# STANDARD OPERATING PROCEDURE FOR MEASUREMENT OF SEMI-VOLATILE ORGANIC COMPOUNDS USING THE TISCH ENVIRONMENTAL INC. TE-PUF SAMPLER

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## Acknowledgement

This Standard Operating Procedure (SOP) was developed by EPA Region 4, Science and Ecosystem Support Division. This SOP is based in part on the Commonwealth of Kentucky's ambient monitoring SOP, **Measurement of Semi-Volatile Organic Compounds by the PUF Sampler (TS17-16)**. In addition, Eastern Research Group (ERG), Morrisville, North Carolina contributed greatly in the development of this document. Special thanks to the Commonwealth of Kentucky, Tisch Environmental, Inc. and ERG for sharing their work in developing this SOP for the National Toxics in Schools Initiative.

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## I. INTRODUCTION

This method is designed to simultaneously collect suspended airborne particulates as well as trap Semi-Volatile Organic Compounds (SVOCs) such as Polycyclic Aromatic Hydrocarbons (PAHs).

The **P**oly-**U**rethane **F**oam sampler (Figure 1), commonly known as the "PUF sampler" is composed of an aluminum shelter, dual chamber sampling head, flow venturi, magnehelic gauge, voltage variator / elapsed time indicator, blower motor, exhaust hose, and seven-day skip timer.

The dual chamber sampling head (Figure 2), contains both filtering systems. The upper chamber supports the 4" diameter Micro-Quartz particulate filter while the lower chamber houses the glass cartridge that contains the PolyUrethane Foam and XAD-2® for vapor entrapment.

The blower motor is manufactured with a by-pass and cooling fan to permit the motor to operate at low sampling flow rates for periods of long duration without motor failure from overheating. Optimum flow rate for the sampler is 0.225 $m^3$/min. which yields a total volume of air sampled per 24 hours of greater than 300 $m^3$. ***Note, however, that the extra course frit glass cartridges used in this study restrict flow such that typical flow rates are on the order of 0.15 $m^3$/min yielding sample volumes on the order of 210 to 220 $m^3$ for a 24 hour sampling period.***

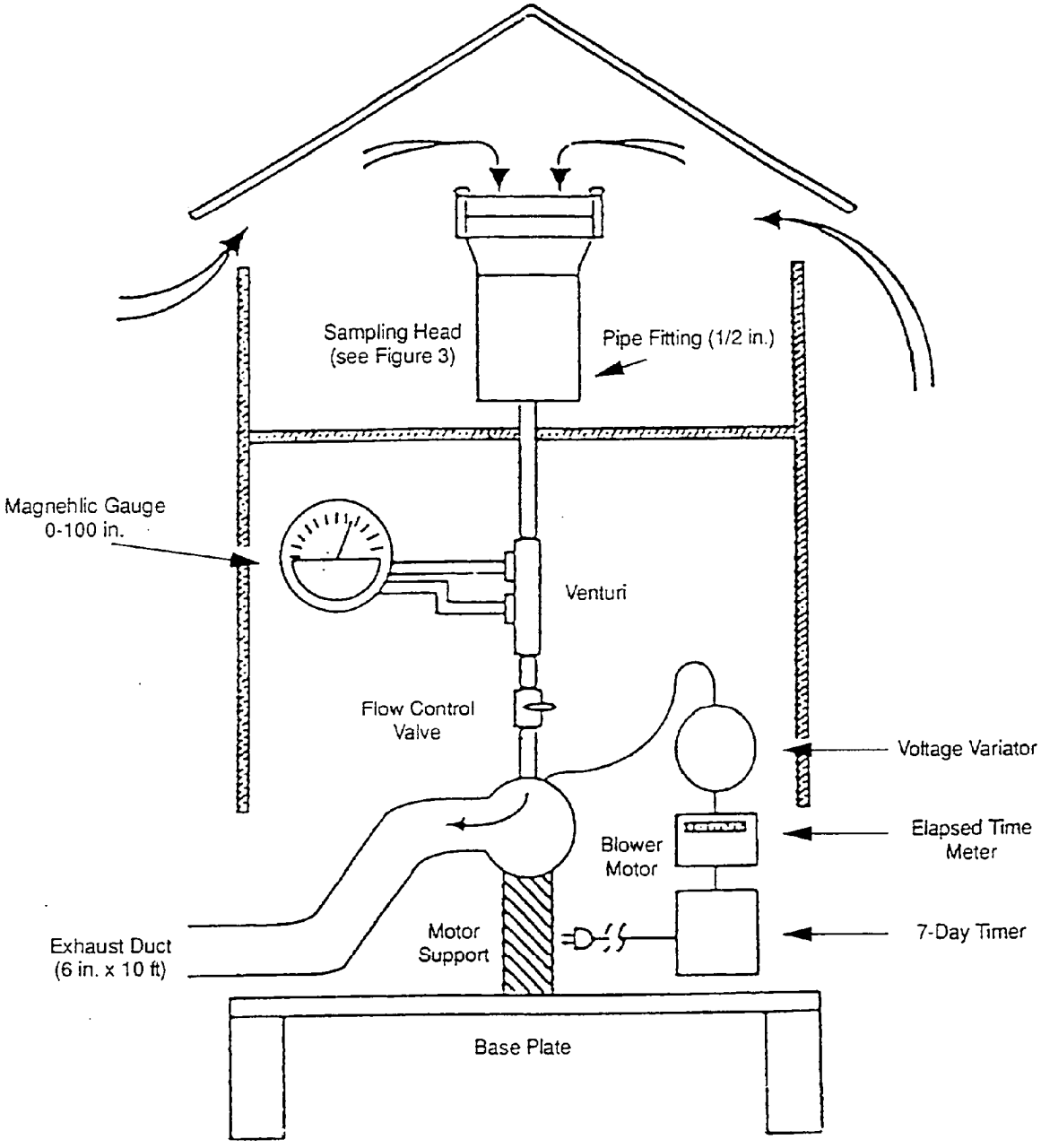
The voltage variator adjusting screw alters the blower motor speed to achieve the desired flow rate. The air flow rate is measured through the flow venturi utilizing a 0-100" magnehelic gauge.

A seven-day skip timer is used to automatically initiate and terminate sampling at preset times. The actual length of sampling is measured by the elapsed time indicator. The whole assembly is housed in a specially designed aluminum shelter that provides protection from precipitation while maintaining ample space for air entering or leaving the sampler. The height of the shelter puts the air inlet at about one meter above the grade.

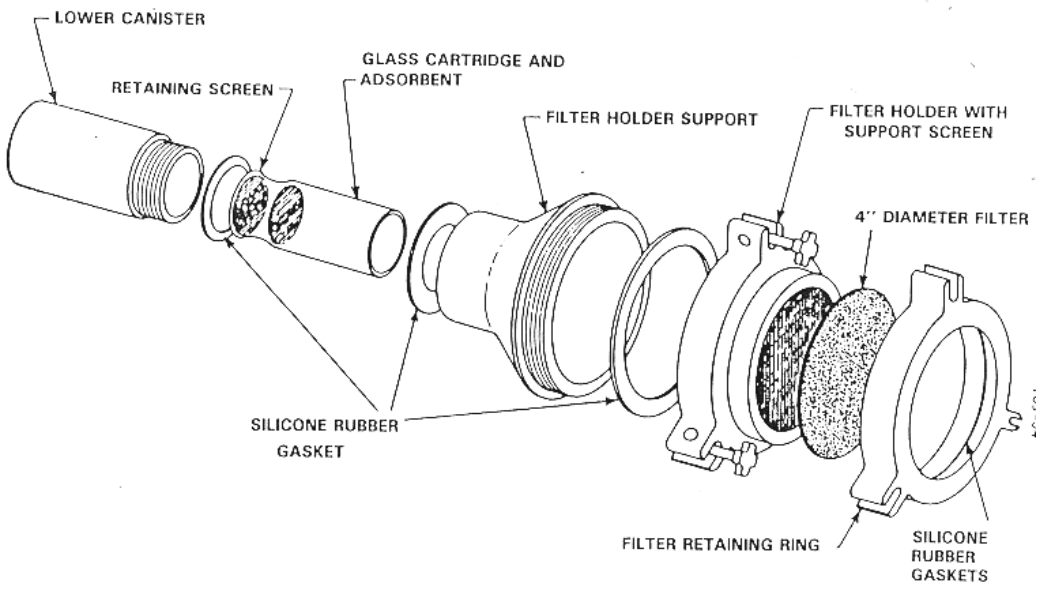
This SOP is designed to be a step by step method for operating the sampler to be used in conjunction with the manufacturer's operations manual; http://www.tisch-env.com/tisch/pdf/te1000.PDF. Maintenance and troubleshooting should be conducted using the Tisch; TE-PUF operations manual.

Laboratory Analysis Methodology may be referenced by contacting the Eastern Research Group (ERG) directly at 919-468-7800 or by email; Julie.Swift@erg.com.

## FIGURE 1. Polyurethane Foam (PUF) Sampler



## FIGURE 2. Sampling Head




# II. INSTALLATION

## A. Sampler Installation and Siting

Assemble the sampler as described in the Tisch Environmental, Inc. TE-PUF Operations Manual shipped with the sampler which can also be found at; http://www.tisch-env.com/tisch/pdf/te1000.PDF.

Check the sample site areas for safety. Ensure there will be enough room for the operator to move freely while working, and ensure physical conditions of the location will allow the operator to work safely.

The sampler should be set in a location unobstructed from any side. No tree limbs or other hanging obstructions should be above the sampler. It is suggested that the horizontal distance from the sampler to the closest vertical obstruction higher than the sampler be at least twice the height of the vertical obstruction. The exhaust hose should be stretched out in a down wind direction if possible.

Install the sampler on a reasonably level structure at a height between two (2) and fifteen (15) meters above the ground.

Two skids of approximately one meter length may be attached parallel to the legs of the sampler, and concrete blocks or sand bags may be placed on the skids to prevent tipping of the sampler.

Connect the sampler to a grounded electrical outlet with 115 volts, and at least 15 amp service. Protect the connector from precipitation by placing it in the shelter or wrapping it with plastic tape.

If collocated samplers will be located at the site, the two samplers must be within four (4) meters of each other, but outside of two (2) meters. The inlet heights must be within one (1) meter vertically.

## III. CALIBRATION

### A. Equipment and Supplies

Empty glass cartridge
Calibration kit containing; Manometer and orifice calibration unit

### B. Procedure

For accurate data the hardware used to obtain this data must be checked and calibrated. This includes the Sample Train which consists of the Dual Chamber Sampling Head Flow through venturi and also the magnehelic gage. Calibration of the sampler is performed without a foam plug or filter paper in the sampling head. However the empty glass cartridge must remain in the head to insure a good seal through the head.

The procedure for calibration is described in the Tisch TE-PUF Operations Manual shipped with the sampler which can also be found at; http://www.tisch-env.com/tisch/pdf/te1000.PDF. The sample train must be calibrated with an orifice calibration unit. The orifice calibration unit itself has been calibrated against a positive displacement primary standard (Roots Meter) so that it can be used to calibrate the sample train. The calibration data sheet for the orifice calibration unit should be copied for safe keeping. Data from this sheet will be required for calibration of the TE-PUF sampler.

Operators collecting SVOC samples should be familiar with the methodology and calculations contained in EPA Compendium Method TO-13A Determination of Polycyclic Aromatic Hydrocarbons (PAHs) in Ambient Air Using Gas Chromatography/Mass Spectrometry (GC/MS), which can be found at; http://www.epa.gov/ttn/amtic/files/ambient/airtox/to-13arr.pdf.

The orifice is generally calibrated once a year. However, before each use, it

should be inspected for visible signs of damage. A calibration check must be made anytime the unit appears to have any nicks or dents.

## IV. STANDARD OPERATING PROCEDURE

### A. Equipment and Supplies

Logbook
Tubular Glass PUF/XAD-2 resin cartridge
110 mm diameter filter
Powderless gloves (example; VWR® MICROGRIP® PURPLE NITRILE® Poly-Coated Powder-Free Gloves, Catalog # 40101-XXX for~$30 pkg. 100)
ERG sample paperwork

### B. Sample Delivery to Field

The filter is packaged in a plastic petri dish sealed by wrapping it with Teflon tape and placed in a zip lock bag along with the associated ASVOC Sample Data Sheet@ (i.e., Chain of Custody (COC)) form. The ends of the glass cartridge are sealed with Teflon/O-ring press-in caps, and the entire cartridge is then wrapped in cleaned aluminum foil. The wrapped cartridge is then inserted into a bubble wrap bag and packaged in a plastic screw lid jar. The plastic jar and the zip lock bag containing the petri dish and COC are placed in a small cooler with a Blue Ice brick(s) and shipped to the field site. Upon receipt at the site, the filter and the plastic jar should be removed from the cooler and placed in a refrigerator with a maximum operating temperature of $4^{B}$C, or in a freezer, until ready for use. The Blue Ice brick(s) should be placed in a freezer until ready for re-use.

### C. Collection Event Set-up and Loading the PS-1 Sampling Head

**SETUP MUST BE PERFORMED ON THE DAY PRIOR TO THE SAMPLING EVENT**

The PS-1 Sampling Head can be loaded at the laboratory/office or at the field site on the discretion of each program participant (agency). Regardless of which approach is used, great care must be exercised to minimize the potential for contaminating the collection media. Whether the media is loaded at the laboratory/office or at the field site, it must be maintained at a cool temperature while transporting the media to the site location for set-up. The following instructions apply to loading the collection media into the PS-1 sampling head at an alternate location in the event of adverse weather conditions:

1. Put on a pair of powder-free nitrile gloves

2. Separate the components of the sampling head. Unscrew the Cartridge Holder from the Filter Holder Base by rotating in a counter-clockwise direction. Detach the Filter Retaining Ring from the Filter Holder by loosening the wing nuts on pivot screw posts and rotating them downward from their associated tabs. Place the components on a clean surface.

3. Remove the prepared sampling glass cartridge from it=s transport packaging. Place the bubble wrap bag back in the plastic jar. Remove the aluminum foil wrap from around the cartridge. Neatly fold the foil and place it back in the plastic jar. Remove the Teflon/O-ring press-in caps from the inlet and outlet ports of the glass cartridge and place them back in the plastic jar.

4. Visually ensure that a silicone gasket is present in the bottom of the Cartridge Holder. Insert the glass cartridge into the Cartridge Holder ensuring that the fritted end is pointing downward.

5. Visually ensure that a silicone gasket is present in the outlet end of the Filter Holder. Place the Filter Holder on top of the Cartridge Holder and screw the 2 components together by rotating the Filter Holder in a clockwise direction until the silicone gaskets barely seat against the lips of the glass cartridge. At this point, rotate the Filter Holder just a small amount further to seal the components; DO NOT OVER-TIGHTEN (*over-tightening can cause the lips of the glass cartridge to chip or the cartridge to crack*).

6. Remove the Teflon tape from the outside of the petri dish. Using cleaned Teflon coated forceps, gently pick up the filter media and center it on the Filter Support Screen positioned at the inlet of the Filter Holder. Immediately place the Teflon Gasket and Filter Retaining Ring on top of the loaded filter, taking care to align the pivot screw posts on the Filter Holder with the corresponding tabs on the Filter Retaining Ring. Ensure the filter is installed between the upper and lower Teflon® gaskets. Windy conditions can make this step tricky; try to replace the hold down ring as quickly as possible so the filter is not lost. If the filter is blown off the sampler; replace with a new filter. Lift the pivot screw posts up into position and tighten the wing nuts until they barely seat against the tabs. At this point, tighten each wing nut a small amount and then move to the next one. Continue this process until all of the wings nuts are hand tight.

7. If you are assembling the Sampling Head at the Laboratory/office, you will need to install the filter protection cap as part of Step 6, and then

remove it at the site. You will also want to cover the outlet port of the Sampling Head with cleaned aluminum foil.

8. Prepare sample paperwork. On the ERG SVOC Sample Data Sheet, complete the "Field Setup" section which includes "Site Operator", "Setup Date", "Collection Date", "System #", and "Elapsed Timer Reset" fields.

## D. Collection Event Set-up and Setting up the PS-1

1. Remove the pin from the latch on the top of the sampler housing and open the top sampler cover/inlet. The top can be latched in the open position from the rear.

2. Insure the throat quick-connect fitting gasket is installed correctly and in good condition.

3. Place the sampling head quick-connect fitting into the throat quick-connect fitting, using the levers, lock the connection. Ensure that the levers are parallel with the sampling head and the "rings" do not prevent the levers from completely closing.

7) Press the reset button (if equipped) on the elapsed time meter on the sampler and record the reading of the timer on the ERG SVOC Sample Data Sheet, under the "Elapsed Time, Start" section. The meter should reset to all zeroes. If the timer is not equipped with a reset button record the current reading of the timer.

8) On the ERG SVOC Sample Data Sheet, record the ambient temperature (°C) and barometric pressure (inches Hg) under the "Elapsed Time, Start" section.

9) Check the zero reading on the magnehelic gauge. Close the roof of the shelter and run the sampler for about 5 minutes to warm up the motor. While the motor warms up, read and record the ambient temperature and pressure.

10) Observe and record the magnehelic gauge reading on the PUF Sample Form (Figure 3) and in the station logbook in the space marked "**Magnehelic Reading:** Initial:". **Note: the initial reading should correspond to a flow rate of 0.226 $m^3$/min ±10%. If reading is outside of these limits adjust the ball valve or voltage variator screw for proper flow rate.**

11) Turn off the sampler and set the seven-day timer to sample from midnight to midnight local time of the sampling day.

12) Record the Sample I.D., Batch #, Sampler I.D., Site I.D., County, Operator, Sample Date, and running time (elapsed) meter reading on the PUF Sample Form and in the logbook. (Be sure to record running time (elapsed) meter reading in the "**Time: (Minutes),** Initial" space.)

## E. Collection Event Recovery

1. After the sampling period, record the running time (elapsed) meter reading in the "**Time: (Minutes)**, Final" space on the form and in the logbook. Check magnehelic gauge zero. Also read and record the ambient temperature and pressure.

**2.** Turn the sampler on and allow the motor to warm up for 5 minutes, then observe and record the magnehelic gauge reading on the PUF Sample Form and in the station logbook in the space marked "**Magnehelic Reading:** Final:".

## F. Collection Event Recovery and Unloading the Sampling Head

The PS-1 Sampling Head can be unloaded at the laboratory/office or at the field site on the discretion of each program participant (agency). Regardless of which approach is used, great care must be exercised to minimize the potential for contaminating the collection media when handling it. If the sampling head is removed from the PS-1 and transported to the laboratory or office to replace the collection media, it must remain in an upright position. This is to prevent particulate collected on the filter from falling off.

The following steps are associated with unloading the collection media from the PS-1 sampling head:

1) Put on a pair of powder-free nitrile gloves. Note: A new set of gloves should always be used between handing parts of the sampling head (wing-nuts, the retaining ring, etc.) and the sampling media.

2) Unscrew the Cartridge Holder from the Filter Holder Base by rotating in a counter-clockwise direction and place it on a clean surface. Open the petri dish. Detach the Filter Retaining Ring from the Filter Holder by loosening the wing nuts on pivot screw posts and rotating them downward from their associated tabs. Lift the Filter Retaining Ring and remove the filter sample from the Filter Holder using cleaned Teflon coated forceps and place it in the open petri dish. With a new set of clean gloves on, gently grasp the filter sample and fold it in half so that the collected particulate from both halves is pressed against each other. Now fold the filter in half again (i.e., quad-

fold) and place it in the petri dish. Re-seal the petri dish by wrapping it with new Teflon tape.

3) Remove the retained aluminum foil, Teflon/O-ring press-in caps, and bubble wrap bag from plastic transport jar.

4) Remove the glass cartridge sample from the Cartridge Holder. Insert the Teflon/O-ring press-in caps into the cartridge inlet and outlet ports. Wrap the glass cartridge sample in the retained aluminum foil, and place it in the bubble wrap bag. Slide the bubble wrap bag (with the cartridge sample) into the transport plastic jar and screw on the cap.

5) Using the current calibration for the motor and the appropriate temperature range, convert the magnehelic readings to flow rate and record on the form and in the logbook.

**NOTE: Final flow rate must be within ±10% of the initial flow rate, otherwise the sample is to be flagged.**

6. Average the initial and final flow rates and record the average on the form and in the logbook.
7. Subtract the initial running time meter reading from the final reading and record the hours sampled in the appropriate space on the form and in the logbook.

**NOTE: Hours sampled must be between 23 to 25 hours.**

8. If the sample is defective, void it at this time by writing with big letters VOID on the form along with a brief reason for voiding. Also enter reason for voiding in the logbook, for example - power off, motor dead, timer malfunction.

9. For data validation purposes the site operator must record information concerning weather conditions and unusual site events that occur on the sampling date.

The following information should be recorded in the appropriate spaces on the record forms for transmittal with the samples.

Weather Conditions (sample date only).

Report newspaper, local airport report, and/or own observations over the 24-hour sampling period. The report should include: Temperatures (high-low), Precipitation (rain, snow, etc.), Sky (clear/cloudy), Wind (calm/light/moderate/strong), and Wind Direction.

Unusual Events

Report fires, tornadoes, dust storms, construction, demolition, etc., that may have an impact at the site on the sampling date. Use newspaper reports and own observations. The report should include; type of event, sites in the area of the event, distance and direction from site, date of occurrence, pictures of the event if visible from site, weekly observations if event is on-going, and date event ended.

10. At least one field filter/PUF blank must be returned to the laboratory with each group of samples. A field blank is treated exactly as a sample except that no air is drawn through the filter/PUF cartridge assembly.

11. Place the completed COC and the sealed petri dish into a zip lock bag**.** Place the zip lock bag and the transport plastic jar into the cooler initially used to ship the media to the site. Place the frozen Blue Ice brick(s) in the cooler and ship the cooler back to the ERG Laboratory using overnight service. If the Sampling Head is transported back to the laboratory/office for recovery, the media must be maintained at a cool temperature while transporting, and protected from ultraviolet (UV) light to prevent possible photo-decomposition of collected analytes. Also, care must be taken to insure that the Sampling Head is transported in a vertical position with the filter pointing upward to ensure that particulate matter is not dislodged from the filter and lost.

ALL SAMPLES MUST BE SHIPPED AS SOON AS POSSIBLE AFTER COLLECTION IS COMPLETED BECAUSE THE EXTRACTION HOLD-TIME FOR THESE SAMPLES IS 7 DAYS AFTER COLLECTION.

THE SAMPLES MUST REMAIN COLD SO ALL SHIPMENTS SHOULD BE MADE MONDAY THROUGH THURSDAY. BECAUSE SAMPLES ARE NOT DELIVERED ON THE WEEKEND, NO SHIPMENTS SHOULD BE MADE ON FRIDAY.

## V. PREVENTATIVE MAINTENANCE

### A. Schedule

1. Weekly

   a. Check power cords and plugs, repair or replace as necessary.

   b. Check filter holder gasket for leakage, replace if worn.

c. Check shelter hinges for breaks or stiffness, repair if necessary.

d. Check tubing from Flow Venturi to Magnehelic gage for holes and/or cracking.

## VI. DATA FORMS

All sample related run data forms will be supplied by ERG. Check the data sheets for completion after every setup or retrieval event. The operator is expected to keep a logbook to document all site activities, quality assurance activities, and sampling activities. The ERG PM10 Metals Sample Data Sheet is attached below.

# Figure 3 SVOC Chain of Custody (COC)

ERG

ERG Lab ID #

## SVOC SAMPLE DATA SHEET

**Lab Pre-Sampling**

Site Code: _____ Collection Date: _____

City/State: _____ Collocated Event (Y/N): _____

AQS Code: _____ Other: _____

_____

Cartridge Certification Date: _____ _____

**Field Setup**

Site Operator: _____ System #: _____

Set-Up Date: _____ Elapsed Timer Reset (Y/N): _____

Collection Date: _____

**Field Recovery**

Recovery Date: _____

Collection System Information:

| | Elapsed Time | Temp (°C) | Barometric ("Hg) | Magnehelic ("$H_2O$) | Flowrate (std. $m^3$/min) |
|---|---|---|---|---|---|
| Start | | | | | |
| End | | | | | |
| Average | | | | | |

Total Collection Time (Minutes) _____ Total Collection Volume (std. $m^3$) _____

Status: Valid Void (Circle one)

**Lab Recovery**

Received by: _____ Date: _____ Refrigerator No.: _____

Status: Valid Void (Circle one) Temperature: _____

If void, why: _____

Comments: _____

White: Sample Traveler Canary: Lab Copy Pink: Field Copy