PART FOUR

$PM_{2.5}$ Chemical Speciation Monitoring

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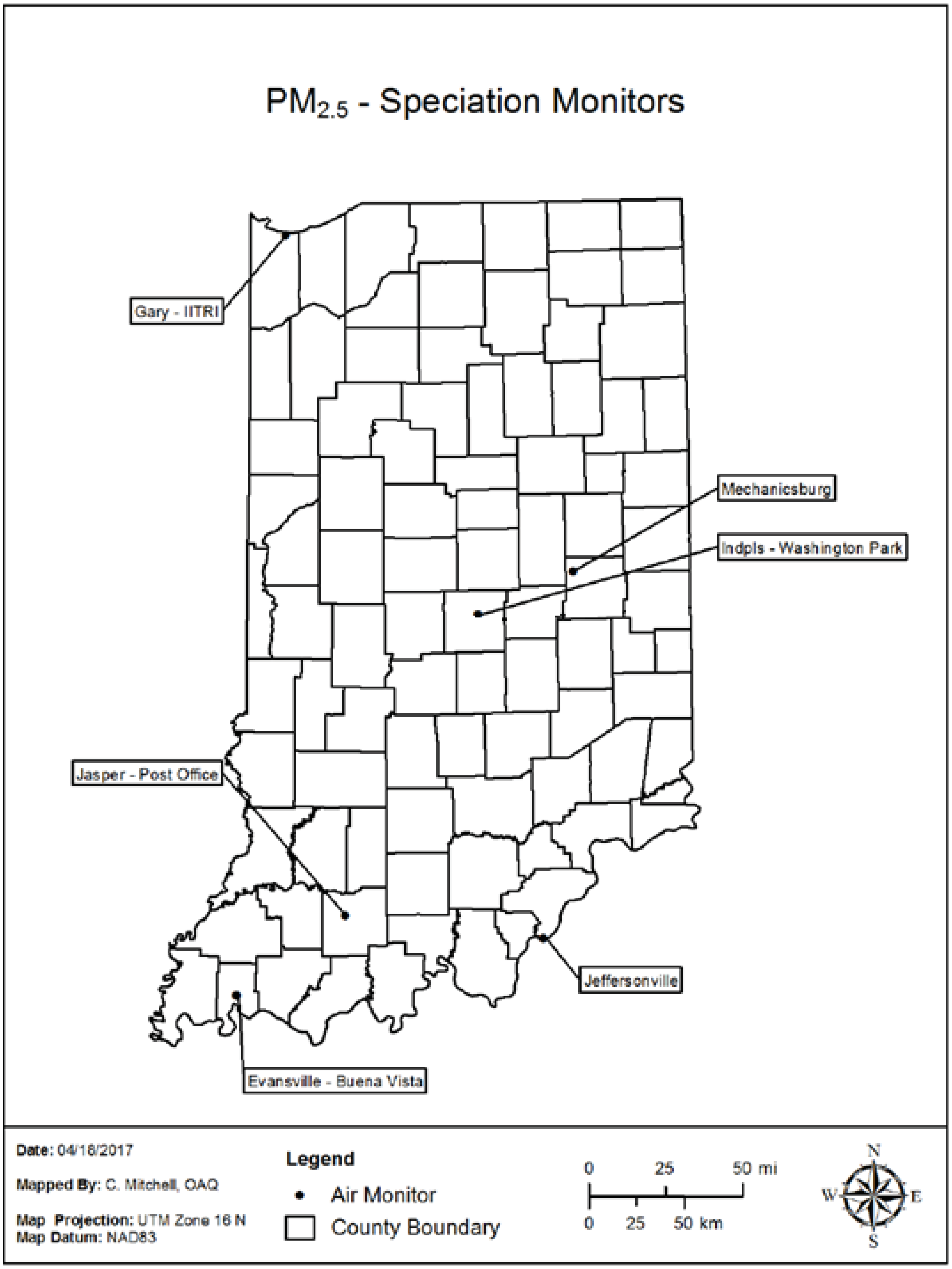
Part Four – $PM_{2.5}$ Chemical Speciation Monitoring

1.0 Introduction

USEPA implemented the $PM_{2.5}$ chemical speciation monitoring program. Knowing the chemical composition of the $PM_{2.5}$ mix is important for determining sources of pollution and links between observed health effects. The basic objective of speciation analysis is to develop seasonal and annual chemical characterizations of ambient particulates across the nation. This speciation data will be used to perform source attribution analyses, evaluate emission inventories and air quality models, and support health related research studies and regional haze assessments.

Monitoring requirements in 40 CFR Part 58 Appendix D §4.7.4 states that "each state shall continue to conduct chemical speciation monitoring and analyses at sites designated to be part of the Speciation Trends Network (STN) $PM_{2.5}$." The STN $PM_{2.5}$ is part of the Chemical Speciation Network (CSN).

Figure 1
Speciation Monitoring Network



Along with toxics, carbonyls, ozone precursors and meteorological data; $PM_{2.5}$ chemical speciation is considered a non-criteria parameter. 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 National Ambient Air Quality Standards (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 five categories of monitoring stations that measure criteria and non-criteria pollutants, 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).

- SLAMS consists of a national network of 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 52 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 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 CSN. A current listing of Indiana's CSN can be found in the annual Ambient Monitoring Plan.

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), Super SASS, 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 total mass and 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-entrapment, the cyclone grit cap must be cleaned prior to each sample 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 (µg/m).

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

Currently, as part of a nationwide conversion aimed at more closely matching the Interagency Monitoring of Protected Visual Environments (IMPROVE) analytical method for carbon, six sites in Indiana are using the URG 3000N for carbon sampling.

As in any monitoring program, it is recommended that site operators and support personnel, follow all manufacturers' 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 summary:

- 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 monitors must be within four (4) meters of each other and at least two (2) meters apart for flow rates greater than 200 liters/minute or at least one (1) meter apart for samplers having flow rates less than 200 liters/ minute to preclude airflow interference. Vertical difference for the inlet height must be within one (1) meter of each other.

5.0 Sample Collection – SASS

As mentioned earlier in this section, all laboratory activities involving SASS samples are completed 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 thoroughly understand the Operations Manual.

5.1 Sampler Components

The components of 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 (federal reference method) 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.
- Certified flow rate measurement device capable of measuring the flow rate at the sampler inlet.
- 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. Additionally, 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

SASS Speciation Sampler V 4.02 Instruments, Inc. www.urgcorp.com			
		Transfer	
Event	Setup	Calibrate	Data

- 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 should be retrieved from the field as soon as possible 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 (at or under 4 °C).

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.
- 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 cooler for transport back to the station.
- 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.

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

Every 3 months for a sampler running every 3 days and every 6 months for a sampler running every 6 days the SCC is brought back to the lab where it is taken apart and given a good cleaning.

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, 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, an electronic log book is kept through LEADS. If there is no computer on-site for electronic log updating, the operator is to enter relevant information upon returning to the station.

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 generally within 96 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 >2.5µg.
- 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.
- 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, an electronic log is kept through LEADS. If there is no computer on-site for electronic log updating, the operator is to enter relevant information upon returning to the station.

6.3 Station Operation - Sample Shipment

Spent sample cartridges must be stored in a protective transport container and transported to the support laboratory generally within 96 hours of the run date. 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 “Certification Methods of Transfer Standards”.

7.1.1 Temperature Standards

Thermometers must be certified traceable to the OAQ/QAS Certification Facility's NIST-traceable thermometer. 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.

Table 1 lists the three ranges that must be used when certifying thermometers (all ranges are in degrees Celsius):

Table 1
Thermometer Certification Ranges

Ambient temperature (water bath)	20 to 30
Cold temperature (ice bath)	-5 to 5
Hot temperature (heated water bath)	35 to 45

The transfer standard thermometer must agree within 0.5 degrees Celsius of the NIST-traceable thermometer for all ranges.

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 ±5 mmHg. Deviations greater than 5.0 mmHg require the barometer to be recalibrated. 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/verified annually. Currently the FTS units used for SASS samplers are certified annually in the IDEM Quality Assurance lab along with an accompanying electronic manometer.

7.2 Routine Calibrations - SASS

Prior to any calibration, a verification must be performed for any samplers in the field collecting data. Confirm that the time is within ±1 minute of the local standard time and the date is correct. Also, 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.

7.2.1 Temperature Sensor Calibration

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

- NIST traceable temperature standard.
- Precision resistor box

Upon arrival:

- Place a certified reference thermometer in close proximity to the ambient air temperature shield and out of direct sunlight.
- 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.
- Compare this reading to the reference standard and document these results.
- Next place the reference standard in the shield opening where the filter temperature is located. The SuperSASS samplers will have 4 filter temperatures to check. Use the up or down arrows to scroll between ambient temperature and filter temperature.
- Compare this reading to the reference standard and document these results.
- Results for both of these should be < 2.1 °C to pass. Since the filter temperature controls the flow, it is very important that the flow verification is performed prior to any adjustments.
- Next hook up the precision resistor box according to the instructions.
- Document the "as found" save and reference values for all of the SASS temperatures.
- Start with the 50 point on the precision resistor box. Make sure this value is entered in the reference box of the SASS display. Record the "as found" display for each temperature. Press calibrate for each temperature and then document the "as left" save and reference values. Also document the difference between the SASS temperature display and 50.
- Next switch the precision resistor box to the -30 point.
- Make sure this value is entered in the reference box of the SASS display. Record the "as found" display for each temperature. Press calibrate for each temperature and then document the "as left" save and reference values. Also document the difference between the SASS temperature display and -30.
- Next switch the precision resistor box to the 10 point.
- No changes are made for this point. Record the SASS display and document the difference between this value and 10.
- Remove the precision resistor box from the SASS and hook the sampler back up.
- Repeat the verification for each temperature.
- The SASS sensors should be within ±2 °C of the reference thermometer.
- Record values.
- If the temperature difference is close to or greater than the ±2 °C limit, repeat the calibration for each point using the precision resistor box. If it fails a second calibration attempt, it may be necessary to replace the temperature sensor that is failing.

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 must be within ±10 mmHg of the reference device. If more than ±5 mmHg a calibration is suggested. 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 must be performed. Additionally, a flow audit and leak check 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.

<u>Flow Rate Calibration Procedure</u>

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
F2:   Flow Calibration
F3:   Temperature Calibration
F4:   Pressure Calibration
F5:
                              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. Adjust until the difference is < ±2.0. 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.
- Ensure the sampler is within one minute of local standard time.
- 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, a verification must be performed for any samplers in the field collecting data. Confirm that the time is within +1 minute of the local standard time and the date is correct. Also, 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
```

- Place the reference thermometer alongside the sampler sensor and allow them both to equilibrate.
- Minimize any interference from wind 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    739.4
SPACE = Calibrate
ENTER = Back
```

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

```
Raw Offset     BP
2753   0    739.4

Ref. BP (mmHg):
```

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

```
Calibration    BP:
739.4 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 flow verification and 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 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. Confirm that the time is within ±5 minutes of the local standard time and the date is correct. Contact site operator if needed and make note of any changes.

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 and 3 (where operational).
- 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 or 0.1 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.

<u>Part 2: Flow Rate Check</u>

- 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 % 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_2O
P_{amb} = ambient barometric pressure in atmospheres
m = the slope of the certified FTS
b = the intercept of the certified FTS

<u>Part 3: Temperature and Pressure Verification</u>

- Prior to replacing the ambient sample canisters and SCC's, insert the certified temperature probe into the sample port. Allow for equilibration. Record the filter temperature value displayed on the upper right hand corner of the system test screen.
- Place the certified temperature probe in close proximity to the sampler's ambient temperature probe, and out of direct sunlight. Allow for equilibration. Record the Ambient 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 SCCs.
- Raise and secure the radiation shield.
- Place the probe of the 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 atmospheres 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.
- Close the control box.

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. These audit filters are supplied by the support laboratory. Confirm that the time is within $\underline{+}$5 minutes of the local standard time and the date is correct. Contact site operator if needed and make note of any changes.

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

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

- 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 (older style) or turn the shutoff valve on the side of the housing to “OFF” (newer style).
- 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.
- Place the temperature transfer standard alongside the sampler probe, and out of direct sunlight.
- 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.
- Save the flow rate verification results to the memory card when prompted.
- The URG flow value should be < ±10.1% of the reference flow.
- Disconnect the transfer standard and replace the sampler inlet.
- Return the sampler to normal operating conditions.

Table 2
Monthly $PM_{2.5}$ Verification Limitations

Parameter	Limit	Corrective Action
Leak Check	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. Data is suspect.
Ambient Temperature	±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. Data is suspect.
Filter Temperature	±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. Data is suspect.
Ambient Pressure	±10 mmHg	Recalibrate or replace the ambient pressure sensor. Consult section 7.2.2 or the SASS Field Operation Manual for specific calibration procedures. Data is suspect.
Flow Rate	< ±5.1% < ±10.1%	Recalibrate. Data is Valid. Recalibrate. Data is Invalid.
Time/Date	< ±5 Minutes of local standard time	Set correct time. Consult the SASS Field Operation Manual for specific procedures. Data is invalid if > 60 minutes or incorrect date.

7.5 Blanks

Sample and trip 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.

The canisters will sit in the sampler until the next pick up, at which time they are removed. 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, pressure, time/date, and leak checks. Quarterly QA audits are done by staff other than the site operator, using different transfer standards to measure those same criteria. Once each quarter an independent audit must be conducted on each Met One SASS/SuperSASS and URG 3000N in operation. Confirm that the time is within ±5 minutes of the local standard time and the date is correct. If not, contact the site operator.

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 Channels 1, 2 and 3 (where operational).
- 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. 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 Channel #2 using an audit canister containing a Nylon filter and denuder ring and the SSC from Channel #2.
- When the leak flow value for both channels has been recorded, Press "Leak". This will turn off the leak check mode.

<u>Part 2: Sample Flow Rate Audit</u>

- 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 repeat the flow audit on channel #2 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.

<u>Part 3: Temperature and Ambient Pressure Sensor Audits</u>

- 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 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.
- 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 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 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, 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_2O
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.
- Calculate the difference in atmospheres between the certified pressure sensor and the pressure sensor value from the SASS.
- See Table 2 for limitations. Any parameter falling outside the outlined limits must be brought to the attention of the site operator 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 (older style) or turn the shutoff valve on the side of the housing to “OFF” (newer style).
- 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 Operations Manual or contact URG@www.urgcorp.com.
- 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.
- Place the temperature transfer standard alongside the sampler probe, and out of direct sunlight.
- 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 ±2.0 °C. If they do not, refer to the Operations 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: 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 ±10.0 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: 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 rate difference should be < ±10.1%. If not, contact the site operator.
- 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.
- Annually, clean the sample inlet tube by pushing a slightly moistened paper towel through the down tube using a wooden dowel rod.
- Inspect filters used for monthly verifications and replace as needed.

10.0 Data Information

10.1 Data Quality Control and Quality Assurance Review

As of 2017, once the data and samples are collected, they are shipped to AMEC. The analysis is performed by UC Davis for the URG samples and DRI analyzes the SASS samples. Besides the site operator applying any data qualifiers and a review by the Quality Assurance Section, UC Davis and DRI will also screen data for potential data qualifiers. See Table 3 below for an example of null value codes or validity flags that may be applied for specific situations.

Table 3
Common Speciation Data Qualifier Codes

Sampler	Data Issue	Data Qualifier
SASS	%CV Flow > 2.0%	W (Flow rate Average out of Spec)
SASS	%CV Flow > 5.0%	AH (Sample Flow Rate or CV out of Limits)
SASS	Filter Temperature out of Specs	QT (Temperature Sensor Questionable)
SASS	Leak Check > 0.1	AK (Filter Leak)
URG	%CV Flow > 1.0%	W (Flow rate Average out of Spec)
URG	%CV Flow > 2.0%	AH (Sample Flow Rate or CV out of Limits)
URG	Ambient Temperature out of Specs	QT (Temperature Sensor Questionable)
URG	Leak Check > 225	AK (Filter Leak)
SASS or URG	Sample Time not 23-25 hours	AG (Sample Time out of Limits)
SASS or URG	Pressure out of Specs	QP (Pressure Sensor Questionable)
SASS or URG	Shipping Temperature out of Specs	TT (Transport Temperature is out of Spec)
SASS or URG	Verification Flow ≥ 10.1%	AH (Sample Flow Rate or CV out of Limits)
SASS or URG	Sampler Malfunction	AN (Machine Malfunction)

10.2 Data Acquisition Requirements

There is non-direct measurement 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). More information can be found in section 18 of the USEPA Quality Assurance Project Plan: PM2.5 Chemical Speciation Sampling at Trends, NCore, Supplemental and Tribal Sites.

10.3 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. and/or URG Corporation 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. Prior to 1986, monitoring was conducted by the Indiana State Board of Health., Air Pollution

Control division. The Indiana Department of Environmental Management was established in 1986 and has subsequently operated these stations. Historical monitoring data and summary information derived from 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 PM_{10} 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
- Radiation
- 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
SASS/SuperSASS Custody and Field Data Form

PM2.5 CSN CUSTODY AND FIELD DATA FORM

☐ White (return to lab)
☐ Yellow (site retains)

Q0422017082301

A. CUSTODY RECORD (Name, Date) Bin ID: IND01-B Set: 3A

	Name	Date		Name	Date
1. Laboratory Out:	BARNARD	8/15/2017	3. Site Out:	MD	8/28/17
2. Site In:	CMR	8/17/17	4. Laboratory In:		

B. SITE AND SAMPLER INFORMATION

1. Site AQS Code: 180650003
2. Sampler S/N:
3. Sampler Type: SASS
4. Sampler POC: 5
5. Site Name: Shenandoah High School Mechanicsburg
6. Intended date of use: Wednesday, August 23, 2017
7. Date of Sampler Setup: 8-18-17
8. Operator's Name: Amanda Howe

C. SAMPLER CHANNEL COMPONENTS

Channel No.	Component ID No	Component Description
1	I6110B	Met One/SASS Cover - Teflon
2	I6111C	Met One/SASS Cover - Nylon

D. START, END, AND RETRIEVAL TIMES

Channel No.	Start Date	Start Time	End Date	End Time	Retrieval Date	Retrieval Time
1	8/23/17	0000	8/24/17	0000	8/24/17	835
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 (°C)	Min. Ambient T (°C)
1	24:00:00	/	9.708	6.74	.8	18.7	26.3	12.4
2	/	/	9.681	6.72	.8	/	/	/

Channel No.	DeltaT 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	/	18.7	25.4	12.2	729	731	728
2	/	/	/	/	/	/	/

F: Comments

1E02A4 AUG 16, 2017 ACT WT 12.0 LBS 1 OF 1
SVC 1DA BL WT 12.0 LBS
TRACKING# 1Z1E02A48442379898
REF 1:Q0422017072401
REF 2:SHENANDOAH HIGH SCHOOL MECHANICSBU

HANDLING CHARGE 0.00
SINGLE – PIECE PUB RATE CHRGS: SVC 137.33 USD
DV 0.00 COD 0.00 RS 0.50
DC 0.00 DGD 0.00 SD 0.00
AH 0.00 PR 0.00 SP 0.00
TOT PUB CHG 137.83 PUB+HC137.83

THIS DOCUMENT IS NOT AN INVOICE.

Chemical Speciation Network
Field Sampling Null Value and Validity Coding Form

☐ White (return to lab)
☐ Yellow (site retains)

Chain of Custody Sampling Request ID: Q0422017082301 Intended Use Date 8/23/2017

Sample Date (if different from Intended Use Date)

Date Received in FISH Received in FISH by:

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
AB	TECHNICIAN UNAVAILABLE
AC	CONSTRUCTION/REPAIRS IN AREA
AD	SHELTER STORM DAMAGE
AE	SHELTER TEMPERATURE OUTSIDE LIMITS
AF	SCHEDULED BUT NOT COLLECTED
AG	SAMPLE TIME OUT OF LIMITS
AH	SAMPLE FLOW RATE OR CV 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
AR	LAB ERROR
AS	POOR QUALITY ASSURANCE RESULTS
AU	MONITORING WAIVED
AV	POWER FAILURE (POWR)
AW	WILDLIFE DAMAGE
AZ	QC AUDIT (AUDT)
BA	MAINTENANCE/ROUTINE REPAIRS
BB	UNABLE TO REACH SITE
BE	BUILDING/SITE REPAIR
BI	LOST OR DAMAGED IN TRANSIT
BJ	OPERATOR ERROR
DA	ABERRANT DATA
SA	STORM APPROACHING
SV	SAMPLE VOLUME OUT OF LIMITS
TS	HOLDING TIME OR TRANSPORT TEMPERATURE OUT OF

Table B. Validity Flags
* samples marked with any of these flags will be analyzed and reported with flags noted

Flag	Description
2	Operational Deviation
3	Field Issue
4	Lab Issue
5	Outlier
6	QAPP Issue
IA	African Dust
IB	Asian Dust
IC	Chem. Spills and Industrial Accidents
ID	Cleanup After a Major Disaster
IE	Demolition
IF	Fire - Canadian
IG	Fire - Mexico/Central America
IH	Fireworks
II	High Pollen Count
IJ	High Winds
IK	Infrequent Large Gatherings
IL	Other
IM	Prescribed Fire
IN	Seismic Activity
IO	Stratospheric Ozone Intrusion
IP	Structural Fire
IQ	Terrorist Act
IR	Unique Traffic Disruption
IS	Volcanic Eruptions
IT	Wildfire - U.S.
QP	Pressure Sensor Questionable
QT	Temperature Sensor Questionable
T	Multiple Flags: Misc
TT	Transport Temperaure is Out of Specs.
V	Validated Value
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 [signature] Date 8/24/17

Form 2
URG Custody and Field Data Form

Q0422017082302

PM2.5 CSN CUSTODY AND FIELD DATA FORM

☐ White (return to lab)
☐ Yellow (site retains)

A. CUSTODY RECORD (Name, Date) Bin ID: IND01-B Set: 3A

	Name	Date		Name	Date
1. Laboratory Out:	BARNARD	8/15/2017	3. Site Out:	NPD	8/23/17
2. Site In:	CMR	8/17/17	4. Laboratory In:		

B. SITE AND SAMPLER INFORMATION

1. Site AQS Code: 180650003
2. Sampler S/N: 3N-B0226
3. Sampler Type: URG 3000N
4. Sampler POC: 5
5. Site Name: Shenandoah High School Mechanicsburg
6. Intended date of use: Wednesday, August 23, 2017
7. Date of Sampler Setup: 8-18-17
8. Operator's Name: Amanda Howe

C. SAMPLER CHANNEL COMPONENTS

Channel No.	Component ID No	Component Description
1	I109211	CF Memory Card
1	I109200	URG 3000N cartridge

D. START, END, AND RETRIEVAL TIMES

Channel No.	Start Date	Start Time	End Date	End Time	Retrieval Date	Retrieval Time
1	8/23/17	0000	8/24/17	0000	8/24/17	849

E. SAMPLER CHANNEL INFORMATION (Post-Sampling)

Channel No.	Run Time	Run Time Flag	Elapsed Time (Total)	Elapsed Time (After)	Sample Volume (m3)	Avg. Flow (L/min)	Avg. Flow CV (%)
1	1440	—	8495	534	31.70	22.0	0.1

Channel No.	Avg. Ambient T (ºC)	Max. Ambient T (ºC)	Min. AmbientT (ºC)	DeltaT Flag	Avg. BP (mm Hg)	Max. BP (mm Hg)	Min. BP (mm Hg)
1	21.2	29.6	14.8	—	734.1	736.3	733.6

F: Comments

Chemical Speciation Network
Field Sampling Null Value and Validity Coding Form

☐ White (return to lab)
☐ Yellow (site retains)

Chain of Custody Sampling Request ID:	Q0422017082302	Intended Use Date	8/23/2017
	Sample Date (if different from Intended Use Date)		
Date Received in FISH		Received in FISH by:	

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
AB	TECHNICIAN UNAVAILABLE
AC	CONSTRUCTION/REPAIRS IN AREA
AD	SHELTER STORM DAMAGE
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AG	SAMPLE TIME OUT OF LIMITS
AH	SAMPLE FLOW RATE OR CV 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
AR	LAB ERROR
AS	POOR QUALITY ASSURANCE RESULTS
AU	MONITORING WAIVED
AV	POWER FAILURE (POWR)
AW	WILDLIFE DAMAGE
AZ	QC AUDIT (AUDT)
BA	MAINTENANCE/ROUTINE REPAIRS
BB	UNABLE TO REACH SITE
BE	BUILDING/SITE REPAIR
BI	LOST OR DAMAGED IN TRANSIT
BJ	OPERATOR ERROR
DA	ABERRANT DATA
SA	STORM APPROACHING
SV	SAMPLE VOLUME OUT OF LIMITS
TS	HOLDING TIME OR TRANSPORT TEMPERATURE OUT OF

Table B. Validity Flags
* samples marked with any of these flags will be analyzed and reported with flags noted

Flag	Description
2	Operational Deviation
3	Field Issue
4	Lab Issue
5	Outlier
6	QAPP Issue
IA	African Dust
IB	Asian Dust
IC	Chem. Spills and Industrial Accidents
ID	Cleanup After a Major Disaster
IE	Demolition
IF	Fire - Canadian
IG	Fire - Mexico/Central America
IH	Fireworks
II	High Pollen Count
IJ	High Winds
IK	Infrequent Large Gatherings
IL	Other
IM	Prescribed Fire
IN	Seismic Activity
IO	Stratospheric Ozone Intrusion
IP	Structural Fire
IQ	Terrorist Act
IR	Unique Traffic Disruption
IS	Volcanic Eruptions
IT	Wildfire - U.S
QP	Pressure Sensor Questionable
QT	Temperature Sensor Questionable
T	Multiple Flags: Misc
TT	Transport Temperature is Out of Specs.
V	Validated Value
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 [signature] Date 8/24/17

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_2O)	Temperature (Kelvin)	Reference Flow (l/min)	% Diff
1					
2					

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	Temperature Shield cleaned?	__ YES __ NO
Sample tube connected to pump?	__ YES __ NO	Solar Shield cleaned and closed?	__ YES __ NO
Temperature probe installed?	__ YES __ NO	Control and pump box cleaned?	__ YES __ NO
Temperature probe secure?	__ YES __ NO	Data Downloaded?	__ YES __ NO

Additional Comments:

____

rev.10/19/09

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	Δ P (in H_2O)	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:

____

____

____ rev.10/19/09

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	Δ P (in H_2O)	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:

____

____

____ rev.10/19/09

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

Δ P (in H_2O)	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:

____

____

____ rev.10/19/09