

**STANDARD OPERATING PROCEDURE  
FOR THE COLLECTION OF  
VOLATILE ORGANIC COMPOUNDS  
FOR THE EPA SCHOOL AIR TOXICS PROGRAM**



**U.S. Environmental Protection Agency  
Region 4, Science and Ecosystem Support Division  
Athens, Georgia, 30605**

### **Acknowledgement**

This Standard Operating Procedure (SOP) was developed by EPA Region 4, Science and Ecosystem Support Division. This SOP is based on the Commonwealth of Kentucky's ambient monitoring SOP template. Special thanks to the State of South Carolina and ERG for operational content.

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## I. INTRODUCTION

This document is designed to provide instruction on collecting volatile organic compounds in air using an evacuated canister and a passive air sampling kit.

The procedure presented is designed for sampling volatile organic compounds (VOCs) in ambient air, based on the collection of whole air samples in SUMMA<sup>®</sup> treated canisters to final pressures below atmospheric. The samples are then analyzed using EPA Compendium Methods TO14A or TO15 *Determination of Volatile Organic Compounds (VOCs) in Air Collected in Specially Prepared Canisters and Analyzed by Gas Chromatography/Mass Spectrometry (GC/MS)* using the EPA National Monitoring Program's contract laboratory (i.e. ERG).

The canisters are 6-liter stainless steel vessels whose internal walls are SUMMA<sup>®</sup> treated with an inert pure chrome-nickel oxide compound to reduce the reactivity of the air sample in the canister. The canisters are outfitted with a stainless steel bellows valve, equipped with a 1/4" Swagelock<sup>®</sup> fitting on the inlet. Prior to use, all canisters are cleaned in accordance with the specifications presented in the EPA NATTS Technical Assistance Document Rev. 2 (April 2009). Once certified as clean, the canisters are evacuated to approximately 29.5 inches of mercury ("Hg) and are ready for use. The collection approach is passive, meaning no 110 volt AC power is required. The canister is attached to a programmable timer/solenoid, a veriflow vacuum regulator, and a sample probe. Figure 1 presents the complete VOC sampling system. When the programmable timer opens the solenoid at a preset time, the canister is filled with ambient air at an integrated collection rate across the 24-hour sampling duration.

This SOP is designed to be a step by step procedure for operating the sampling system described, and is to be used in conjunction with the manufacturer's operator's manual(s). Laboratory Analysis Methodology using the TO-15 method may be referenced by contacting the Eastern Research Group (ERG) directly at 919-468-7800 or by email [Julie.Swift@erg.com](mailto:Julie.Swift@erg.com). Maintenance and troubleshooting should be conducted using the relevant operator's manual(s).

FIGURE 1. Photograph of Total VOC Sampling System  
With Timer and Probe



## II. INSTALLATION

### A. Sampler Siting

Inspect the site area to ensure there will be enough physical space for the operator to move freely while working, and ensure there is nothing at the location that will negatively impact the safety of the operator.

The sampler should be mounted in a location that is unobstructed on all sides. There should be no tree limbs or other hanging obstructions 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 inlet of the sampling system must be positioned at least 2 meters above grade (ideal), but not more than 15 meters above grade.

### B. Sampler Installation

1. The sampling system consists of three components: a sample canister, a programmable timer/solenoid (Nutech 2701), and a passive vacuum regulator (Veriflow with gauge and sample inlet probe). All components will be received from the ERG laboratory where: the cans will have been cleaned, tested for contamination and evacuated; flow controllers will have been cleaned, tested for contamination, and calibrated for 24 hour sampling; and the sample inlet will have been tested for contamination.
2. The complete sampling system must be securely mounted on a support structure which ensures that the sample inlet meets the siting criteria (at least 2 meters above grade, but not more than 15 meters above grade).

*Note: If the support structure is to be located on a roof top, efforts must be made to protect the roof covering (i.e. membrane, etc.). This can be accomplished by securely attaching the support structure to a wooden frame and then using weight (i.e. sandbags) to hold the entire mounting structure in place.*

3. For collocated samplers, horizontal spacing should be between one (1) and four (4) meters, and inlet heights within one (1) meter vertically. .

### III. OPERATING PROCEDURE

#### A. Equipment and Supplies


6 liter sample collection canister  
Veriflow vacuum regulator/gauge/inlet probe  
Nutech 2701 programmable timer/solenoid  
Support structure with holder for assembled sampling apparatus  
Logbook  
ERG sample paperwork


#### B. Sampler and Sample Media Receipt Activities

Complete Sampling System

1. Check parts and components against the packing list.
2. Ensure all fittings are present and in good condition.
3. Prior to sampling keep all components in a clean area free of contamination.

Nutech 2701 Programmable Timer/Solenoid – Battery Charge

1. Charge the internal battery by opening the front cover and plugging the supplied USB adapter cable into the labeled USB port located on the bottom right of the front panel (mini USB).
2. Plug the other end of the USB cable into a USB port on a computer (standard USB). Allow the timer to charge for at least 12 hours. A battery charge indicator is located at the top center left of the display. The battery will display  after a full charge is reached.

*Note: The display will show  when the battery is drained. To ensure that there is always a sufficient charge on the battery, recommend recharging every six days.*

Sample Collection Canister

1. The sample collection canister and associated sample data sheet will arrive from ERG in a cardboard box.

*Note: The canisters do not need to be refrigerated after receipt or during return shipping.*

2. Ensure the canister is not damaged. Confirm that the valve remained in the closed position during shipping and that the top plug is secured on the bellows valve inlet fitting.

## C. Preparing for a Sampling Event

### Initial Steps

1. Ensure the Nutech 2701 timer battery is fully charged. If there are not at least two (2) bars displayed, the timer must be recharged before conducting the sampling event.
2. Prepare sample paperwork. On the ERG Toxics/SNMOC Sample Data Sheet, supply all required information in the "Lab Pre-Sampling" section. Record any pertinent observations in the notes section at the bottom of the form.
3. Remove the plug attached to the bellows valve inlet. Retain the plug in a clean place so that it can be used to reseal the bellows valve inlet after the sampling event.
4. Assemble the complete sampling system.
  - a. Attach the outlet fitting of the Nutech 2701 timer/solenoid to the canister bellows valve inlet.  
  
*Note: Do not over tighten the nut. When the nut feels snug, another quarter turn should be sufficient to secure the timer inlet to the can.*
  - b. Attach the outlet fitting of the Veriflow vacuum controller to the inlet fitting of the Nutech 2701 timer/solenoid.  
  
*Note: Again, do not over tighten the nut. When the nut feels snug, another quarter turn should be sufficient to secure the timer inlet to the can.*

### Measuring and Documenting the Pre-Collection (Set-up) Canister Pressure

The following steps are to be performed prior to programming the Nutech 2701 timer/solenoid for the initial/subsequent collection event:

1. On the timer control panel, press the bubble switch labeled "Enter" once. This will take the timer out of the power-saving/hibernation mode.



2. On the timer control panel, press the bubble switch labeled “Manu” once. This places the timer in the manual operation mode. On the display in the center of the bottom zone, the word “Open” should be present. If the word “Closed” is present, press the “Manu” bubble switch again and it should shift to the word “Open”. This action manually opens the solenoid and clears a flow/pressure path between the canister valve and the Veriflow control orifice and pressure gauge.
3. Fully open the canister bellows valve. Observe the pressure (i.e., “Hg vacuum) indicated on the gauge. Fully close the canister bellows valve.  
  
*Note: The bellows valve should be kept open for as short of a duration as possible – 10 seconds or less.*
4. Record the Pre-collection Canister Pressure in the appropriate space on the supplied Chain-of-Custody.

#### Programming the Timer



At this point, the Nutech 2701 timer/solenoid is ready to be programmed to automatically conduct the next scheduled collection event. Follow the programming steps provided below.

1. Set the current time (*local standard time*)
  - a. Push the “Set” key twice.
  - b. The LCD will show flashing digits that can be changed by pushing the left or right arrow keys. When finished, press the set button to move to the day of the week.
  - c. Change the day by pushing the left or right arrow keys. An arrow will be present above the selected day. When finished, press the “Enter” key to finish the time and day setting.
2. Set the sample start and end date / times
  - a. Program the sampling event by pushing the “set” button once to enter event setting.
  - b. Set event number (SEG on the display). Select 1 as your event number using the arrow keys. Once the event number

is set, "Open" will be flashing to set the valve function.


- c. Press "Enter" to confirm the open function. The time will flash. Set the sampling start time, followed by the day of the week using the arrow keys. Confirm the settings by pressing "Enter" to complete the program.

*Note: It's critically important that **00:01** be entered for the event start time (the timer will not recognize a start time of 00:00 and will not actuate).*

- d. The valve icon on the timer should appear as  indicating that the valve is in the closed position. During the sampling event, the icon on the timer will appear as .

3. To set the event stop time, push "Set" once to enter event setting. Set event number (SEG) first. Select 1 as your event number. Once you set the event number the (Open) will flash. Using right arrow key to move flashing to (Close), now (Close) is flashing for you to set the valve function. Push (Enter) to confirm the close function. Then the time will be flashing. You now set your sampling stop time [use **23:50**], followed by day of the week. Select the day of the week then push (Enter) to finish.

#### D. Sample Recovery and Data Collection

1. Activate the timer display by pressing the "Enter" button once. This will activate the screen with the current day of the week and current time of day (in Standard Time not Daylight Savings Time). The valve icon on the timer should appear as  indicating that the valve is in the closed position. The display will also indicate the total elapsed time for the previous sampling event.
2. Record the total elapsed time on the ERG Toxics/SNMOC Sample Data Sheet in the "Elapsed Time" blank in the "Field Recovery" section.
3. Open the solenoid valve by pressing the "Manu" button once.
4. Fully open the canister bellows valve.
5. Read the gauge and record the remaining pressure left in the can on the ERG Toxics/SNMOC Sample Data Sheet and record the reading in the "Field Recovery", "Field Final Can. Press. ("Hg)" blank. If the pressure is zero, note the lack of pressure in the "Comments" section of the form.

6. Close the canister bellows valve by turning the knob until it is snug.

*Note: The canister bellows valve should not be opened for any longer than is required to get an accurate pressure measurement (i.e. approximately 10 seconds).*

7. Close the timer solenoid valve by pressing the “Manu” button again.
8. Disconnect the canister from the Nutech 2701 timer/solenoid by unfastening the bellows valve inlet fitting from the timer outlet fitting.
9. Replace and secure the retained plug on the canister bellows valve.
10. On the ERG Toxics/SNMOC Sample Data Sheet, supply all required information in the “Field Recovery” section. Be sure to record any observations that were made during the run period.

#### 11. Sample Shipping

- a. Remove the pink copy of the ERG Toxics/SNMOC Sample Data Sheet and file in a site record.
- b. Pack the can and the completed white copy of the ERG Toxics/SNMOC Sample Data Sheet in the original cardboard shipping box and tape it closed. The can does NOT need to be shipped cold.
- c. Use the pre-filled out FedEx label provided by ERG, and fill out the “Sender” section with the sampling agency’s address and phone number. Send priority overnight to ERG at the address below.

ERG  
601 Keystone Park Drive  
Suite 700  
Morrisville, NC 27560  
919-468-7924

*Note: if the shipping form is lost, use the address below for shipping to ERG, and contact them directly for the FedEx accounting.*

#### IV. QUALITY ASSURANCE

To ensure that quality data is being collected the following checks should be considered:

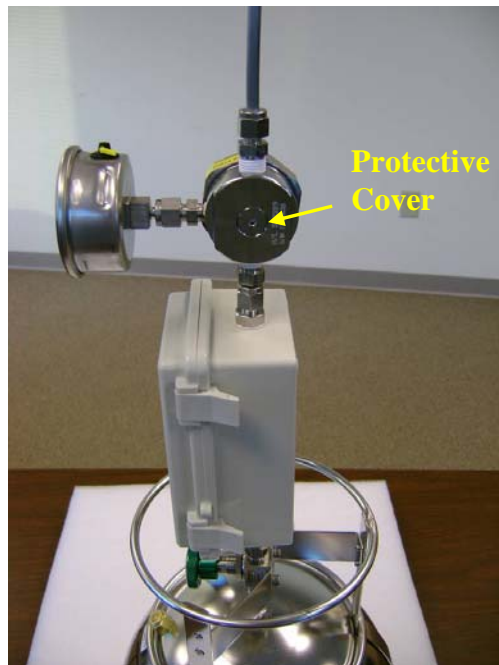
## A. Flow Calibration

Prior to deployment each Veriflow must be calibrated to a collection flow rate of approximately 3.2 cc/min to insure that the final pressures obtained over a 24-hour collection duration are appropriate. This calibration will be performed by EPA Contract Laboratory prior to shipment of each Veriflow to the field. Ideally, with a collection flow rate set-point of 3.2 cc/min, a 6L canister will attain a final volume of approximately 4,700 cc over a 24-hour (i.e. 1440 min) collection duration. The final volume of 4,700 cc equates to a final sample pressure in the canister of between 6 and 7 "Hg, which is the target final pressure for the EPA SAT program.

Because the Veriflows were calibrated at the EPA Contract Laboratory in Research Triangle Park, NC, variations in elevation, temperature, and barometric pressure between the calibration site and the field deployment site can cause variations in the final flow rate set-point realized. This variation in flow rate may necessitate adjustment of the collection flow rate set-point in the field. The following procedure presents the steps to accomplish the in-the-field set-point adjustment.

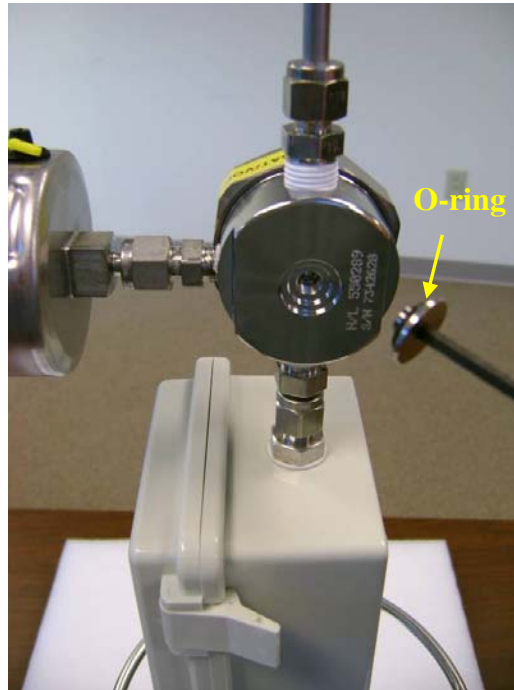
1. On the right hand side of the Veriflow unit, locate the adjustment screw protective cover (1/2 inch diameter disk with a 1/8 inch hex port located in the center) as shown in Figure 2.

Figure 2. Veriflow adjustment screw protective cover



2. Insert a 1/8 inch hex key into the hex port and rotate the protective cover counter-clockwise until it can be removed from the protective cover. Please note that the protective cover has an o-ring attached to it, as shown in Figure 3. The purpose of the o-ring is to ensure that the unit remains weather-tight while deployed. It is important that the o-ring be present when the protective cover is reattached to the Veriflow.

Figure 3. Removed protective cover with o-ring



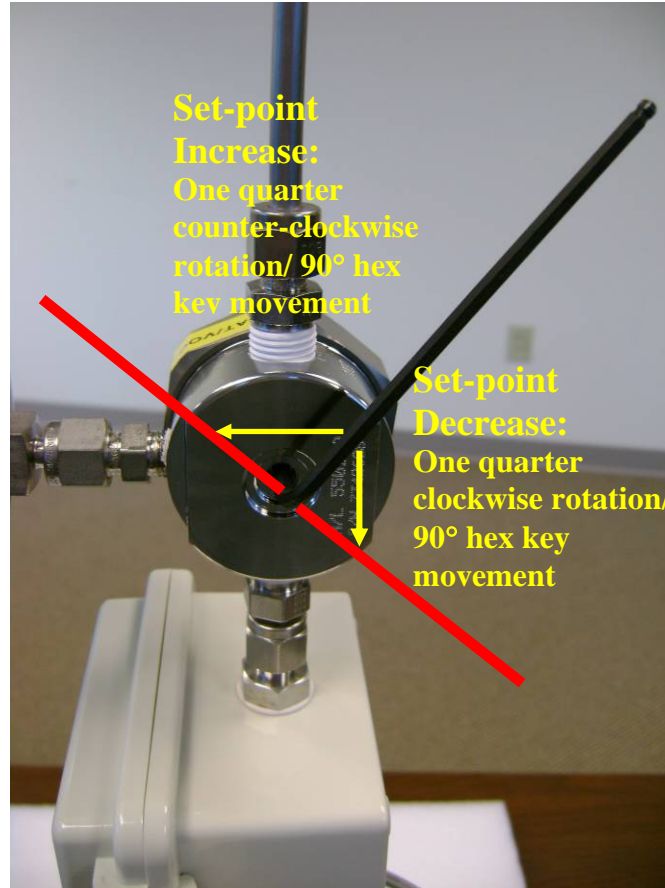
3. Under the cover is the actual flow rate adjustment screw (3/16 inch black circle with hex port located in the center), as shown in Figure 4.

Figure 4. Flow rate adjustment screw



4. To make adjustment to the flow rate set-point, insert a 1/8 inch hex key into the hex port on the adjustment screw. The Veriflow unit utilizes 5 full rotations to take the set-point from the bottom of its operational range (i.e. approximately 2 cc/min) to the top of its operation range (i.e. approximately 4 cc/min). As stated earlier, the units have been pre-calibrated for approximately 3.2 cc/min and should yield a final sample pressure is between 6 and 7 "Hg. However, it should be noted that final pressures between 1 and 10 "Hg are considered valid samples. If a final sample pressure between 1 and 10 "Hg is achieved, no adjustment is required. If the final sample pressure achieved is outside the acceptable range, or if a final pressure closer to the ideal set-point of 6 to 7 "Hg is desired a set-point adjustment will need to be made. To increase the flow rate, insert a 1/8 inch hex key into the hex port located in the center of the adjustment screw. Rotate the adjustment screw counter-clockwise. To decrease the flow rate, rotate the adjustment screw clockwise. It is recommended that adjustments be made in one quarter rotation increments between collection events, until the desired final sample pressure is achieved. The quarter turn adjustment can be easily gauged by observing the handle of the hex key so that it is positioned 90 degrees before or past its original position. See Figure 5.

Figure 5. Flow rate set-point adjustment



5. After adjustment replace the o-ring and protective cover. The Veriflow unit is now ready for use on the next sample collection episode.

## B. System Cleanliness


All equipment, with the exception of the timer, will be cleaned by ERG before shipment to the agency. If anomalies are observed, the ERG laboratory will notify the agency and a course of action will be identified. The operator should take care not to touch or contaminate the inlet, fittings, and other parts of the sampling train. These areas should be kept covered if possible when sampling is not occurring.

## V. 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. Figure 6 presents the ERG Toxics / SNMOC Sample Data Sheet.

FIGURE 6. ERG Toxics/SNMOC Sample Data Sheet

		ERG Lab ID # _____
<b>TOXICS/SNMOC SAMPLE DATA SHEET</b>		
<b>Lab Pre-Sampling</b>	Site Code: _____ City/State: _____ AQS Code: _____ Collection Date: _____ Options SNMOC (Y/N): _____ TOXICS (Y/N): _____	Canister Number: _____ Lab Initial Can. Press. ("Hg): _____ Date Can. Cleaned: _____ Cleaning Batch # : _____ Duplicate Event (Y/N): _____ Duplicate Can # : _____
	Operator: _____ Sys. #: _____ Setup Date: _____ Field Initial Can. Press. ("Hg): _____	MFC Setting: _____ Elapsed Timer Reset (Y/N): _____ Canister Valve Opened (Y/N): _____
<b>Field Recovery</b>	Recovery Date: _____ Field Final Can. Press. ("Hg): _____ Status:   Valid       Void       (Circle one)	Sample Duration (3 or 24 hr): _____ Elapsed Time: _____ Canister Valve Closed (Y/N): _____
	Received by: _____ Date: _____ Status:   Valid       Void       (Circle one) If void, why: _____	Lab Final Can. Press. ("Hg): _____
<b>SNMOC</b>	Analyst: _____ Batch I.D.: _____	Date: _____
	Analyst: _____ Batch I.D.: _____	Date: _____

Comments: \_\_\_\_\_  
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White: Sample Traveler

Canary: Lab Copy

Pink: Field Copy