

# National Human Exposure Assessment Survey (NHEXAS)

## *Region 5 Study*

## Quality Systems and Implementation Plan for Human Exposure Assessment

Research Triangle Institute  
Research Triangle Park, NC 27079

Cooperative Agreement CR 821902

### Field Operations Protocol

**RTI/ACS-AP-209-012**

**Title:** Procedure for Collection, Storage, and Shipment of Samples for Volatile Organic Compounds in Personal, Indoor, Outdoor, and Occupational Air

**Source:** Research Triangle Institute

U.S. Environmental Protection Agency  
Office of Research and Development  
Human Exposure & Atmospheric Sciences Division  
Human Exposure Research Branch

**Notice:** The U.S. Environmental Protection Agency (EPA), through its Office of Research and Development (ORD), partially funded and collaborated in the research described here. This protocol is part of the Quality Systems Implementation Plan (QSIP) that was reviewed by the EPA and approved for use in this demonstration/scoping study. Mention of trade names or commercial products does not constitute endorsement or recommendation by EPA for use.

**TITLE:** PROCEDURE FOR COLLECTION, STORAGE, AND SHIPMENT OF  
SAMPLES FOR VOLATILE ORGANIC COMPOUNDS IN PERSONAL,  
INDOOR, OUTDOOR, AND OCCUPATIONAL AIR

**SOURCE:** Research Triangle Institute  
Post Office Box 12194  
Analytical and Chemical Sciences  
Research Triangle Park, NC 27709-2194

**AUTHOR(s):**

Nert W. Turner

Date: 4/8/96

Date: \_\_\_\_\_

Date: \_\_\_\_\_

**APPROVED BY:**

Principal Investigator:

E. Pelligrani

Date: 4/23/96

QA Officer:

D.J. Smith

Date: 4/11/96

<b><u>STATUS:</u></b>	IN PROGRESS:	<input type="checkbox"/>
	DRAFT:	<input type="checkbox"/>
	FINAL VERSION:	<input checked="" type="checkbox"/>

**REVISIONS:**

No.	Date	No.	Date
0	4/23/96	6	
1	‡	7	
2		8	
3		9	
4		10	
5		11	

‡ Effective date of this version is the date of the last approval signature;  
revision 0 is the original version.

PROCEDURE FOR COLLECTION, STORAGE, AND SHIPMENT OF  
SAMPLES FOR VOLATILE ORGANIC COMPOUNDS IN PERSONAL, INDOOR,  
OUTDOOR, AND OCCUPATIONAL AIR

TABLE OF CONTENTS

<u>Section</u>		<u>Page</u>
<a href="#"><u>1.0</u></a>	<a href="#"><u>Scope and Application</u></a> .....	3
<a href="#"><u>2.0</u></a>	<a href="#"><u>Summary of the Method</u></a> .....	3
<a href="#"><u>3.0</u></a>	<a href="#"><u>Sample Collection Materials</u></a> .....	4
<a href="#"><u>4.0</u></a>	<a href="#"><u>Preparation of Materials</u></a> .....	4
<a href="#"><u>5.0</u></a>	<a href="#"><u>Sample Collection</u></a> .....	4
<a href="#"><u>6.0</u></a>	<a href="#"><u>Sample Storage and Shipment</u></a> .....	9
<a href="#"><u>7.0</u></a>	<a href="#"><u>QA/QC Procedures</u></a> .....	10

## 1.0 SCOPE AND APPLICATION

The procedures described in this protocol are designed to guide the collection of volatile organic compounds (VOCs) in air on passive charcoal badges, and the procedures for storage and shipping of the badges after collection. The badges will be used to assess personal exposures, occupational exposures, indoor air levels, and outdoor air levels of specific VOCs during Phase I of the National Human Exposure Assessment Survey (NHEXAS). Benzene, chloroform, perchloroethylene, and trichloroethylene are the primary target analytes; all of the analytes are listed in Table 1.

## 2.0 SUMMARY OF THE METHOD

The 3M Organic Vapor Monitor (OVM) #3520 (dual stage) will be used to passively collect VOCs in personal, indoor, and outdoor air. Sample collection is initiated by removing the cap from the OVM. The VOCs diffuse through a fixed membrane at a known rate and are adsorbed onto activated charcoal disks. The OVM badge will be attached near the breathing zone of participants for periods of approximately 144 hours to measure total inhalation exposure. For a subset of participants, a second badge will be covered during those periods spent at work. Occupational exposure will be measured by the difference between the two measurements. Badges will be deployed in the main living area of all homes and outdoors at a subset of homes over monitoring periods of approximately 144 hours (coincident with personal monitoring) to assess the sources of VOC exposure. At the end of the monitoring period, each badge will be capped and stored until it is shipped to the analysis laboratory, where it will be solvent extracted and analyzed by GC/MS.

### Method References

3M, "Organic Vapor Monitor Sampling Guide for Organic Vapor Monitor #3500/3510, Organic Vapor Monitor with Back-Up Section #3520," 70-0701-1274-6(68.3)R2CFD260A.282A, 3M Occupational Health and Safety Products Division, Building 220-3E, 3M Center, St. Paul, Minnesota 55144-1000.

3M, "Organic Vapor Monitors #3520 with Back-up Section, Instructions for Use," 3M Occupational Health and Environmental Safety Division, 3M Center 220-3E-04, St. Paul, MN 55144-1000.

Shields, H.C. and C. J. Weschler. "Analysis of Ambient Concentrations of Organic Vapors with a Passive Sampler," JAPCA 37:1039-1045, 1987.

Pellizzari, E., L. C. Michael, and S. Cooper. "Performance and Validation of VOC Collection and Analysis Using OVM 3520 Charcoal Badges," manuscript in preparation.

### 3.0 SAMPLE COLLECTION MATERIALS

- 3.1 3M #3520 Organic Vapor Monitor
- 3.2 Personal OVM badge holder
- 3.3 OVM badge cover for occupational exposure monitoring
- 3.4 Indoor VOC badge holder
- 3.5 Outdoor VOC badge holder
- 3.6 Refrigerator, freezer, or cooler
- 3.7\* Custom-made protective screen cap for personal badges, with Viton o-rings

### 4.0 PREPARATION OF MATERIALS

All materials are used "as is"; no presampling preparation is necessary.

### 5.0 SAMPLE COLLECTION

#### 5.1 Personal Samples

- 5.1.1 Identify the participant that will wear the OVM badge.
- 5.1.2 Remove the badge and the closure cap from the can.
- 5.1.3 Affix a sample code label to the back of the badge. Apply a piece of clear tape over the label to protect it from abrasion or adverse weather.
- 5.1.4 Return the closure cap to the can and replace the plastic can lid.

5.1.5\* Slide two o-rings onto the badge, then slide the protective screen over the o-rings

5.1.6\* Attach the badge to the lapel of the participant or to the badge holder that the participant will wear, making sure that the holder is adjusted to keep the badge no lower than the middle of the participant's chest. (If the participant is collecting aerosol samples, the VOC badge will be attached to the aerosol belk pack).

NOTE: For babies, attach the badge as close as possible to the baby but out of the baby's reach. For toddlers and young children, the badge may pinned to the shirt or badge holder to keep the child from removing.

5.1.7 Record the sample code, start time, start date, and your identification number in the sample collection record (see Figure 1 for information to be collected).

5.1.8 Train the participant (or participant's caretaker) how to wear the OVM badge.

5.1.8.1 Tell the participant that it is very important that the badge be worn whenever the participant is awake and not in the water (shower, bath, pool, etc.). We are trying to collect a sample of all of the air that they breathe.

5.1.8.2 Tell the participant that the badge should be in the same room when they shower, bathe, or go in a pool.

5.1.8.3 Tell the participant that the badge should be placed on a table or hanger as close as possible to their heads while they sleep, and to start wearing the badge as soon as they arise. (It may help to write a note or attach the badge to something they will wear the next day so that they don't forget to put on the badge in the morning).

5.1.8.4 Tell the participant that the white side of the badge should never be covered with clothes, jackets, or coats and that the white side should never be face down against any surface.

5.1.8.5 Demonstrate for the participant how and where to attach the badge.

5.1.8.6 Ask the participant to attach the badge or put on the badge holder while you watch. Suggest corrections as necessary.

- 5.1.8.7 Ask the participant if they understand how and when to wear the badge. Provide additional instruction as necessary.
- 5.1.8.8 If the participant is a child 6 years old or older, discuss with them the importance of wearing the badge all of the time and not playing with it or losing it.
- 5.1.8.9 If the participant is a child younger than 6 years old, work with the caretaker for the best wearing arrangement. Ask the parent to discuss the badge with teachers or day care providers.
- 5.1.8.10 If the participant forgets to wear the badge for any period of time, they should be asked to write down the approximate amount of time the badge was not worn on each day. They may write this on the instruction sheet.
- 5.1.9 At the end of the monitoring period (approximately 144 hours after deployment), retrieve the OVM badge.
- 5.1.10 Remove the white face and retaining ring from the top section of the badge.
- 5.1.11 Remove the closure cap from the can and immediately snap the closure cap on the top of the badge and insure that the ports are tightly plugged.
- 5.1.12 Write the study sample code (not the badge number) on the plastic lid of the can. Double check the number you have written to be sure it matches the code number on the label.
- 5.1.13 Place the closed badge into the can and replace the plastic lid.
- 5.1.14 Record the finish time, finish date, and your identification number on the sample collection record. Verify the sample code.
- 5.1.15 Return the collected badge to the mobile laboratory.
- 5.1.16 Place the collected badge in a freezer, refrigerator, or cooler, so that it is stored at a temperature of 6EC or colder until it is shipped to the analytical laboratory.

## 5.2 Occupational Monitoring

- 5.2.1 Samples will be collected from a subset of participants to calculate their occupational exposure by a differential method.
- 5.2.2 Repeat steps 5.1.1 through 5.1.6 to begin sample collection.

- 5.2.3 Place a piece of white marking tape on the occupational badge so the participant can easily identify it.
- 5.2.4 Train the participant how and when to use the badge cover.
  - 5.2.4.1 Explain to the participant that the second badge is going to be used to help find out how much of their exposure is due to the air in their work environment. Explain that we will calculate work exposure by covering the second badge during working hours, then subtracting the result from the first badge that stays uncovered all of the time. Explain that the first badge should be worn uncovered at all times.
  - 5.2.4.2 Tell the participant that most of the time the second badge will be worn just like the first badge.
  - 5.2.4.3 Tell the participant that we want them to cover the second badge (the badge with the tape) as soon as they enter their workplace or, if they do not have a fixed work location, to cover the badge as soon as they begin their work duties.
  - 5.2.4.4 Tell the participant that they should uncover the second badge as soon as they leave their workplace, or finish their work duties each day.
  - 5.2.4.5 Tell the participant that they do not have to uncover their badge if they take a break for 15 minutes or less during the middle of a work period (i.e., coffee breaks).
  - 5.2.4.6 Tell the participant that outside of work, they should treat both badges in an identical manner.
  - 5.2.4.7 Demonstrate for the participant how to cover and uncover the badge.
  - 5.2.4.8 Ask the participant to cover and uncover the badge. Suggest corrections as necessary.
  - 5.2.4.9 Tell the participant to write down the total amount of time they cover their badge each day. They may write this time on the instruction sheet.
  - 5.2.4.10 Ask the participant if they understand how and when both badges are to be worn. Provide additional instruction as necessary.



- 5.2.5 At the end of the monitoring period, retrieve the sample using procedures described in Section 5.1.8 through 5.1.15. Calculate and enter the total time covered in the sample collection record.

### 5.3 Indoor Sample Collection

- 5.3.1 Repeat steps 5.1.1 through 5.1.3 to begin sample collection.
- 5.3.2 Record the sample code, start time, start date, and your identification number in the sample collection record.
- 5.3.3 Attach the badge to the indoor sampling stand.
- 5.3.4 Locate the stand using the following criteria.
- 5.3.4.1 Determine the main living area of the home. It is defined as the room where the participant spends the most time when awake. Ask the participant (or parent) to provide this information.
- 5.3.4.2 Make sure the stand is at least one foot away from any wall. The target height is three feet from the floor, with an allowable range of two to six feet.
- 5.3.4.3 Make sure that air from heating or air conditioning systems will not blow directly on the badge.
- 5.3.4.4 Make sure that the badge is not within three feet of any observable VOC source; including ashtrays, shelves or cabinets with cleaners or chemicals, etc.
- 5.3.4.5 Make sure that the white face of the badge is not covered or obscured, nor is in danger of being obscured during the sample collection period.
- 5.3.4.6 Make sure that the stand is not in a location where it is likely to be knocked over, particularly if there are small children or pets in the home.
- 5.3.5 At the end of the sampling period, retrieve the badge using the procedures described in Sections 5.1.8 through 5.1.15.

### 5.4 Outdoor Sample Collection

- 5.4.1 Repeat steps 5.1.1 through 5.1.3 to begin sample collection (Note: samples are collected only at a subset of homes).
- 5.4.2 Record the sample code, start time, start date, and your identification number in the sample collection record.
- 5.4.3 Attach the badge to the outdoor sampling stand under the rain/sun shield.
- 5.4.4 Locate the stand using the following criteria:

- 5.4.4.1 Whenever possible, place the stand in the back yard of the home. When this is not possible, try to place the stand at least 12 feet from the home. When this is not possible, locate the stand in the most secure area, trying to follow the remaining siting instructions below. If absolutely necessary, the badge may be placed on an apartment balcony or fire escape, or hung out of a window if the home is a multi-story apartment building and no suitable ground sites are available.
- 5.4.4.2 The badge will ideally be sited between four to six feet above the ground. Alternative heights may be used for non-ground floor locations.
- 5.4.4.3 Make sure that the badge is at least 12 feet, and generally as far as possible, from vehicle parking areas.
- 5.4.4.4 Make sure that air from heating, air conditioning systems, or exhaust vents will not blow directly on the badge.
- 5.4.4.5 Make sure that the badge is not within three feet of any observable VOC source; including grills, fuel, chemical or cleaner containers, etc.
- 5.4.4.6 Make sure that the white face of the badge is not covered or obscured, nor is in danger of being obscured during the sample collection period.
- 5.4.4.7 Make sure that the stand is not in a location where it is likely to be knocked over, particularly if there are small children or pets at the home.
- 5.4.5 At the end of the sampling period, retrieve the badge using the procedures described in Sections 5.1.8 through 5.1.15.

## 6.0 SAMPLE STORAGE AND SHIPMENT

- 6.1 Place the collected sample in a refrigerator, freezer, or cooler upon return to the field laboratory or storage area.
- 6.2 The sample must be kept at a temperature no higher than 6EC until it is shipped.
- 6.3 Ship the sample to the Research Triangle Institute within fourteen days of collection.
- 6.4 Ship the sample by overnight carrier, no refrigeration is required during shipment.
- 6.5 Upon receipt in the laboratory, badges will be stored inside their cans inside a freezer with a temperature of -10EC or lower.

## 7.0 QA/QC PROCEDURES

### 7.1 Sample Code

7.1.1 A unique sample code must be assigned to each sample.

7.1.2 The badge must have a label with a sample code identical to the code in the sample collection record.

### 7.2 Sample Custody

7.2.1 Complete the sample collection information (sample code, time and date collected) on the sample collection record when the sample is collected.

7.2.2 Enter the collector ID in the appropriate field in the collection record.

7.2.3 Print the custody record prior to shipping the sample and enclose the original custody record with the samples when they are shipped.

### 7.3 Quality Control Samples

#### 7.3.1 Collocated Sample Collection

7.3.1.1 Collocated samples are collected to assess collection and analysis precision.

7.3.1.2 Collocated samples are collected from a small percentage of participants, with the percentage to be defined in the QSIP.

7.3.1.3 Collocated samples are collected, stored and shipped following the same procedures as samples.

#### 7.3.2 Field Blanks

7.3.2.1 Field blanks are used to assess background and contamination associated with the OVM materials, storage, and shipping procedures.

7.3.2.2 Field blanks (unused badges) will be set-aside for a small percentage of the participants, with the percentage to be defined in the QSIP.

7.3.2.3\* Field blanks will be prepared by taking a OVM badge to a home, opening the can, applying a label, and immediately placing the closure cap on the badge and returning the badge to the can. The field blank is then stored and shipped with the samples.

#### 7.3.3 Field Controls

7.3.3.1 Field controls are used to assess recovery of target analytes from the sample collection medium.

- 7.3.3.2 Field controls will be prepared for a small percentage of the participants, with the percentage to be defined in the QSIP.
- 7.3.3.3 Field controls will be prepared in the laboratory and shipped to the field site. Analytes will be loaded onto badges from atmospheres containing known levels (Pellizzari, et al, 1994). The total quantity of each analyte loaded will yield a nominal level of 500 pg/FL in the extraction solvent prior to analysis.
- 7.3.3.4 The field control is carried to a home. The field control is then stored and shipped with the samples.

TABLE 1. TARGET ANALYTES

Primary	Secondary
Benzene	Methylchloroform
Chloroform	Methylene Chloride
Perchloroethylene	Styrene
Trichloroethylene	Toluene
	Xylenes
	p-Dichlorobenzene

SAMPLE TYPE:	Personal, Occupational, Indoor, or Outdoor
SAMPLE CODE:	Same as label on the OVM badge
PARTICIPANT ID:	Three digit participant i.d. number
START DATE:	Date sample collection begun
START TIME:	Time sample collection begun
COLLECTOR ID:	ID number of person that initiated sample collection
END DATE:	Date sample collection ends
END TIME:	Time sample collection ends
COLLECTOR ID:	ID number of person that completes sample collection
COLLECTION LOCATION:	P=personal                      NW=non-workplace O=outdoor                      I=indoor
COVERED TIME:	For occupational samples, the amount of time that the badge is covered.
COMMENT CODE:	Default = 0; change to 1 or 2 if a comment is added below
COMMENT:	Add text for any comments associated with this particular sample.

Figure 1. Information to be included on the sample collection record.

## EXPLANATION OF REVISIONS

Revisions Made 4/96; Denoted by\*

Sections 3.7 and 5.1.5

A protective screen was developed to prevent the badge membrane from puncture during a participant's normal activities. These revisions add the screen at its application.

Section 5.1.6

If participants are going to wear a personal aerosol sampler, the VOC badge will be attached to the aerosol pump belt pack. This change was made to simplify wearing different personal samplers by the participant.

Section 7.3.2.3

Revised to include application of a sample code label.