <u>9/16/08</u>							
4. Sampler PO <u>5</u>	8. Operator's name <u>Scott Keller</u>							
C. SAMPLER CHANNEL COMPONENT								
Position	Component ID No.	Component Description						
1	I8647B	Quartz Cartridge ID						
1	I8648C	Memory Card ID						
D. START, END, AND RETRIEVAL TIMES								
Position	Start date	Start time	End date	End time	Retrieval date	Retrieval time		
1	9/21/08	00:00	9/21/08	00:00	9/21/08	9:20		
E. SAMPLER CHANNEL INFORMATION (Post-Sampling)								
Position	Run Time	Run Time, Flag	Sample Volume (m3)	Avg. flow (L/min)	Avg. flow CV (%)	Avg. ambient (°C)	Max. ambient (°C)	Min. ambient (°C)
1	1447		31.70	22.0	0.1	20.7	28.0	15.7
Position	Δ T Flag	Avg. BP (mm Hg)	Max. BP (mm Hg)	Min. BP (mm Hg)				
1		752.7	755.0	757.7				
F. Comments								

Form 3
PM_{2.5} Speciation Monthly Check Sheet – Met One SASS

Operator Initials: _____

General Site Information

Start Time:		Site ID/County:	
End Time:		AQS#:	
Status-Arrival:		Sampler SN:	
Status-Left:		Sampler Cal Date:	

Transfer Standard Information

Temp. Probe ID:		Cert Date:	
Pressure Sensor ID:		Cert Date:	
Flow Standard ID:		Cert Date:	
FTS Slope (m):		FTS Intercept (b):	

Ambient Temperature (°C)

Filter Temperature (°C)

Sampler Display:		Sampler Display:	
Reference Temp:		Reference Temp:	
Difference:		Difference:	

Flow/Leak Check

Ch.	Leak Check Pass/Fail	ΔP (in H ₂ O)	Temperature (Kelvin)	Reference Flow (l/min)	% Diff
1					
2					

Time/ Date

Display Time:		Stand. Time:		Adjustment made?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Display Date:		Actual Date:		Adjustment made?	<input type="checkbox"/> YES <input type="checkbox"/> NO

Conditions

Sampler set up for next run?	<input type="checkbox"/> YES <input type="checkbox"/> NO	Temperature Shield cleaned?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Sample tube connected to pump?	<input type="checkbox"/> YES <input type="checkbox"/> NO	Solar Shield cleaned and closed?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Temperature probe installed?	<input type="checkbox"/> YES <input type="checkbox"/> NO	Control and pump box cleaned?	<input type="checkbox"/> YES <input type="checkbox"/> NO
Temperature probe secure?	<input type="checkbox"/> YES <input type="checkbox"/> NO	Data Downloaded?	<input type="checkbox"/> YES <input type="checkbox"/> NO

Additional Comments:

Form 4
PM_{2.5} Speciation Monthly Check Sheet – URG

Operator Initials: _____

General Site Information

Start Time:		Site ID/County:	
End Time:		AQS #:	
Status-Arrival:		Sampler SN:	
Status-Left:		Sampler Cal Date:	

Transfer Standard Information

Temp. Probe ID:		Cert Date:	
Pressure Sensor ID:		Cert Date:	
Flow Standard ID:		Cert Date:	
FTS Slope (m):		FTS Intercept (b):	

Ambient Temp (°C)

Ambient Pressure (mmHg)

Sampler Display:		Sampler Display:	
Reference Temp:		Reference Press:	
Difference :		Difference:	

Leak Check/Flow Check

Diff Value	Pass/Fail	ΔP (in H ₂ O)	Temp (Kelvin)	Reference Flow (l/min)	% Diff	Gain- Offset
						/

Time/ Date

Display Time:		Stand. Time		Adjustment made?	__ YES __ NO
Display Date:		Actual Date:		Adjustment made?	__ YES __ NO

Conditions

Sampler set up for next run?	__ YES __ NO	Rain Shield cleaned?	__ YES __ NO
Temperature probe installed?	__ YES __ NO	Control and pump box cleaned?	__ YES __ NO
Temperature probe secure?	__ YES __ NO	Log book updated?	__ YES __ NO
Filter in place?	__ YES __ NO	Data Downloaded?	__ YES __ NO

Additional Comments:

Form 5
PM_{2.5} Speciation Audit Sheet – Met One SASS

Operator Initials: _____

General Site Information

Start Time:		Site ID/Count:	
End Time:		AQS #:	
Status-Arrival:		Sampler SN:	
Status-Left:		Sampler Cal Date:	

Transfer Standard Information

Temp. Probe ID:		Cert Date:	
Pressure Sensor ID:		Cert Date:	
Flow Standard ID:		Cert Date:	
FTS Slope (m):		FTS Intercept (b):	

As Found Results

Ambient Temperature (°C):	
Filter Temperature (°C):	
Ambient Pressure (mmHg):	

Did both Channels pass leak check? _____

Flow Check

Channel	ΔP (in H ₂ O)	Temp (Kelvin)	Reference Flow (l/min)	% Diff
1				
2				

Was the time and date on the sampler within specs. _____

Were any adjustments made? _____

Were cleaning operations performed? If so, what?

Was data downloaded? _____

Additional Comments:

Form 6
PM_{2.5} Speciation Audit Sheet – URG

Operator Initials: _____

General Site Information

Start Time:		Site ID/County:	
End Time:		AQS #:	
Status-Arrival:		Sampler SN:	
Status-Left:		Sampler Cal Date:	

Transfer Standard Information

Temp. Probe ID:		Cert Date:	
Pressure Sensor ID:		Cert Date:	
Flow Standard ID:		Cert Date:	
FTS Slope (m):		FTS Intercept (b):	

As Found Results

Ambient Temperature (°C):	
Ambient Pressure (mmHg):	

Leak Check Value? _____
(225 limit)

Flow Check

ΔP (in H ₂ O)	Temp (Kelvin)	Reference Flow (l/min)	% Diff	Gain/Offset
				/

Was the time and date on the sampler within specs? _____

Were any adjustments made? _____

Were cleaning operations performed? If so, what?

Additional Comments:
