Environment Canada | Environnement Canada

Centre For Atmospheric Research Experiments | Centre de Recherche Atmospherique

Environment Canada

Great Lakes Water Quality Agreement Annex 15

Integrated Atmospheric Deposition Network

Sampling Protocol Manual (SPM)

September 2002 (Version 4)

TABLE OF CONTENTS

1. INTRODUCTION

This document is one of a series of manuals, reports, and quality assurance documents which describe in detail the procedures for the operation of Canadian Master and Satellite stations established under the auspices of the Integrated Atmospheric Deposition Network (IADN) for measuring the input of toxic chemicals to the Great Lakes. This network of Canadian and U.S. stations form the basis for the acquisition of air concentration and precipitation concentration data on the priority chemicals of concern in the Great Lakes Water Quality Agreement (GLWQA) as updated from time to time. A description of the IADN can be found in the report entitled "Technical Summary of Progress 1990-1996 (Hoff and Bandemehr, 1998), and Atmospheric Deposition of Toxic Substances to the Great lakes: IADN Results to 1996 (Galarneau, et al, 2000).

Examples of chemicals currently being studied under the IADN are polychlorinated biphenyls (total PCBs and major congeners), hexachlorocyclohexane (the alpha and gamma congeners), the polycyclic aromatic hydrocarbons (PAHs, with benzo(a)pyrene identified as a goal for routine measurement) and the trace metal, lead.

In addition to these, methodologies have been developed during the period of the IADN first implementation period (1990-1996) for the accurate measurement of chlorinated pesticides, such as DDT plus its metabolites, chlordane, nonachlor, heptachlor epoxide, methoxychlor, dieldrin, endrin, and the trace metals arsenic, selenium, cadmium and mercury.

The IADN is an evolutionary network of research grade and routine monitoring stations involving a number of different U.S. and Canadian agencies. Each agency which contributes to the IADN has prepared sampling and analysis protocol documents as part of the Quality Assurance and Quality Control programme. The present document describes the sampling protocols for the Canadian federal agency sampling done within the IADN. The U.S. EPA sampling program operates under a separate Quality Assurance Project Plan (QAPP) and has separate protocol documents (Basu et al, 1995). These programmes and their operating/analysis protocols are described in the documents listed in Appendix A.

As outlined in the second IADN Implementation Plan (1999), the conceptual design for the network consists of one "Master" station on each of the Great Lakes and additional "Satellite"

stations. Master stations contain some replication of sampling in order to determine the precision of the measurements. Satellite stations are smaller, consisting of a subset of samplers, often only measuring either air or precipitation samples. Master stations are also host sites for co-located sampling from the various agencies involved. In particular, Point Petre is now operating as such an intercomparison site.

The Canadian Federal component of sampling in the IADN consists of continuous (routine) research-grade monitoring and short-term research projects. The latter varies from year-to-year and will not be described in this document.

This amendment incorporates improvements to the methods of using existing equipment, and equipment recently introduced such as Volumetric Hi-Volume Samplers and roots meters, to the network as part of the processes involved to acquire more accurate samples to measure for toxic substances. The latest date for each chapter is noted in the header.

This document is designed to serve both as a description of the sampling procedure and as a manual for the laboratory and field personnel. Sample analysis procedures are described here but not in detail. Each chapter provides distinct headings for the laboratory personnel and for the field personnel. As a training aid, it will be simplest if field personnel read the introductory sections of each chapter and then proceed to the Field Technician's Duties. For completeness, he or she will want to understand what is carried out by the laboratory staff, but this is not mandatory for initial training.

Future modifications to these instructions will be issued as replacement pages to this manual.

Since there will be errors and omissions found in this Manual, Chapter 6 provides a mechanism for reporting and changing those errors.

The IADN web page is at: http://www.msc.ec.gc.ca/iadn/

ORGANICS HIGH VOLUME SAMPLER

OPERATORS MANUAL

2. OPERATOR'S MANUAL FOR ORGANICS HIGH VOLUME SAMPLERS

2.1 PURPOSE AND DESCRIPTION

The mass flow high volume sampler's polyurethane foam plug (PUF) assemblies are designed to sample both particulate and gas phase organic compounds in air. They do so by pulling a regulated flow of air through the sampling assembly for a measured amount of time. The flow, in cubic meters per minute, times the number of minutes sampled, gives the total air sample volume (in cubic metres). The concentration of material in the sampled air is determined by dividing the mass of the material collected by this sample volume. From this we can see that it is just as important to measure the flow (air volume), as it is to measure the amount of material on the filter/foam assembly, for determining concentrations of matter in the air. See the commercial suppliers' description for further details.

The high volume sampler and the sample cartridge are pictured in Figure 2.1. A brief description of these follows.

The sampling cartridge assembly consists of an interchangeable head which seats in the one inch inlet (sample port) in the upper chamber of the sampler. This port is connected to the flow manifold and the pump. The cartridge is installed by seating the sample head and pushing down on the two locking pins (levers). This secures the cartridge in place. Removal of the cartridge is the reverse; pull up on the pins, and lift out of the sample port.

The upper stage of the sample cartridge is a filter holder. Within is a 10.2 cm glass fibre filter, supported between two teflon gaskets. The lower section contains the PUF plug, which has been inserted in a pyrex cylinder. The upper stage filter is designed to remove particulate matter from the air flow. The PUF plug (similar to upholstery foam) is porous and allows the air to flow through. As this happens, gaseous organic compounds are left behind in the foam. The size of the foam plug, the air flow rate and the sampling period have been calculated so as to saturate the foam plug but minimize the amount of loss of some of the lighter organic compounds (breakthrough).

Figure 2.1 High Volume (Hivol) PUF Sampler

The lower compartment of the sampler contains the motor, metering and timing readouts.

The flow is regulated by providing a restriction (orifice) to the flow within the brass by-pass system, located just ahead of the motor. The manometer gauge (magnahelic) measures the pressure drop across this orifice (a measure of the flow through the orifice). Flow rates are regulated by varying the voltage on the motor. The magnahelic reading is specified during regular motor servicing and calibrations.

The timer records the accumulated time the sampler is in operation. Timer start and finish readings are recorded by the operator for each sample. Since the timer is dependent on the sampler power supply for power, it will not run during power failures, hence it will only record time that the motor was on for the purposes of sampling. Note however that the timer will continue to run in the event of a motor failure. The sample volume will then be adjusted by the actual time of sampling.

The PUFS are cleaned and each cleaned batch is sent to the AES chemistry laboratories for proofing prior to being released for sampling.

2.2 LABORATORY TECHNICIAN'S DUTIES (AES or CARE Chemistry laboratory)

2.2.1 PUF CLEANING

All glassware, utensils, and foil that come into contact with the PUFS must be rinsed in hexane. Batches of 12 PUFS are extracted in ~2500 ml of 50/50 mixture of acetone/hexane (grade) using boiling ships to prevent “bumping”. After 24 hours the solvent is dispensed and the PUFS are further extracted in 2500 ml hexane . Following extraction, the PUFS are dried in a heated glass drying tube with nitrogen as a drying gas. UHP nitrogen gas is passed through a florisel cartridge for 4 to 6 hours and then through the drying tube at a rate of 3 ml/min for ~ 70 minutes.

Glassware is cleaned in a dishwasher without soap, rinsed with acetone and heated to 250^0C. The PUFS are stored in cleaned glass jars with teflon lined caps, as well as teflon tape lining the threads of the jar. The caps are previously washed in detergent, then rinsed with acetone.

2.2.2 PROOFING OF PUF’S CLEANED

Cleaned PUFs in the sample jars are then sent to the MSC Chemistry laboratory for proofing prior to being cleared for use.

The polyurethane PUF plug cartridges should be a precisely sized sampling medium. The ability of these cartridges to sample organics in air is related to their cross-sectional surface area, length and density. Since these factors should be constant, they should be checked and recorded for each batch of PUFs purchased. Current procedures require the purchase of the pre-cut and packaged PUF cartridges in lots of 200 or more with 25 PUFs per package.

To check the PUFs from each lot, use the following procedure:

a) Wearing clean poly gloves, randomly remove three PUFs from each batch.
b) Using a stainless steel ruler which has been wiped clean with hexane, measure the PUF diameter (d in cm) and length (L in cm) to the nearest 0.5 mm.
c) Using a weighing boat which has been tared on the scale, weigh each PUF (W in g),
d) Calculate the PUF density, m in g cm^3, from:

$$m = \frac{W}{p \; d^{2} L / 4}$$

e) Average the three results and record this density with the PUF batch number on the initial sample sheet for this PUF batch.

f) Since these weighed PUFs will still be cleaned, they may be returned to the batch for later use.

The date and any other information pertaining to the cleaning of each batch is to be recorded in a log.

All handling of the PUFs is to be recorded on the PUF Batch Inventory Form, the PUF/GFF Sample Tracing Log and the Sample History Form (section 2.3.4).

PUFs are to be stored in jars in a clean storage area until mounted for sampling. From each clean batch, 1 PUF is randomly selected to submit to the the laboratory for proofing. The laboratory will analyze the PUF for organics (PCB's, PAH's, and OC's) and provide results within 2 weeks. PUFs will be considered clean if no peaks greater than 2 times the instrument detection limit (IDL) are found. PUFs will be recleaned if the batch does not meet this criteria. **PUFs are not to be used in the field until the batch has been cleared for use by the laboratory.**

2.2.2 PUF BATCH INVENTORY FORM

The PUF Batch Inventory Form (Figure 2.3) is used to assist the Laboratory Technician at CARE by keeping a record of the number of PUFS cleaned and approved from each batch. It also provides a record of the number of PUFS available for loading on the sampling cartridges so action may be taken to clean more when necessary. This form is to be completed by the technician at CARE and is to be kept in the CARE Laboratory.

Figure 2.3 PUF Batch Inventory Form

PUF Batch Inventory Form

Batch #	Number of Pufs	Date Sent to HQ	Approved Y/N	Date Approved

Number of PUFS Available	Date	Remarks

REV: November 22, 2000

2.2.3 CLEANING SAMPLING CARTRIDGES AND LOADING THE PUF

This section outlines the steps to be taken by the laboratory technician when loading the PUF plugs and glass fibre filters into the sampling cartridges. All steps are to be carried out in a clean environment, using approved safe handling techniques when handling chemicals, such as hexane.

Review the necessary safety regulations prior to commencing operations. To ensure clean, uncontaminated samples, all instruments used are to be cleaned with hexane. A fume hood MUST be used when cleaning with hexane. As well, technicians shall wear polyethylene (poly) gloves while handling this chemical.

a) All components of the cartridges must be cleaned prior to loading a new PUF and filter. This is normally done the day preceding the loading of the cartridges. The pyrex inserts are washed in the laboratory glassware cleaner (dishwasher) using the normal reference cycle. A separate tray is used to hold the pyrex inserts. The Teflon gaskets are also washed using the short cycle for plastic materials. **No detergents are to be used** for any of the components, only hot water is to be used with a de-ionized water rinse. The components are allowed to air dry overnight in the cleaner.
b) Put on protective clothing as supplied.
c) Place a box of poly gloves, a box of large Kimwipes, a pipette dispenser of hexane, a PUF sample cartridge (disassembled - Figure 2.4), a hexane waste container and the tongs/forceps required to load both PUF and glass fibre filters, in the fume hood. Turn on the fume hood fan to high speed.
d) Wearing poly gloves, ensure there is a sufficient supply of hexane in the dispenser.
e) Dispense hexane on a new Kimwipe and wipe down the outer shell components of the sample cartridge, the silicon gaskets and the snap cap. Place on a clean Kimwipe to dry. With a fresh Kimwipe, wetted with hexane, wipe the teflon gaskets, the inside and outside of the pyrex insert, the tongs and forceps, and the screen grid of the glass fibre filter holder.
f) Dispose of the Kimwipes in the waste container in the fume hood and allow the hexane to evaporate. Remove and dispose of the poly gloves.
g) Cover a suitable portion of the surface of a clean lab bench with Kimwipes or benchkote paper. This will be the assembly area. Remove the jar containing the PUF plug that will

be sampled next and place on the lab bench. Place the box of glass fibre filters nearby. Wearing clean poly gloves, place the sample cartridge components and instruments just cleaned, onto the work area.

h) Put the snap cap on the lower exhaust port.

i) Place the thinner teflon gasket on the screen grid of the filter holder. Using the forceps, remove a glass fibre filter and place this onto the teflon gasket, rough side up (Figure 2.5). Place the thicker teflon gasket over the filter. Install the top section of the filter holder as well as the cover plate (Figure 2.6). Secure finger tight with the thumbwheels. Do not overtighten, as the filter may rip. Clean filters are stored smooth side up in the box.

j) Install the silicon gaskets in the upper and lower sections of the sample cartridge.

k) The next step is loading the PUF plug. Put on fresh poly gloves. Open the sample jar and with the tongs, remove the plug using as little compression of the plug as possible (this is best accomplished by alternately freeing opposite sides of the plug from the jar while lifting out).

l) Place the plug into the pyrex cylinder, tamping it in place to ensure that there are no gaps present (Figure 2.7). Place the pyrex cylinder into the lower shell casing (Figure 2.8) and screw this into the top (filter holder) section (Figure 2.9). Affix proper identification labels using plastic marking tape on both the cover plate and the lower shell.

m) Store the assembled cartridge in a clean poly lab bag and seal with either twist ties or an elastic band (Figure 2.10). Store in a clean area until needed (a refrigerator may be used at this point but it is not necessary).

n) Label the jar ensuring the station identifier (eg. EGB - see Appendix D) is correct (see appendix F), reseal the glass jar and place it in the refrigerator. Ensure that the jar has the same ID label as the cartridge.

o) Remove poly gloves and dispose.

p) The PUF/GFF Tracing Log (Figure 2.11) must be filled out immediately noting the sample number, PUF batch number, the GFF lot number, and the date loaded.

q) Any additional components that are clean may be placed in a clean poly lab bag and stored until needed.

Figure 2.4 Materials for Assembling PUF/GFF Cartridges

Figure 2.5 Place filter on Teflon Gasket

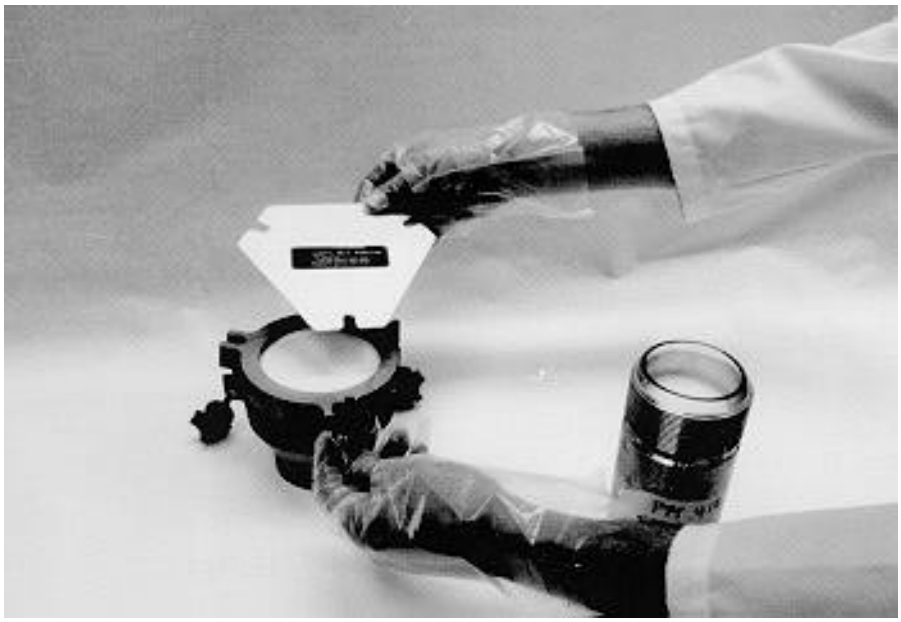


Figure 2.6 Install the Top Section

Figure 2.7
Place the PUF into the Pyrex cylinder

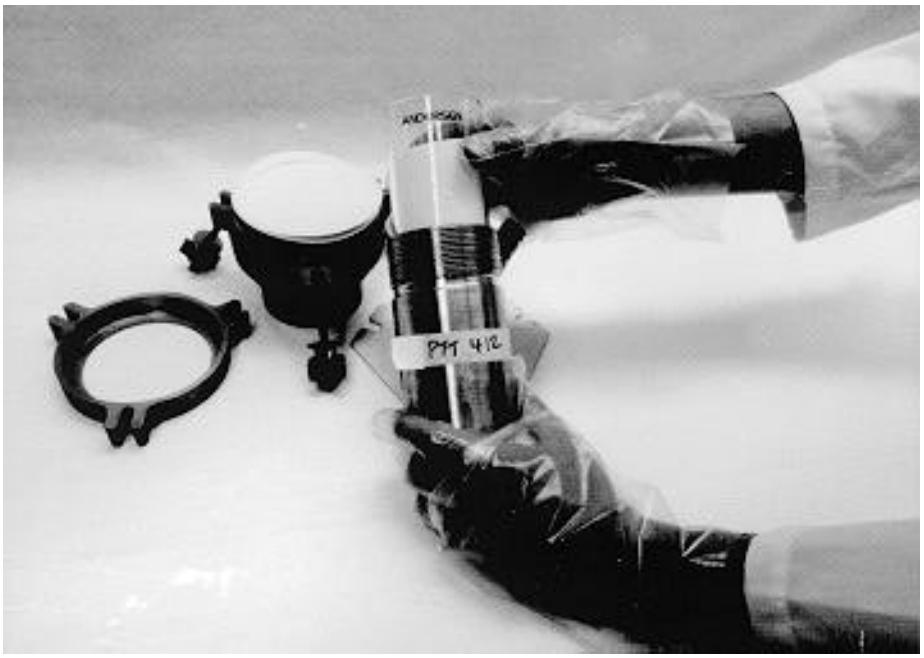
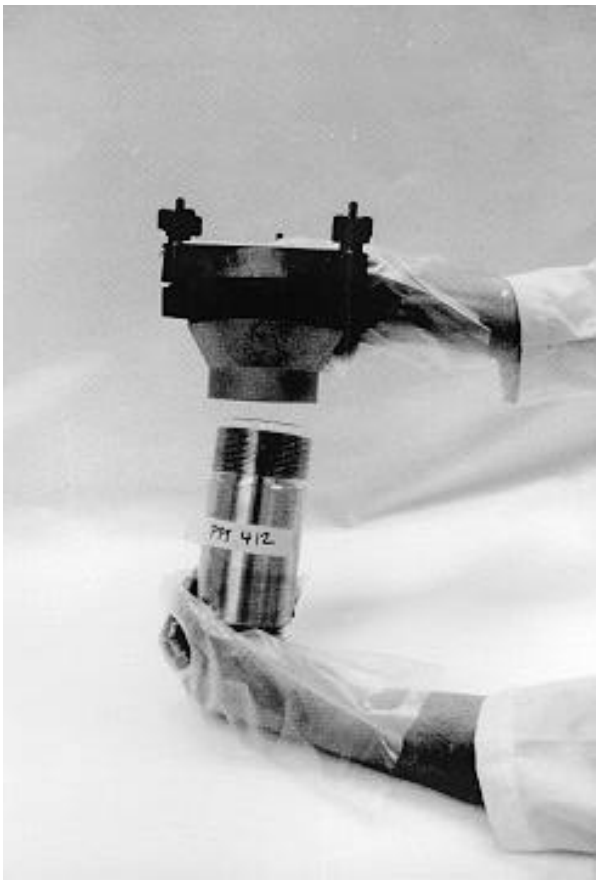


Figure 2.8 Place the Pyrex cylinder into the lower shell casing.

Figure 2.9
Screw the top and bottom cylinder casings together.



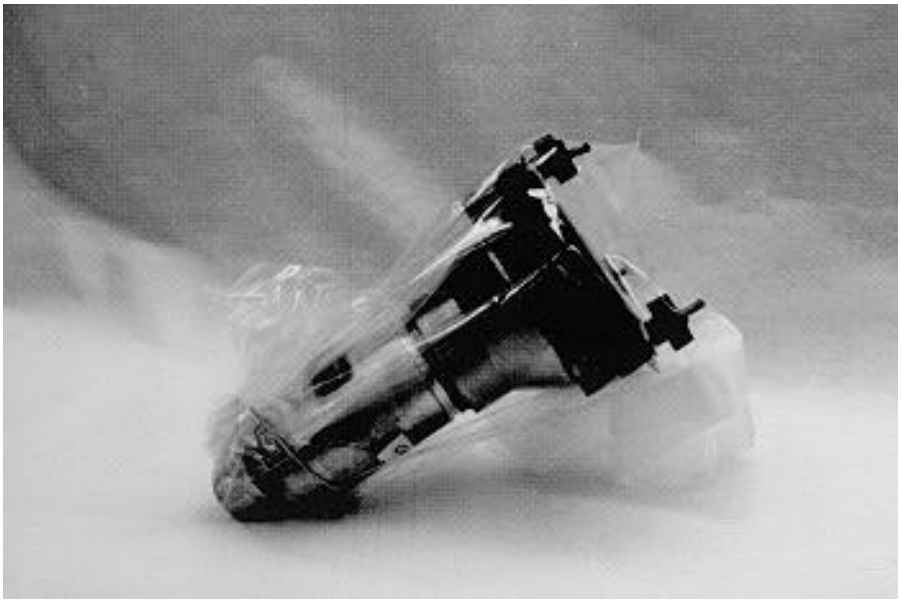


Figure 2.10 Store in a clean poly bag and seal.

2.2.4 SHIPPING AND RECEIVING OF SAMPLES (PUF PLUGS)

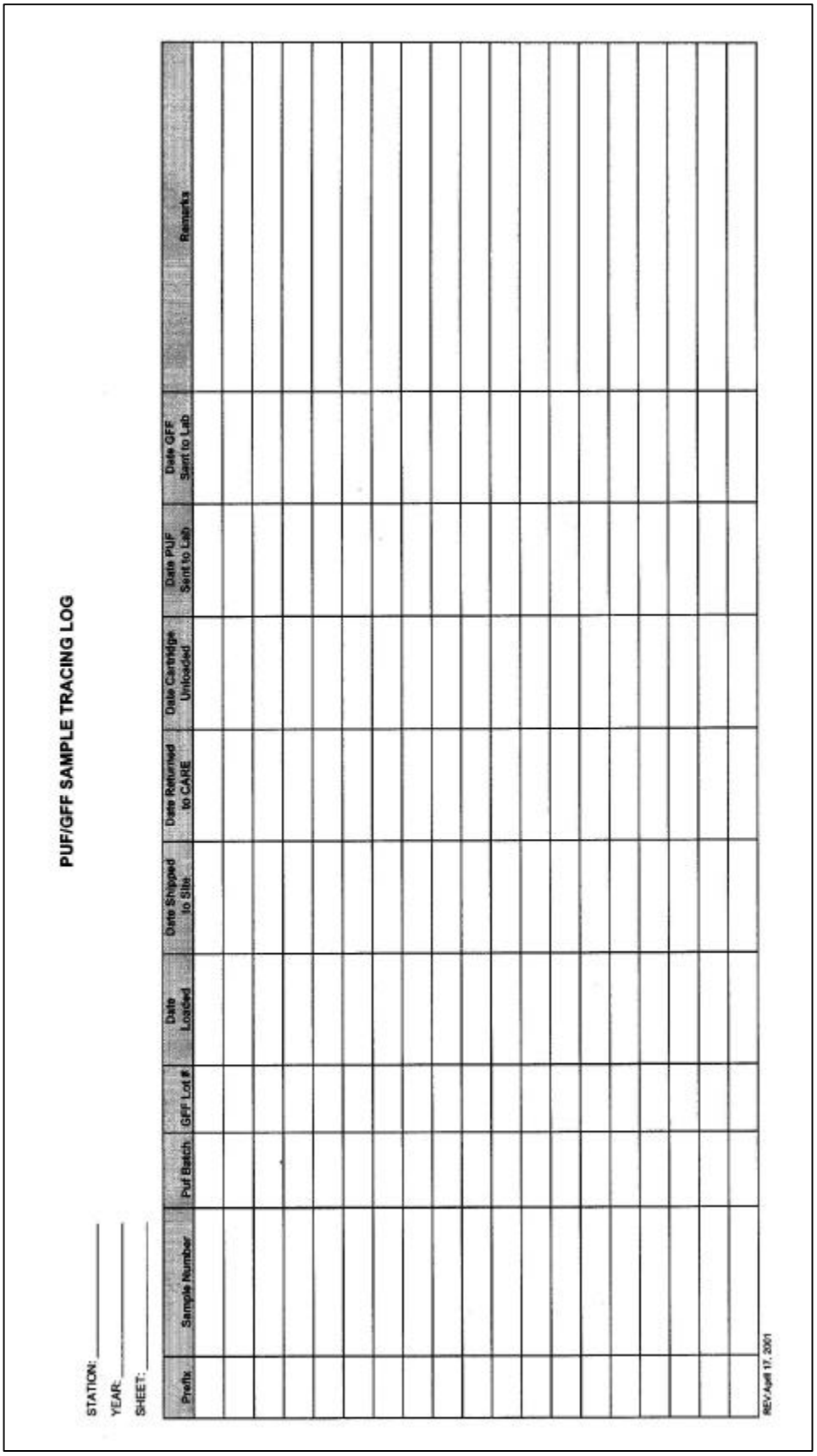
Samples are usually shipped to the sites in refrigerated coolers. It is not necessary to keep them refrigerated at this stage, but coolers are used as a clean container since they are required to transport exposed samples. Samples are shipped in lots of two sets (minimum) and transported to and from sites, on average, every field visit (3 months). The actual shipping date of the samples to the site must be noted on the PUF/GFF Sample Tracing Log (Figure 2.11).

Exposed filters should not remain at a field site for more than 3 months and are to be returned to CARE in batches of no less than 3-5 (full cooler lot) during each trip. During return from the site the samples must be kept refrigerated and the return date recorded on the PUF/GFF Sample Tracing Log.

All exposed filters are to be shipped to the Organics laboratory for analysis within 15 days after the quarters end (Dec. 15, Mar. 15, Jun 15, Sep. 15). If, due to weather or other reasons it is not possible to meet the above schedules alternate arrangements are to be discussed with the CARE manager.

2.2.5 PUF/GFF SAMPLE TRACING LOG

The PUF/GFF Sample Tracing Log (Figure 2.11) is to be completed by the CARE Laboratory Technician and is used to keep a record of the location of all PUFS and GFF filters loaded for sampling at each site and subsequent shipping to the MSC Laboratories for analysis.



PUF/GFF SAMPLE TRACING LOG

STATION: _____
YEAR: _____
SHEET: _____

Prefix	Sample Number	Puf Batch	GFF Lot #	Date Loaded	Date Shipped to Site	Date Returned to CARE	Date Cartridge Unloaded	Date PUF Sent to Lab	Date GFF Sent to Lab		Remarks

REV April 17, 2001

Figure 2.11 PUF/GFF Sample Tracing Log

2.3 FIELD TECHNICIAN DUTIES

2.3.1 INSTALLING PUF CARTRIDGES

A sampling schedule will be provided to the field operator. On sample days, remove the sample cartridges from the portable refrigeration units. It is not necessary to take the Sample History Form to the sample platform but a record must be made of the time on etc. for transfer to the form. Place the cartridges, intact with protective plastic bag, polyethylene (poly) gloves, Kimwipes and Log Book (or other recording device) in the Sample Transfer Case, and take to the sampling platform.

At the sampling platform:

a) Open the hood cover of the sampler.
b) Using Kimwipes, clean any water or foreign matter from inside the sampler.
c) Remove a sample cartridge from the transfer case. Open the end of the protective bag, taking care not to put hands/fingers inside.
d) Put on a clean pair of poly gloves.
e) Remove the cartridge from the bag. **Note**: The bag may be left over the cartridge if desired at this point.
f) Remove the cap from lower end of cartridge.
g) Insert the end of the cartridge into the sample port of the sampler (Figure 2.12). Press down on the locking pins to secure the cartridge in place.
h) Remove the bag (if it was kept over cartridge while loading).
i) Loosen the thumbwheels on the upper portion of cartridge enough so that the cover plate (triangular) can be removed. Remove the cover plate and store in the bag with end cap.
j) Re-tighten the thumbwheels so that filter assembly is secure.
k) Close the sampler cover and secure.
l) The plastic gloves may now be removed.
m) Open the lower access door of the sampler. In the LOG Book or Field Log form provided by CARE, record the sampler I.D., the reading on the timer, and the reading on the Roots Meter if there is one installed.
n) Turn the sampler ON and record the time in EST. Wait about 1 minute for the motor to come to full speed. Adjust the flow to the setting derived from the latest calibration and

record the reading from the Magnahelic gauge (Figure 2.13), and the Roots Magnahelic, in the log book. The required flow setting is to be marked on the inside of the access door as well as the Sample History Form after the last calibration.

o) Close the access door and secure. Before leaving the sampling area, and after the motor has been running for about 5 minutes, re-check the magnahelic readings and adjust as required.

p) If the station has more than one PUF sampler in operation at a time, go on to the remaining samplers and repeat the above steps (a-o).

q) Once all PUF samplers have been attended to and other programs completed (if any), return to the sample handling building. Make appropriate entries on the Sample History Form (from information in the Log Book or Field Log form. If a portable tape recorder is used at the sampling area, all information must be transcribed into the site Log Book, Field Log form as well as on the Sample History forms. Store the sample cartridge bags (with cap and cover) in the sample transfer case until needed for cartridge removal.

2.3.2 REMOVING THE PUF CARTRIDGES

a) At the sample handling building gather together the sample transfer case, the Log Book, a box of poly gloves and the sample cartridge bag (with the cap and triangular top cover inside). Take these to the sampling area.

b) Open the lower access door of the sampler.

c) In the Log Book, note the day, month and year as well as the sampler I.D.

d) Record the Magnahelic Gauge and Roots Magnahelic reading in the Log Book.

e) Turn the sampler OFF. Record time in the Log Book or Field Log form. This is the END time that goes on the Sample History Form.

f) Record the reading from the Timer and the Roots Meter in the Log Book or Field Log form.

g) Close lower access door and secure.

h) Open hood of sampler.

i) Put on a clean pair of poly gloves.

j) Loosen the thumbwheels on the upper portion of the cartridge, so that the cover plate can be installed.

k) Remove cover plate from bag and install (make sure to check the sample I.D. number, so as not to mix up covers). Re-tighten thumbwheels so that cover plate is secure. Place the

sample bag over the sample head.

l) Pull up on both locking pins simultaneously and slip cartridge out of sample port (this requires some dexterity on the operator's part).

m) Install the end cap on the bottom end of the cartridge and place in the plastic bag.

n) Close the bag and place the assembly in the sample transfer case.

o) Close the hood and secure.

p) Remove gloves and dispose of them.

q) When all samplers have been attended to, return to sample handling area and make all appropriate entries on the Sample History Form.

r) PUF samples are to be stored refrigerated until transport to CARE to prevent evaporation and degradation of the species of interest.

NOTE: If for some reason the sampler did not operate properly and a 23-25 hr. sample at the correct flow rate +/- 10% was not collected, another sample is to be collected immediately for a 24 hr. period. Comments are to be noted in the Sample History Form for both the failed and subsequent sample.

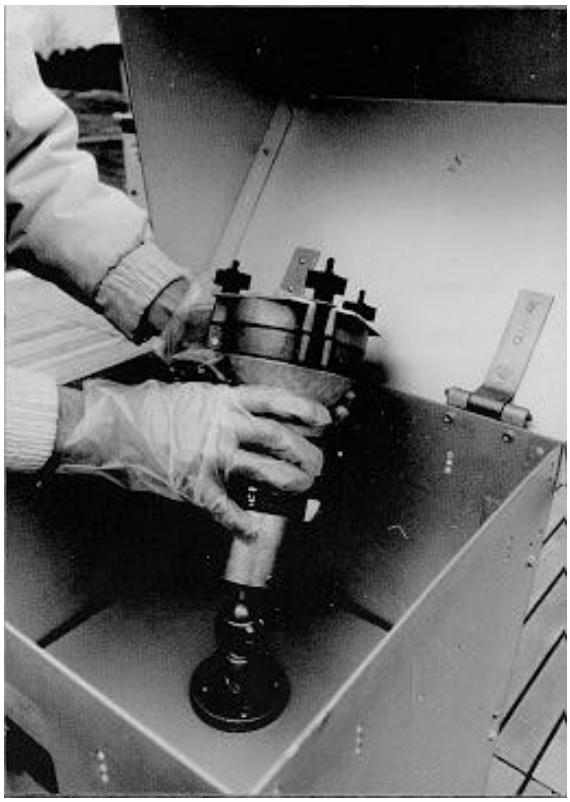


Figure 2.12
Remove cartridge from bag and secure in the high volume sampler.

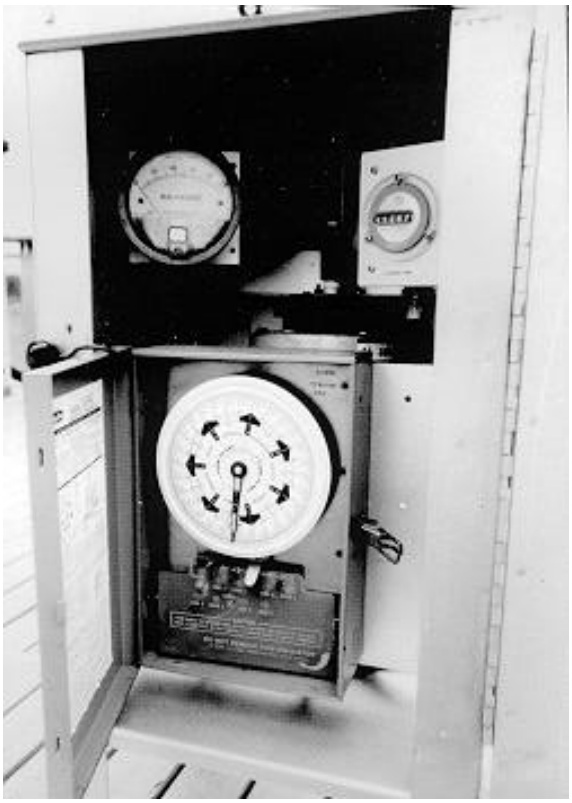


Figure 2.13
Record timer and magnahelic reading.

2.3.3 BLANK SAMPLE PROCEDURE

Blank samples are taken to determine a background or zero level for the sampling media. Nothing today is absolutely clean or pristine - the sampling media included. To be able to clearly state that what is measured on the filters comes from the air being sampled, the chemical nature of an unsampled medium has to be known. At the laboratory, filters are removed from the main batch of cleaned media and analyzed to see their contamination levels. These are called Laboratory Blanks.

This, however, is not enough. Any handling of the filters may potentially introduce contamination to the samples. To estimate this level of contamination, Field Blanks are taken at regular intervals, usually one Field Blank for **approximately every six regular sample changes.** It is important to note that blank samples are just as important as any sample. It is crucial that blanks are treated the same way as samples.

The procedure for taking a Field Blank is the same as taking an actual sample, with the following modifications:

a) Blanks are **NOT TO BE TAKEN DURING A PRECIPITATION EVENT**. Blanks will be taken on removal of the sample or during the next convenient sample change. If the blank is taken on a date other than the date pre-labelled on the cartridge, the date on the cartridge must be updated to reflect the actual sampling date.

b) The Blank never actually samples air, i.e. the motor of the sampler is NOT turned on.

c) The Blank is exposed to air for only one minute (as opposed to a 24 hour sample).

d) A Field Blank is prepared in the same manner as a sample (Section 2.2.1) and shipped to the field sites.

e) At the field site, install the sample (Section 2.3.1, steps a-m), close the cover of the sampler, wait one minute, and proceed to the removal procedure (Section 2.3.2, steps h-p). Use clean gloves for the removal procedure.

f) On returning to the sample handling area, follow the instructions for sample storage. This is still a sample - a **Blank sample** - and it is just as important as any other sample taken. The date and on/off time are recorded as well as he sample number.

2.3.4 SAMPLE HISTORY FORM ENTRIES

The Sample History Form (Figure 2.14) is to be completed by the site operator. The grey shaded areas of this form are for use by the laboratory staff. The site operator is to complete white section with the appropriate information from the Log Book. All times are to be recorded in local standard time (i.e. E.S.T.)

Note: Any remarks codes (Appendix C) are to be confirmed with a note in the remarks section. Enter any remarks that are pertinent for the sample period. Such remarks could help explain oddities that may appear in sample analyses. Some examples may be thus:

- May 15, Vehicle on site 09:00 - 10:00

or; - May 23, Smoke from nearby grass fire noticeable, 14:35

or; - June 2, Power outage 11:27 - 13:00

The remarks section is the field operator's way of conveying information to the Laboratory technicians and scientists, concerning samples taken. Please note anything that is felt to be important in the remarks section. Always indicate the sample number when entering a remark or comment. Precipitation during sample changes should always be noted.

A copy of the Sample History form is to be retained at the sampling site. The original completed Sample History form must accompany the exposed samples back to CARE.

2.4 POST SAMPLING DUTIES (Laboratory Technician)

2.4.1 REMOVING PUF SAMPLES

This exercise is the reverse of the loading protocol. A clean lab coat must be worn and everything must be wiped down with hexane, using appropriate safety precautions.

a) Label, with the station identifier and with a G appended to the filter sample number (see appendix F), a filter sample envelope which will be used to store the glass fiber filter.

b) Wearing poly gloves, take a Kimwipe soaked in hexane and wipe the forceps and tongs that are needed. Place these aside to dry (covered with a Kimwipe). Clean a piece of aluminum foil with hexane to be used to wrap the filter. Remove and dispose of the poly

gloves.

c) Open the bag containing the PUF sample cartridge. Put on clean poly gloves. Open the sample jar. Remove the cartridge from the bag and unscrew the upper and lower sections. Place the upper section to one side. Gently remove the pyrex glass insert from the lower shell of the sample cartridge (being careful not to touch the PUF plug). Put the shell aside. Using the tongs, gently remove the PUF from the pyrex insert using slight compression on alternate sides while pulling upwards (try to minimize the compression of the PUF as this might force a sample to be expelled from the pores of the PUF). Place the PUF in the jar using as little compression as possible. Seal the jar and set to one side.

d) Unscrew the three thumbwheels on the upper portion of the sample cartridge. Remove the triangular cover plate and the top section so as not to dislodge the fibre filter. Lift the top Teflon gasket away from the glass fibre filter and set to one side. **CAUTION**: Sometimes the filter will stick to the gasket. If this happens, use a pair of forceps to carefully separate the two (the filter medium is brittle and tears easily). Grasp the filter with one set of forceps, place it on the aluminum foil and fold it with the exposed sides facing each other. If any filter material is torn away from the main filter, it should be placed between the folded filter halves. Place the filter in the envelope and close, but do not seal the envelope. Place both the envelope with the filter and the jar with the PUF in the refrigerator.

e) Record the date the sample was unloaded on the PUF/GFF Sample Tracing Log.

f) The cartridge components are stored on a shelf until next required. All aluminum components are to be rinsed with hexane. The glassware is to be washed, baked and rinsed with before reuse. The exposed Kimwipes, poly gloves, etc. are be disposed of. The sample handling area must be kept clean at all times.

2.5 SAMPLER CALIBRATION PROCEDURES

2.5.1 MOTOR MAINTENANCE

Periodic maintenance of the motor is required to ensure it will continue running properly. The following are to be performed during this period.

a) Check the brushes and replace as necessary.
b) Clean any carbon out of the motor.
c) Record the motor serial number and number of hours on the motor.
d) Check all hoses and connections for wear and tear. Replace as necessary.

2.5.2 SAMPLER CALIBRATION (Field Technician)

Once per quarter (four times per year), or when a high volume sampler motor is changed or maintained (i.e. brush change), each sampler must be calibrated. This procedure involves varying the flow rate through a smaller limiting orifice in a calibrator unit and measuring the pressure drop across the calibrator in reference to the manometer pressure drop in the high volume sampler.

a) Place the calibrator assembly (with a PUF installed) on the quick connect fitting of the PUF sampler.
b) Connect the **sample in** port of the digital manometer to the 1/4" fitting of the calibrator assembly.
c) Start the Hivol and note the existing manometer flow reading and the digital manometer reading.
d) Do a leak check by covering the opening with your hand. The flow should go to zero. If not check for any leaks and repair as necessary.
e) Increase the motor speed to its maximum value. Using the lever arm on the ball valve inlet to the hivol motor, restrict the flow to read values decreasing from the maximum, to 0 inches in 10 inches of water decrements. Record the digital manometer readings which correspond to these values (ignore the + or - sign). NOTE: Some newer manometers allow for automatically averaging readings and this function should be used.
e) Take a second set of readings by increasing the flow from 0 to 100 inches, in 10 inches of water increments (reverse of step d). Record the second set of readings.

f) For each increment, there should be a difference of 10% or less between the two readings. If the readings differ by more than 10%, check the sampler for clogs, worn brushes, or other problems. After correcting the problem, repeat steps d and e.

g) Set the hivol using the motor speed screw, **with the ball valve completely open**, to the original setting.

h) Record the barometric station pressure and temperature at the site (available from the CR21X data logger).

2.5.3 CALCULATION OF SYSTEM FLOW CONSTANTS

Once the calibration is complete it is necessary to perform a regression analysis to determine magnahelic setting to obtain a flow of 0.24 m^3/min. The flow for each setting is calculated by converting the pressure drop at the calibration head using a calibration constant. A regression analysis is then performed on the flow versus the sqaure root of the magnahelic reading.

This regression may be performed using any one of a number of software programs such as Microsoft Excel.

The calibration date, y-intercept, slope and magnahelic setting are to be recorded on the Sample History Form as they are to be used in the calculation of the volume for each sample collected.

2.6 ENTRY OF SAMPLE FLOWS AND SAMPLE VOLUMES

Data from the Sample History Forms which are delivered to CARE quarterly is entered on a spreadsheet to calculate the flow and volume of air that has passed through the sample during the sample period as well as to store the data for further consolidation with lab results. During this procedure the sample time from the elapsed timer is compared to the time from the site operator's watch to see if there are any major discrepancies. As there is no chart recording device this is a method of checking for power outages or other malfunctions.

The actual air flow in m^3/min and sample volume in m^3 are calculated for the hivol sample using:

$$\textbf{Flow } (\textbf{m}^3\textbf{/min}) = \textit{slope} * \sqrt{MF * \frac{P_1}{P_2} * \frac{T_2}{T_1}} + \textit{y-intercept}$$

Sample Volume ($\mathbf{m^3}$) = *T (min) * Flow (m^3/min)*

Where:

MF (mean flow) = 0.5 * (Magnahelic On + Magnahelic Off)

slope = from latest calibration

P_1 = average station pressure in millibars over sample period

P_2 = standard atmospheric pressure (1013.2mb)

T_1 = average T^0C over sample period in ^oK (T_1 + 273.2)

T_2 = standard temperature (273.2 ^oK)

y-intercept = from latest calibration

T (min) = Timer Off - timer On

Note: During the calibration procedure the flow is converted to m^3/min and a magnahelic setting is calculated to achieve the desired flow based on this setting.

In the case where pressure or temperature is not available, data is to be used from the nearest available site. This is to be noted on the Sample History Form for use when flagging the data during the quality control procedure.

If the sampler is equipped with a Roots Meter, the volume may be calculated by subtracting the initial Roots Meter reading from the final. This volume is corrected for standard temperature and pressure as follows.

$$V_{STP} = V_{ambient}\left(\frac{P_1}{P_2}\right)\left(\frac{T_2}{T_1}\right)$$

Where:

$V_{ambient}$ = roots meter reading off - roots meter reading on

P_1 = average station pressure in millibars over sample period

P_2 = standard atmospheric pressure (1013.2mb)

T_1 = average T^0C over sample period in ^oK (T_1 + 273.2)

T_2 = standard temperature (273.2^0K)

If the volume calculated by the two different methods differs then a new calibration should be performed and potential problems (leaks, etc.) should be investigated.

The calibration head should be re-calibrated periodically since a change in the orifice due to nicks or other damage will change the calibration constant.

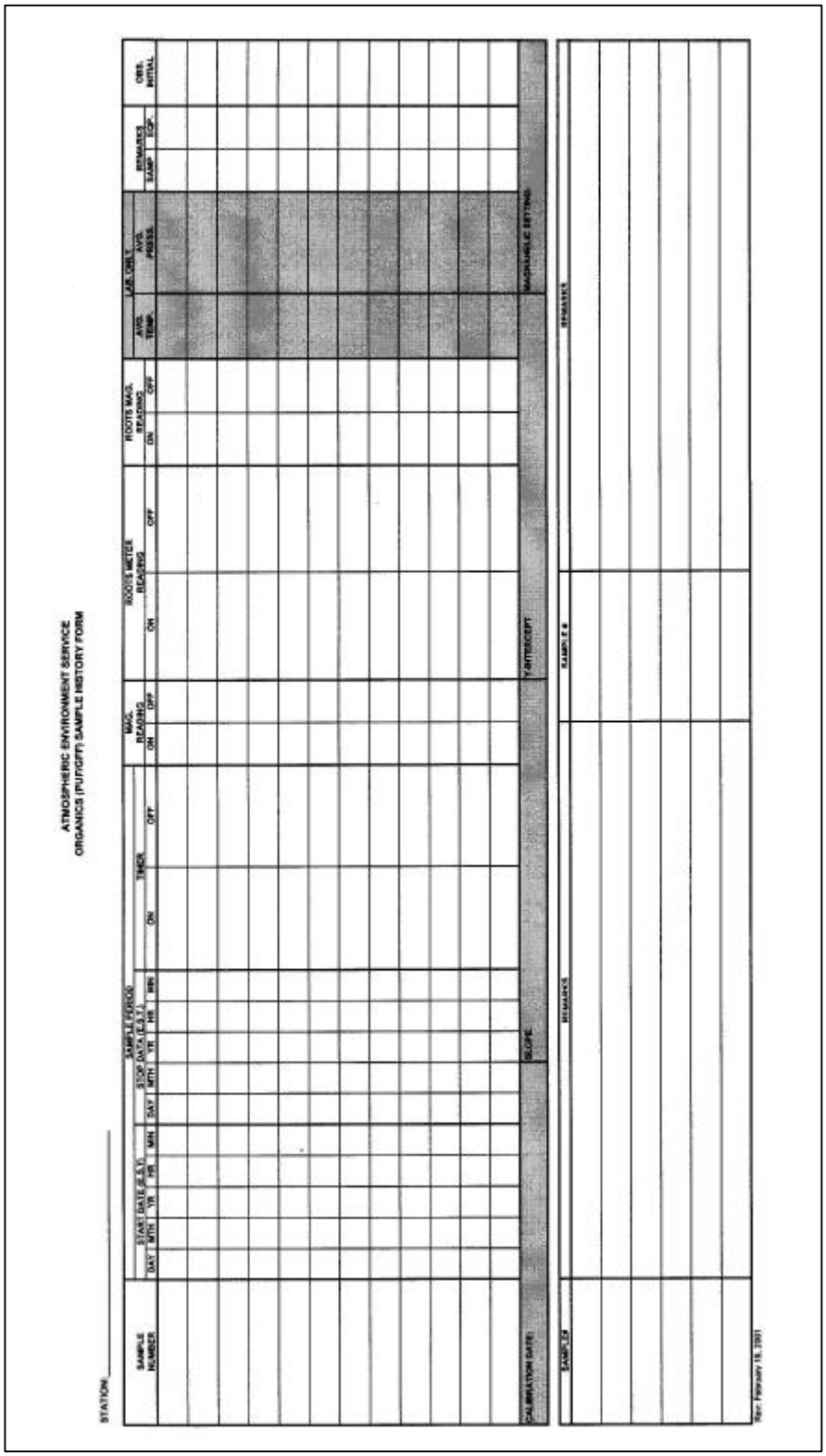


Figure 2.13 Sample History Form

EHD

ORGANICS AND TRACE

METALS IN PRECIPITATION

3. EHD ORGANICS AND TRACE METALS IN PRECIPITATION

3.1 EHD (Ecosystem Health Division) ORGANIC SAMPLER

See figure 3.1 for a diagram of the Organic Precipitation Collector. The sample bottle should be changed every two weeks or when it is full, which ever occurs first. The sample bottle should be changed after two weeks, even if no sample has been collected. That is, if it hasn't rained for the two week sample period, the sample bottle should be taken off and shipped back to EHD.

The overflow bottle included is to be changed when the sample bottle is changed, but only if it has some sample in it. If there is no water in the overflow bottle then it can be kept in place to act as an overflow for the next sample period.

The sample history form (figure 3.2) is be filled out recording the following information:

a) the date the sample was put on the sampler.
b) the date the sample was taken off the sampler.
c) site location and operators name.
d) any events, sampler problems or breakdowns which have affected the collection or reliability of the sample.
e) the number of rinse bottles, sample and/or overflow bottles.

Please make note when your supplies are running short.

The sampler funnel and Teflon tubing collection assembly should be inspected and cleaned regularly **see Cleaning Procedure** (3.1.2 and 3.1.4).

The samplers are shipped via ground courier service. Please refer to **Shipping Instructions** and **Purolator Instructions** (3.1.6 and 3.1.7)for the method.

Figure 3.1 Organic Precipitation Collector

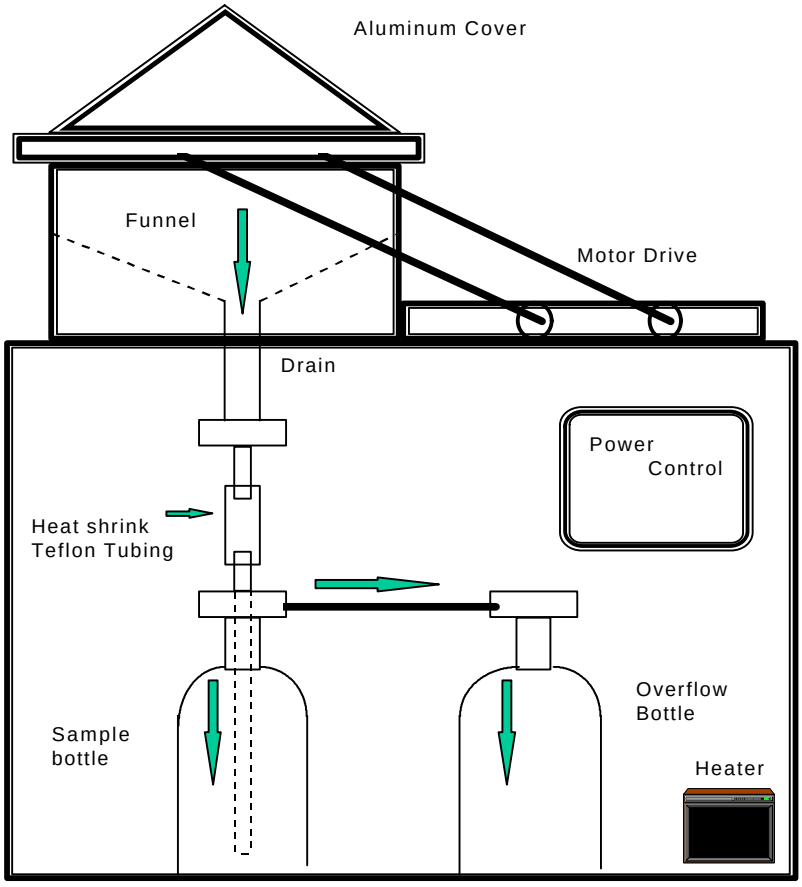


Figure 3.2 Sample History Form

INSTRUCTIONS:
Field Operators fill in the shaded areas only. Circle approximate volume in sample and overflow bottles.

STATION :	**OPERATOR :**	
STARTING DATE/TIME :	**ENDING DATE/TIME :**	
SAMPLER STATUS : O.K. (yes / no)	**# OF SAMPLE BOTTLES ON SITE**	**# OF OVERFLOW BOTTLES ON SITE**
COMMENTS: (please indicate any events, observation or breakdowns which may have affected the integrity of the sample)		
Solvent bottle : 1/8 1/4 3/8 1/2 5/8 3/4 7/8 full		
Overflow bottle : 1/8 1/4 3/8 1/2 5/8 3/4 7/8 full		

LABORATORY EXTRACTION DATA SHEET

EXTRACTION DATE	FULL BOTTLE WEIGHT	PRE-WEIGHED BOTTLE	SAMPLE VOLUME	INT	COMMENTS

3.1.1 BOTTLE CHANGING PROCEDURE

The stainless steel funnel and the Teflon tubing should be cleaned whenever a sample is changed. The cleaning should include a solvent rinse of the funnel, and cleaning of the Teflon tubing and the funnel drain port, (figure 3.1). Two brushes and clean water are supplied for this purpose.

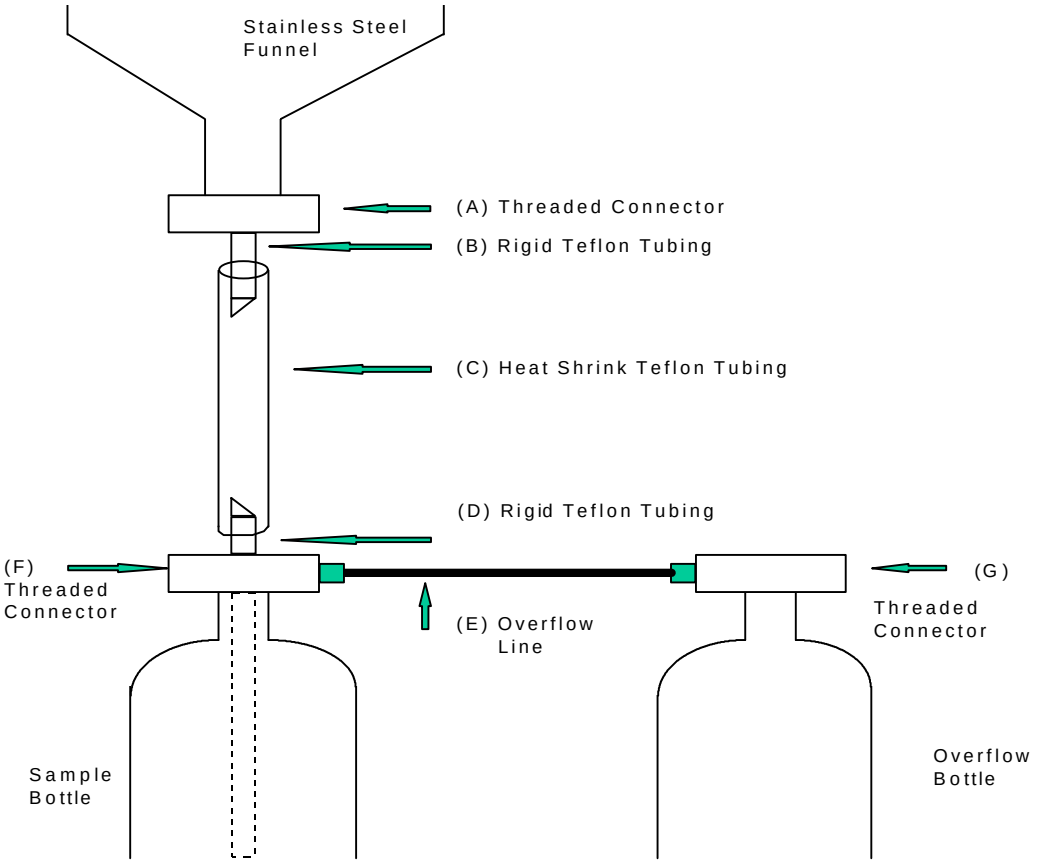
3.1.2 RINSING THE FUNNEL

a) Rinse the stainless steel collection funnel with 50 mls of dichloromethane (DCM), before the current sample is taken off. The 60 ml amber glass rinse bottle is used to rinse the funnel. The operator should be positioned so to minimize breathing exposure to the DCM fumes when rinsing. The rinse bottle is poured over the funnel and allowed to drain into the sample bottle. If the sample bottle is full prior to rinsing, continue to rinse and allow the sample water to be displaced into the overflow bottle. If the overflow bottle is also full, remove it and pour out enough sample to make room for the displaced sample water.

3.1.3 REMOVING THE SAMPLE BOTTLE (figure 3.3)

a) Disconnect the overflow line (E) from the threaded Teflon cap (F) at the sample bottle.
b) The sample bottle and tubing apparatus will separate where the heat shrink Teflon tubing meets the rigid Teflon tubing at (B). Grasp the sample bottle and tubing apparatus and carefully pull down and out from the rigid teflon tubing (B) while guiding the sample bottle out the sampler door. The heat shrink Teflon tubing has been securley attached to the rigid Teflon tubing at (D) and should not come apart at that point.
c) Remove the threaded Teflon cap (F) from the sample bottle, recap the sample bottle and ship it to EHD **(see Shipping Instructions).**
d) The overflow bottle is removed by removing it's threaded teflon cap (G). Recap the overflow and ship to EHD.

Figure 3.3 Sample Bottle



3.1.4 INPECTION AND CLEANING

Prior to installing a new sample bottle it is necessary to inspect and clean the water delivery tubing. Use the brush and clean water provided to rinse, clean and flush all Teflon tubing. The funnel drain port should also be cleaned and rinsed. Place a catch basin below the drain port to minimize mess when cleaning and rinsing the funnel drain.

3.1.5 REPLACING THE SAMPLE BOTTLES

a) Attach cap and tubing assembly to new sample bottle.
b) Fit the open end of the heat shrink Teflon tubing (C) over the rigid Teflon tubing at (B) and carefully push tubing apparatus and bottle into place.
c) Attach threaded Teflon cap (G) to new overflow bottle, and attach overflow line (E) to threaded Teflon cap (F) at sample bottle.

3.1.6 SHIPPING INSTRUCTIONS

a) Ensure cap is on bottle securely. Tape closed with Teflon tape if available.
b) Place bottle in poly-plastic bag provided. Twist the top of the bag tight, and secure with a twist tie. Place inside shipping box. Place sample history form in plastic bag and put in shipping box. Close lid of shipping box making sure clasps are closed tight.
c) One copy of the shipping document is to accompany the shipment. To fill out the shipping document,
   a) circle courier and ground, as the means of transmittal
   b) sign your name
   c) date it
   Put the shipping document into an envelope, label the front of the envelope Shipping Documents, and tape the unsealed envelope to the shipping box.
d) Apply one **TEST SAMPLE** label to the shipping box so that it is visible.
e) Complete Purolator form (see Purolator Instructions) and apply to shipping box.

NOTE:

The above instructions apply only for the sample bottles with DCM in them. When shipping the overflow bottles, a shipping document and TEST SAMPLE label are not required. The overflow bottles need a separate bill of lading when shipped at the same time a sample bottle

is shipped. Please ensure that every item shipped back to us has our address on it.

3.1.7 PUROLATOR INSTRUCTIONS

Pre-printed Purolator bills of lading have been provided for return shipment to EHD. Most of the information required is already filled out, although it is necessary to complete the bill of lading as described below (Appendix 4).

Area on bill-of-lading	*Information required*
2	***DATE:*** month day and year
5	***DESCRIPTION OF GOODS*****: Test Samples** is all that is required. Do not check off the dangerous goods box.
7	***SENDER SIGNATURE:*** please sign your name
10	***No. OF PIECES AND WEIGHT:*** identify how many pieces have been included under this bill of lading number. If there is more than one item shipped, and a package I.D. has been affixed to the second parcel, please ensure that the return address of EHD has also been affixed to the parcel. The weight of a full sample bottle with DCM in it is 9.5 kilograms (kg). A full overflow bottle is probably around 9.0 kg. Approximate the weights, if there is any question Purolator will reweigh the shipment.
11	***DECLARED VALUE:*** There is no declared value for these shipments. Put a slash through this box or write in a '0'

NOTE:

Please take care in following the above instructions. Purolator adds a penalty charge to the shipment if the bill of lading does not include all relevant information. If you have any problems or questions please call.

3.1.8 HANDLING OF DICHLOROMETHANE (CH2CL2)

Dichloromethane (or Methylene Chloride) is a common industrial solvent widely used in dry cleaning, furniture stripping, paint remover and cleaning of machine tools. It is a universal solvent for most organic chemicals. Its purpose is to stabilize pesticides in rain samples.

It smells like chloroform and has similar physical and chemical characteristics as chloroform. It should be handled in well ventilated areas. It evaporates rapidly and breathing it should be avoided. Dichloromethane (DCM) is not corrosive, non flammable and non combustible. Using proper care and caution, the handling of DCM for this purpose should not pose any danger or health hazard.

It is important that the users of DCM read the Material Safety Data Sheets (*Appendix 5)* and be aware of its properties and health and safety information. A respirator mask, lab coat and neoprene gloves are supplied for the operators use.

3.1.9 RINSING THE FUNNEL

When rinsing the stainless steel funnel of the rain sampler with 50 mls of DCM, the technician should stand upwind from the funnel to minimize the potential of inhaling fumes. Neoprene gloves and safety glasses should be worn when handling the solvent. The rinse bottle is uncapped and quickly poured over the entire surface of the funnel, and allowed to drain into the sample bottle below. Recap the rinse bottle. Be sure to open the lower cabinet door to allow its ventilation prior to changing the sample bottle.

3.2 EHD ORGANIC PRECIPITATION COLLECTOR (RESIN COLUMN)

The resin column is changed at the end of each four week period.

A replacement column will be available prior to a required change. If the replacement column is late in arriving to the field site, leave the old column in place until a new one arrives. Please advise EHD staff if a new column has not arrived, within a reasonable time period. Store resin columns (fresh or used) in the refrigerator.

Due to long sampling duration, the amount of precipitation in the collection reservoir should be measured and emptied at the end of any significant rainfall, to ensure the reservoir does not overflow.

3.2.1 TO REMOVE COLUMN

a) Wear a clean pair of disposable gloves when changing columns.
b) Disconnect the outlet tubing from the collection reservoir
c) Carefully unscrew the column assembly from the funnel
d) Tighten screw cap, complete with O-ring, into the top port of the column. Tighten by hand, the caps should be tightened firmly to prevent leaks but do not over tighten.
e) Invert the column and remove the U-tube assembly by gently wiggling and pulling the U-tube away from the bottom port. Tighten another cap into the bottom port.
f) Label the column with the station name and the ‘on’ and ‘off’ dates.
g) Measure and record the volume of rainfall in the collection reservoir using a graduated cylinder. Discard the water.
h) Rinse the funnel with deionized water (discard the rinsed water).

3.2.2 TO ATTACH COLUMN

a) Hold column upside down on a solid surface and remove the bottom cap (the end with the tape).
b) Insert the U-tube assembly by “pulling down” with a rocking/wiggling action. It is stiff, but both O-rings should disappear into the column.
c) Put in an upright position (tape is down) and gently tap the column to settle the resin inside.
d) Unscrew the top cap and screw the column into the funnel; **BE CAREFUL WHEN STARTING IT, AS TEFLON IS EASILY CROSS-THREADED**.
e) When column installed, open the collector by touching the sensor with a wet finger.

Pour in small amount (approx. 50 ml) of the "clean" water provided to further settle the resin and to check that there is flow. If flow is inadequate, gently draw on the outlet hose with an aspirator bulb while blocking the vent tube at the top of the U-tube.

When flow is adequate, connect the tubing to the receiver.

3.2.3. RAINFALL RECORDING AND SAMPLE HISTORY FORMS

After every significant rainfall, the volume of rainfall collected in the collection reservoir is measured and recorded.

3.2.4. SHIPPING

Place the column and the sample history in the shipping tube and affix a pre-printed Purolator bills of lading and ship it by courier or other arrangement to EHD.

3.3 EHD TRACE METALS (INORGANIC) SAMPLER

The Trace Metal Sampler operates along the same manner as the Organic Sampler. In this case, precipitation falls directly into a polyethylene bucket and the sample is un-protected throughout the entire sampling period. The bucket is changed at the end of each calendar month.

3.3.1 BUCKET CHANGING PROCEDURE

a) Wear a clean pair of disposable gloves.
b) Moisten sensor to activate the lid.
c) Turn the power switch to OFF position to keep the lid open.
d) Remove sample bucket from sampler.
e) Place clean bucket in the sampler, ensuring it seats properly.
f) Place a funnel over the 2 litre shipping bottle. Gently swirl the bucket and carefully pour the rain sample from the sample bucket into the shipping bottle. If there is any excess, measure the excess volume in a graduated cylinder and note the extra volume on the sample history form. Discard the excess rain sample.
g) If the sample is <u>frozen</u>, thaw the sample indoors and then follow step f.

h) Manually return the lid to closed position and turn the power back ON. The lid should always be in the closed position when turning the power back ON to prevent arcing in the relay.

i) Complete sample history form.

Notes:

When thawing a frozen, please take care to minimize any evaporation of the sample. Let the bucket sit at room temperature with the lid on until the sample is completely thawed. Do not place the bucket near a furnace or in front of an air blown heater because this may result in a loss of sample through evaporation.

3.3.2 SHIPPING INSTRUCTIONS

a) Place the 2 litre shipping bottle inside the used sample bucket. Cover bucket with the lid and put the bucket in the wooden shipping box.
b) Place the sample history form in a waterproof baggie, seal and place it in the wooden box with the sample bucket.
c) Close lid of wooden shipping box and seal securely with steel clip and tape.
d) Secure address label on top of the box and ship via Canada Post ground parcel mail.

Ecosystem health division
867 Lakeshore Rd., P.O. Box 5050
Canada Center for Inland Waters
Burlington, Ontario
L7R 4A6

3.4 CONTACTS

C.H. Chan	(905) 336-4644
Bruce Harrison	(905) 336-4643
Mary Lou Archer	(905) 336-4467
Fax	(905) 336-4609

TRACE METAL HIGH VOLUME SAMPLER

OPERATOR'S MANUAL

4. OPERATOR'S MANUAL FOR TRACE METAL HIGH VOLUME SAMPLER

4.1 PURPOSE AND DESCRIPTION

Trace Metals on air particulates are collected for twenty-four hour periods. The Sierra Anderson High Volume Sampler (Hivol) with a PM-10 head (it looks like a large mushroom - (figures 4.1, 4.8 & 4.9). The Trace Metal sampler uses a single sheet filter mounted in a flat filter cassette. This filter must be free of metal inclusions in the filter matrix. For this reason Whatman 41 8" x 10" filters are supplied for the Trace Metals sampler (these filters are not interchangeable with any other sampler).

Two types of high volume samplers are currently in use as part of an intercomparison study. Mass flow hi-volume samplers regulate the air flow by varying the speed of the motor using a voltage variator to a pre-determined setting using the latest calibration results. In the Spring of 1998 volumetric hi-volume samplers were introduced where there is a constant flow of 1.13 cm/m (40 cfm) with no adjustments required to the voltage.

For both samplers the filter cassette is mounted over a sampling orifice and secured with four locking screws. Beneath the orifice opening (and in the chamber) is a hot-wire anemometer probe which monitors the flow rate of the air being pulled past the filter. In the case of the mass flow hi-vol this probe is connected to a controller which can be pre-set. The controller adjusts the motor speed so that a constant flow rate is maintained.

The samplers come with a chart metering device for sample flow for a twenty-four hour period. There is also an elapsed time indicator on the flow control box. This elapsed time indicator registers in hours and decimal hours (less accurate than the minutes recorded on the PUF sampler). For this reason, it is essential for the field operator to record the time ON and time OFF accurately. The time interval between ON and OFF will be used in the calculation of the sampled air volume and compared to the timer reading. These values are entered on the Trace Metals Sample History form in Figure 4.10

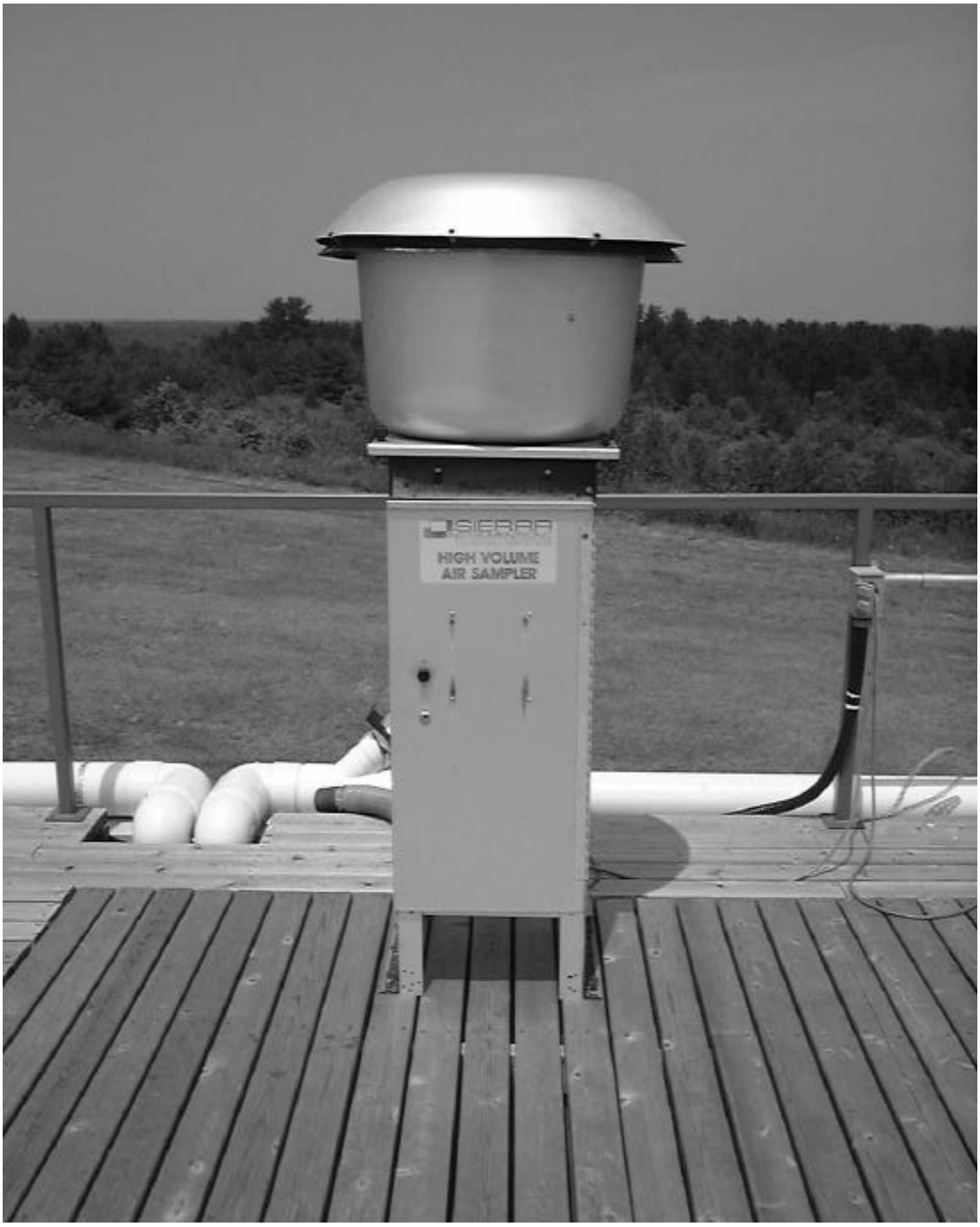


Figure 4.1 Mass Flow Hi-Volume Sampler

4.2 SITE TECHNICIAN DUTIES - MASS FLOW HI VOLUME SAMPLER

4.2.1 SAMPLE LOADING PROCEDURE AT THE SAMPLE HANDLING AREA

The following procedures apply to sample loading for both the mass flow and volumetric sample filters.

The filters must be loaded in a laminar flow chamber (figure 4.2) in a clean, smoke free room. Cartridges must be placed on fresh Kimwipes and disposable poly gloves must be worn during the loading and unloading procedures. Cartridges, filters, and tweezers (figure. 4.3) must be kept clean and stored inside bags until ready for use.

a) Put on a clean pair of poly gloves.
b) If no cassette has been cleaned and dried as per chapter 4.2.4. (g), clean a cassette with deionized water and Kimwipes and dry completely.
c) Take a pair of forceps (tweezers) and clean them using deionized water and a Kimwipe.
d) Put on a new pair of poly gloves.
e) Open the filter box and, with clean tweezers, remove a clean 8" x 10" filter from box. Do not use the top or bottom filter as these are cover filters.
f) Place the filter on the screen grid of the lower portion of the cassette so that it completely covers the screen (Figure 4.4).
g) Place the upper portion over the lower (Figure 4.5), taking care not to move the filter. Secure in place with the brass nuts (finger tight only).
h) Replace the cover plate (Figure 4.6) and label the cover plate with the date and sample identification number. Put the assembly into a new plastic bag. Fold over the top and tape shut.
i) Place the bag containing the filter cassette, the station log book (or portable cassette recorder) and a box of gloves in the sample transfer case.
j) Remove and dispose of the poly gloves.

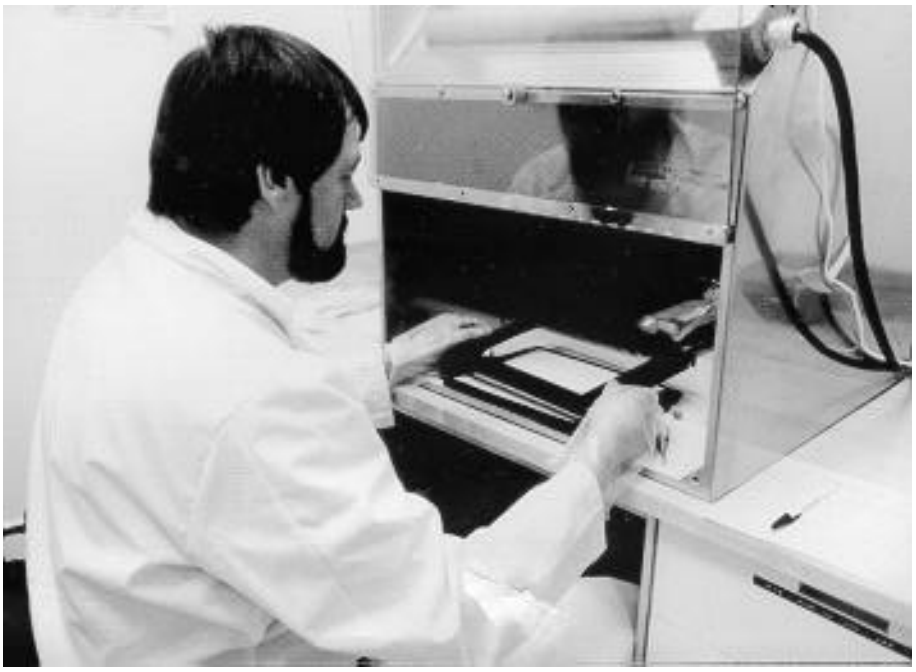


Figure 4.2
Filter loading must be done in a flow chamber.

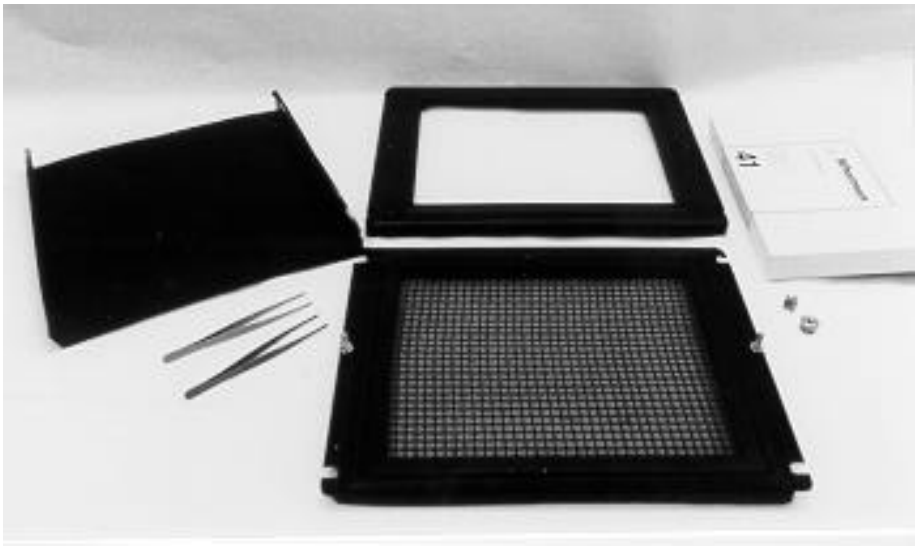


Figure 4.3
What you need to get started.

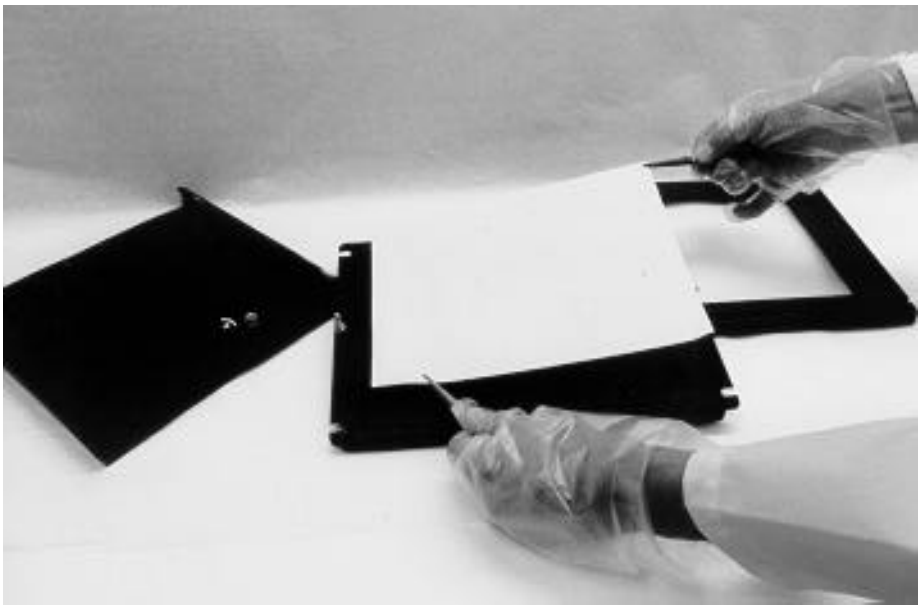


Figure 4.4
Place the filter on the screen grid.

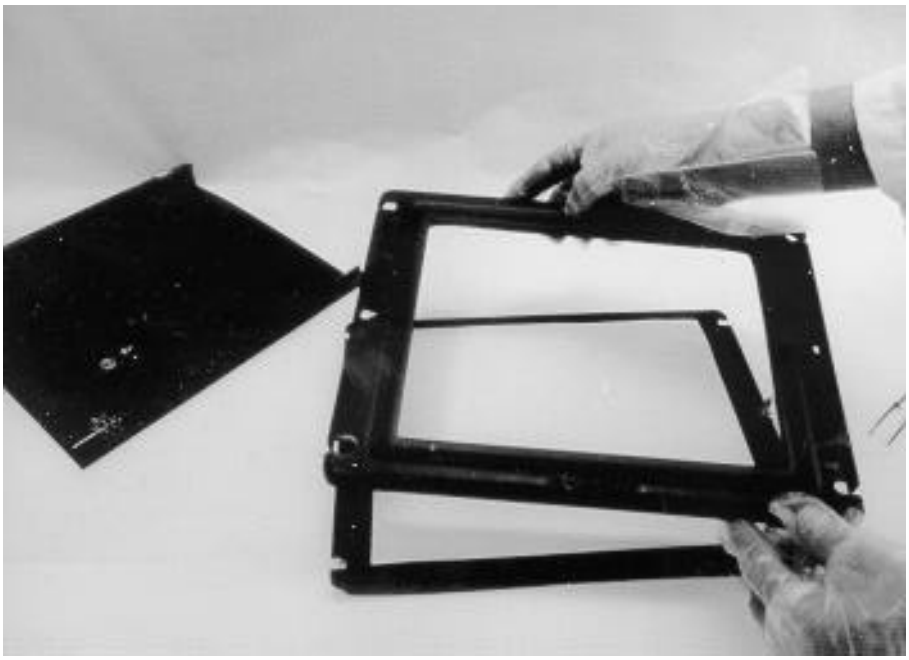


Figure 4.5
Place the upper portion over the lower.

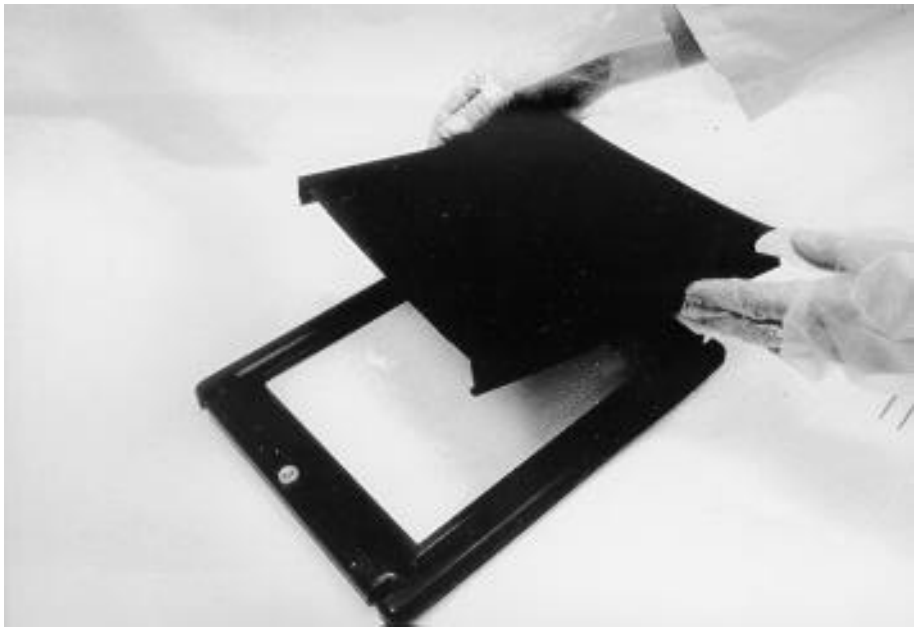


Figure 4.6
Replace the top cover.

Figure 4.7
Place the cassette over the sampling orifice.

4.2.2 SAMPLE INSTALLING PROCEDURES: AT THE SAMPLING SITE

At the sampling location the filter cassette is loaded into the Hivol sampler using the following steps:

a) Open the upper lid cover of the hivol.
b) Clean any dirt or debris from the sampler using a Kimwipe and distilled water.
c) Remove the bag containing the filter cassette, from the transfer case.
d) Put on a clean pair of poly gloves. Open the bag and remove the cassette. Keep the bag for storing the cover plate.
e) Place the cassette onto the holder over the sampling orifice (Figure 4.7). Secure it in place using the four locking screws (finger tight only, overtightening compresses the gasket too much). Remove the cover plate and place it into the bag. Store the bag in the sample transfer case until need for cassette removal.
f) Close the lid cover and secure. Remove poly gloves and retain them for proper disposal.
g) Open the lower compartment door. Open the access panel to the chart recorder mechanism. Install a new chart making sure that it is set to the correct time of day. The date, station name, sample number and type of sample (ie. Aerosol) are to be written on the chart.
h) Lower pen arm and make sure pen is in contact with the paper chart. Check that the pen is properly zeroed by rotating the chart one rotation. If not, reset the pen to zero by turning the adjusting screw. Close access panel and secure.
i) Record the accumulated time reading from the timer in the log book or Field Log form, along with the day, month and year.
j) Turn ON the Hivol. Note the time ON on the log book or Field Log form as provided. Using the voltage variator screw, adjust the flow to the required setting (determined from latest calibration) for 40 cfm on the flow chart. Close lower door and secure.
k) Return to sample handling area. Place the lid cover in the laminar flow chamber until it is time to off-load the sample. Make appropriate entries on the Sample History form (from the log book). If a portable tape recorder is used at the sampling area, all information must be transcribed into the site Log Book and Field Log form as well as on the Sample History forms. The remarks section should include comments about precipitation during the sample change period.

4.2.3 SAMPLE REMOVAL PROCEDURES: AT THE SAMPLING SITE

a) Collect the plastic bag/cover plate in the sample transfer case, the site Log Book, and a box of gloves. Take these out to the sampling site.
b) Open lower door to the hivol. Turn the sampler OFF.
c) Record the the accumulated time reading from the timer in the log book or Field Log form along with the day, month and year.
d) Open the access panel to the chart recorder. Lift pen arm and remove chart. Note the date and time off on the back of the chart. Check the chart for periods of low or no flow and note on the log book or Field log form. Place it in the transfer case. Close access panel and lower door.
d) Open upper lid cover of the Hivol sampler.
e) Put on a clean pair of poly gloves.
f) Remove the cover plate from the bag and place it over the cassette, snugly.
g) Loosen the four locking screws and remove cassette. Place cassette in the bag. Fold over the top of the bag and place it in the transfer case.
h) Close upper lid and secure. Remove gloves and retain for proper disposal.
i) Return to sample handling area.

Figure 4.8 Trace Metals (Mass Flow) High Volume Sampler (Lid Open).

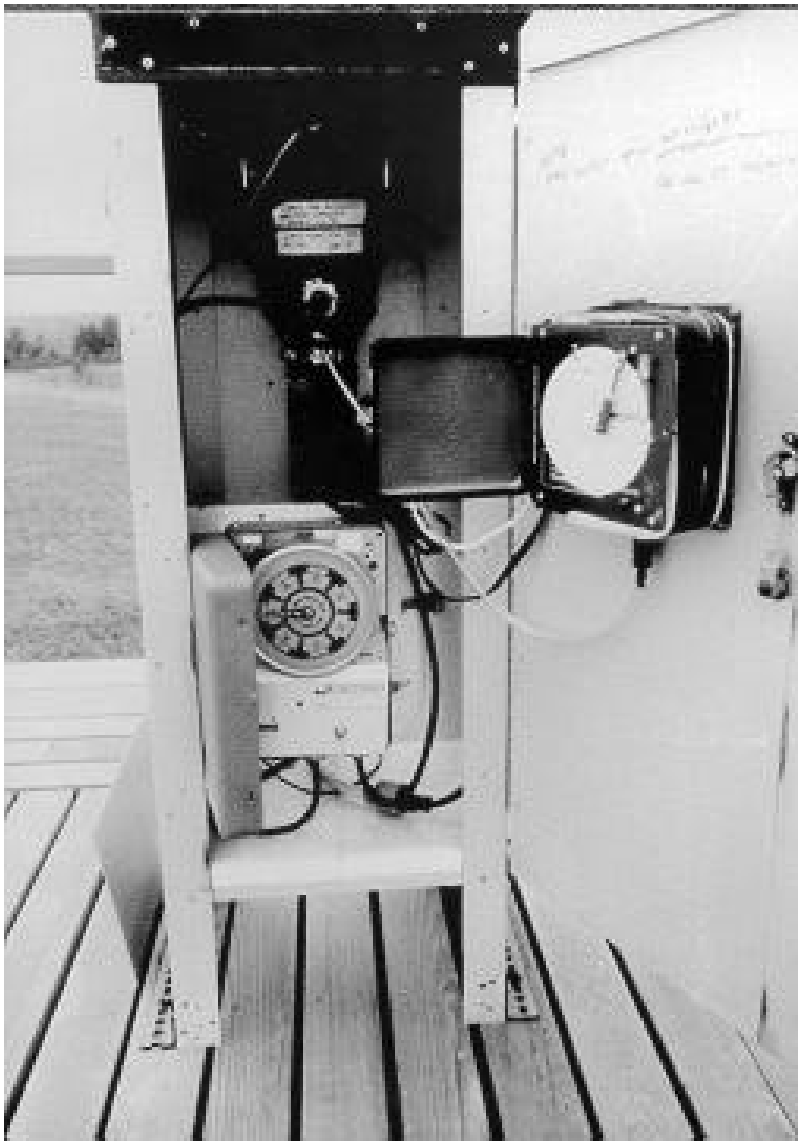


Figure 4.9 Trace Metals (Mass Flow) High Volume Sampler

4.2.4 SAMPLE UNLOADING PROCEDURES: AT THE SAMPLE HANDLING AREA

Once back in the sample handling area, the filter must be removed from the cassette and properly packaged and stored until it is picked up for return to CARE and subsequent analysis. This procedure requires the utmost care in handling the filter. A clean lab coat must be worn at all times.

a) Place the transfer case next to the Laminar Flow chamber. Open chamber and turn on the fan. The fan should run for several minutes before sample unloading so any particles that may have settled in the chamber are blown out.

b) Put on a clean pair of poly gloves. Remove cassette from transfer case and remove from bag. Place it in the chamber.

c) Label a clean ziplock bag with the date, station and sample identification number.

d) Remove and discard gloves. Put on a clean pair.

e) Undo the brass screws and remove the upper section of the cassette, including the cover plate, being careful not to touch the filter. Set these aside.

f) Using forceps that have been cleaned with deionized water and dried using Kimwipes, remove the filter and place inside the labelled ziplock bag. Do not touch the dark, exposed area and do not fold this filter as it must be cut in a frame by the laboratory technicians. Store the filters in the bubble pack envelopes for shipping to CARE. These filters need not be refrigerated.

   Note: In the case where a filter has become wet due to exposure to precipitation, the cassette is to be left in the bag with one end open to allow for air flow to dry the sample. The cassette in the bag is to be left in the laminar flow chamber.

g) Using deionized water and a clean Kimwipe, wipe down the inside and outside of the cassette components. Dry thoroughly with a clean Kimwipe (this is of particular importance during the winter when residual water may freeze to the filter and cause subsequent tearing).

h) Re-assemble the cassette and store in the bag for the next event. The gasket on the upper section of the cassette should be periodically checked and the cassette replaced if worn. See chapter 4.6 for further information. The cassette may also be periodically wiped with a Kimwipe soaked in hexane, dried and then rinsed with deionized water.

i) Turn off the chamber fan and close door.

j) Remove and dispose of the poly gloves.

k) Make the appropriate entries on the Sample History Form (from the site Log Book notes,

including sample changes during precipitation).

The exposed filters will be collected routinely by A.E.S. field personnel visiting your site, along with the Sample History Forms. Station observers will be advised as to the pick-up dates by these personnel prior to a visit.

4.2.5 BLANK SAMPLE PROCEDURE

Blank samples are as important in interpreting results as the actual sample of air. The procedure to follow is exactly the same as for a sample, with the following modifications:

a) Blanks **ARE NOT TO BE TAKEN DURING A PRECIPITATION EVENT.** In the event there is precipitation, the blank is to be taken on removal of the sample or the next convenient day. The blank is to be labelled correctly to reflect the day the sample was taken.
b) The Blank never actually samples air, i.e. the motor of the sampler is NOT turned on.
c) The Blank is exposed to air for only one minute (as opposed to a 24 hour sample).
d) Prepare the Field Blank in the same manner as a sample (Section 4.2.1). As the field sites have more than one cassette, randomly use a different cassette for the Blank. DO NOT designate a cassette specifically for the Blank, as this does not take into account random contamination.
e) At the field site, install the sample (Section 4.2.2, steps a-e), close the cover of the sampler, wait one minute, and proceed to the removal procedure (Section 4.2.3, steps d-i). Use clean gloves for the removal procedure, open the sampler, remove the sample and bag it - just as though it were an exposed filter.
f) On returning to the sample handling area, follow the instructions for sample unloading (4.2.4). This IS still a sample - a Blank sample - and it is just as important as any other sample taken. On the log sheet, indicate that the sample is a "Blank Sample" in the columns "Timer ON/OFF". The date and on time are also required, as well as the sample number.

Blank samples are taken according to a schedule provided and can be set up in a second cassette which is taken out to the site. Since a blank sample will have the same date as a regular sample, it should clearly be labelled as "Blank".

4.2.6 SAMPLE HISTORY FORM ENTRIES

With each set of samples received, there is an accompanying Sample History Form (Figure 4.13 - Mass Flow). The grey shaded areas of this form are for use by the CARE staff. Fill in the white section with the appropriate information from the Log Book or Field Log form.

REMARKS: enter ANY comments that are pertinent for the sample period. Such remarks could help explain oddities that may appear in sample analyses.

Note: Any remarks codes (Appendix C) are to be confirmed with a note in the remarks section. Enter any remarks that are pertinent for the sample period. Such remarks could help explain oddities that may appear in sample analyses. Some examples may be thus:

- May 15, Vehicle on site 09:00 - 10:00

or; - May 23, Smoke from nearby grass fire noticeable, 14:35

or; - June 2, Power outage 11:27 - 13:00

The remarks section is the field operator's way of conveying information to the Laboratory technicians, concerning samples taken. Please record anything that is felt to be important in the remarks section. Always indicate the sample number when entering a remark or comment. Precipitation during sample changes should always be noted.

A copy of the Sample History form is to be retained at the sampling site. The original completed Sample History form in the provided plastic bag must accompany the exposed samples back to CARE.

4.2.7 MASS FLOW CALIBRATION PROCEDURE

The trace metal Hi-volume sampler is to be calibrated quarterly and whenever the brushes on a motor are changed or the motor itself is changed or after any modifications to the system. Inspect all hoses for any leaks and replace as necessary.

a) The following equipment is required to perform a calibration:
- manometer

- blank filter
- calibration head
- calibration log book
- screwdriver
- chart recorder
- computer with Excel (or similar) software to perform regression analysis

b) Note the current temperature in °C and the station pressure in the calibration log book.

c) Place a clean filter over the mesh that normally holds the cassette, but do not use the cassette.

d) Place filter paper over the screen mesh. Place the calibration orifice over the paper on the mesh so that the gasket fully seals any gaps between the filter paper and the border of the screen plate.

e) Place the calibration head over the filter and clamp in place so there is even pressure all around.

f) Connect the manometer hose to the outlet on the calibration head.

g) Place a chart on the chart recorder and zero the pen by using the adjusting screw.

h) Turn on the manometer and set to inches of H_2O.

i) Turn the sampler on and using the voltage variator, ensure the motor is running at maximum speed.

j) Note the setting on the chart recorder and turn the chart slightly so a record is made of the setting on the chart.

k) Note the manometer reading and the chart setting in the calibration log book.

l) Adjust the flow in increments of 2, by turning the voltage variator screw to slow down the motor speed so it is at the next desired setting on the chart recorder (i.e. from 50 to 48).

m) Tap the chart recorder periodically to ensure the pen is not stuck and adjust the flow as necessary.

n) Make a mark on the chart by turning it slightly and note the manometer reading and chart setting in the calibration log book.

o) Continue this process until the chart is at zero and the motor is off.

p) Repeat steps l-n but this time increase the motor speed in the same increments until the motor is at full speed. **NOTE**: it is desirable to get 8 to 10 readings (or more) in both directions in order to perform accurate calculations of the flow to get the correct volume.

q) Shut the system down but do not dismantle anything until it is ensured that there are no problems with the calibration.

r) Perform a regression analysis to determine the correct chart settings for the desired flow.

s) If the calibration was done accurately, the readings will be in a fairly straight line on a graph displaying the best fit and not scattered all over the graph. If it was done accurately the equipment may be dismantled.

t) If the calibration is not acceptable, check the sampler for leaks, clogs, worn brushes, or other problems. When the problem has been corrected, the calibration procedure is repeated.

u) The calibration log book is archived at CARE. The new flow settings are marked on the inside of the access door and recorded in the site Log Book.

4.3 CALCULATION OF FLOW SETTINGS/ VOLUME CALCULATIONS

Once the calibration is complete it is necessary to perform a regression analysis to determine the correct chart setting for the desired flow for each subsequent sample collected until the next calibration. The flow for each setting is calculated by converting the manometer reading using a calibration constant for the calibration head. A regression analysis is done on this flow versus the chart recorder setting. The regression provides a chart setting to provide for a flow of 40 cu. ft/min (1.13 cu m/min). As the chart records the flow in cu ft/min this is converted to cu m/min during the volume calculations.

This regression may be performed using any one of a number of software programs such as Microsoft Excel.

The calibration date, y-intercept, slope and chart setting are to be recorded on the Sample History Form as they are to be used in the calculation of the volume for each sample collected

The air flow and volume are calculated using the following.

F = (MF * y-intercept + slope)

V = T * F

Where:

F = Flow (cu/m min)

MF = average reading from chart recorder

y-intercept = from last calibration

slope = from last calibration

V = volume (cu/m)

T = time in minutes sampler was on

4.4 FIELD TECHNICIAN'S DUTIES

The Field Technician ensures that stock is kept for all supplies for the Trace Metals hivol, including spare hivol parts, spare charts, pens, bags, and filters. Supplies must be kept both at the laboratory and at the field sites.

When samples are returned to the laboratory, the filters must be cut into strips for analysis. These should be done in batch mode. Analysis is done under contract at a private sector laboratory. The filters are cut into four quarter strips and thus two strips are kept for archiving purposes.

4.4.1 TRACE METALS FILTER CUTTING

Aerosol filters are cut into 4 strips, although this may vary depending on the analysis method, using a specially designed cutting board which ensures the strips are of equal size. The materials required are a cutting board, tweezers, Kimwipes, poly gloves, surgical knife with a supply of blades, distilled or deionized, water and 3" x 6" sampling bags. All work must be done in a laminar flow chamber to ensure there is no contamination of the filter being cut. A clean lab coat must be worn at all times.

a) Put on a clean pair of poly gloves and change them periodically.
b) Clean all equipment with deionized water and wipe dry before commencing.
c) Using the tweezers remove the filter to be cut from the storage bag and place it on the cutting board (figure 4.10)
d) Close the plexiglass cover of the cutting board over the filter and while doing so ensure the filter is seated squarely on the board.
e) Using the surgical knife, carefully cut the filter into four strips (there may be a periodic requirement to cut them into eighths). Also cut off the unexposed sides (of pieces A and D), but do not cut off the unexposed top and bottom ends of the four pieces (Figure 4.11).
f) It may be necessary to hold down the end of each strip after the major cut has been made to ensure the filter is cut from end to end. Use the tweezers to hold the filter down.
g) Once the filter is cut, fold each strip in half with the exposed portion facing in. Ensure that they are kept in the order they were cut.
h) Label sample bags with the station identifier and sample number on the outside of each bag. Each bag will also be labelled with a separate letter (A,B,C,or D).
i) Using the tweezers, insert the individual strips in each bag and seal the bag (figure 4.12).
j) Strips B and/or C are to be delivered to the labs for analysis while strips A, and D are archived at CARE.

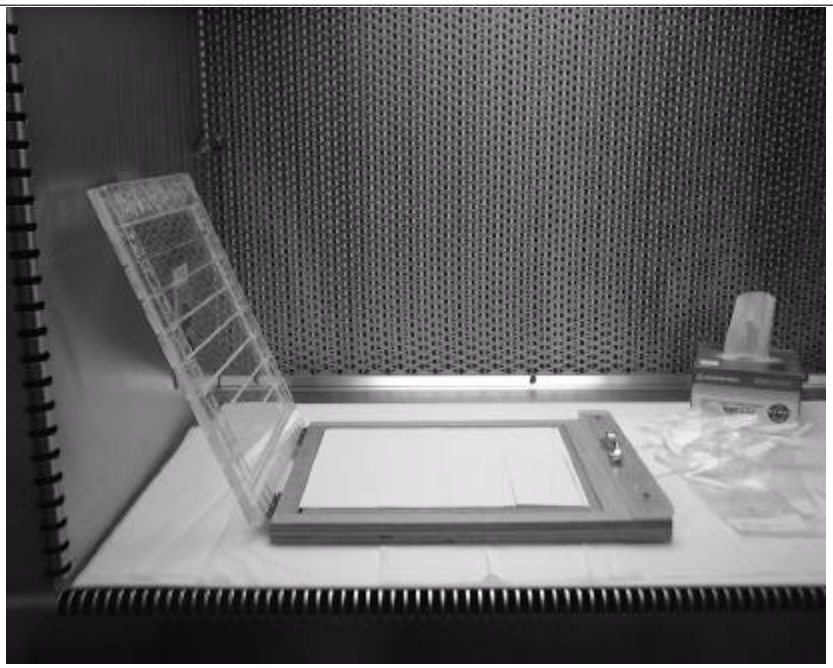


Figure 4.10 Place the Filter on the Cutting Board

Figure 4.11 Cut the Filter Into Strips

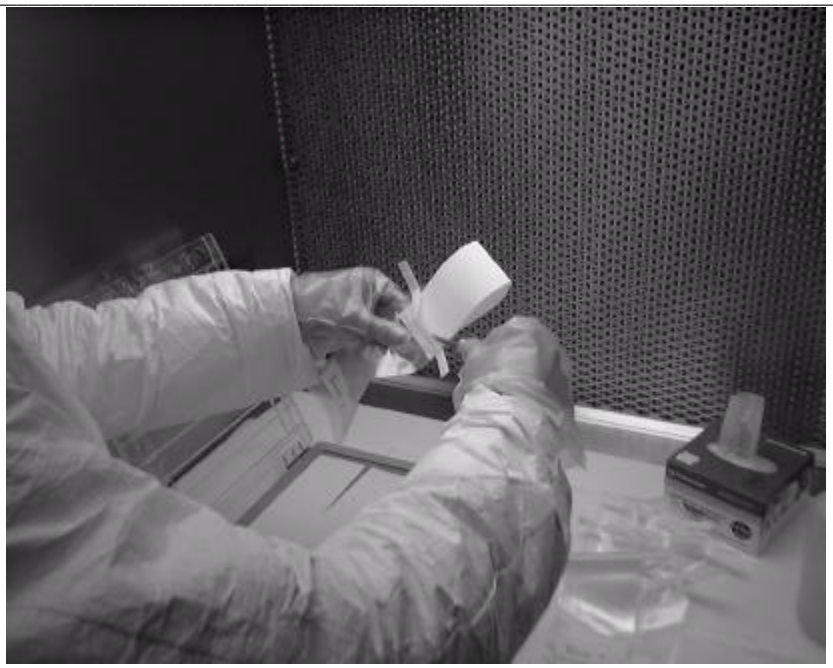


Figure 4.12 Place Each Strip in a Sample Bag (exposed sides in).

4.5 SIZE SELECTIVE INLET CLEANING

After each 3 months of operation, or after 100 full 24 hour sample periods, the Selective Size Inlet (SSI) should be cleaned as follows:

a) The inlet hood should be removed by unscrewing the 8 screws which hold the hood to the SSI housing. Care should be exercised to avoid losing the spacers because the width of the inlet gap between the hood and housing is a critical dimension.
b) Clean the interior surface of the hood and acceleration nozzle plate with Kimwipes. Special attention should be paid to the lip of the acceleration nozzle plate as dust will tend to build up on the lip.
c) Unscrew the 12 screws which hold the 1st stage acceleration nozzle plate onto the SSI housing and lift the acceleration nozzle plate vertically straight off the housing. Care must be exercised to avoid bending any of the nine acceleration nozzles.
d) Clean out the 1st impaction chamber with a clean, lintless cloth or Kimwipes.
e) Clean out the 1st stage acceleration nozzles (total of 9) with a clean, lintless cloth or Kimwipes.
f) Clean out the 2nd stage acceleration nozzles (total of 16) with a clean, lintless cloth or

Kimwipes.

g) Unscrew the 4 screws which hold the 2nd stage acceleration nozzle plate to the housing, and lift the plate vertically straight out of the housing. Care must be exercised to avoid bending any of the 16 nozzles.

h) Clean the final stage vent tubes with a clean, lintless cloth or Kimwipes.

i) Inspect the joints and screw holes where the acceleration nozzles are attached to the acceleration nozzle plates and where the vent tubes are attached to the impaction plate.

j) Replace all the gaskets in the SSI (especially the gasket on the bottom of the SSI that seals to the filter paper cartridge).

k) Reassemble the acceleration nozzle plates back to the housing using the same screws and holes.

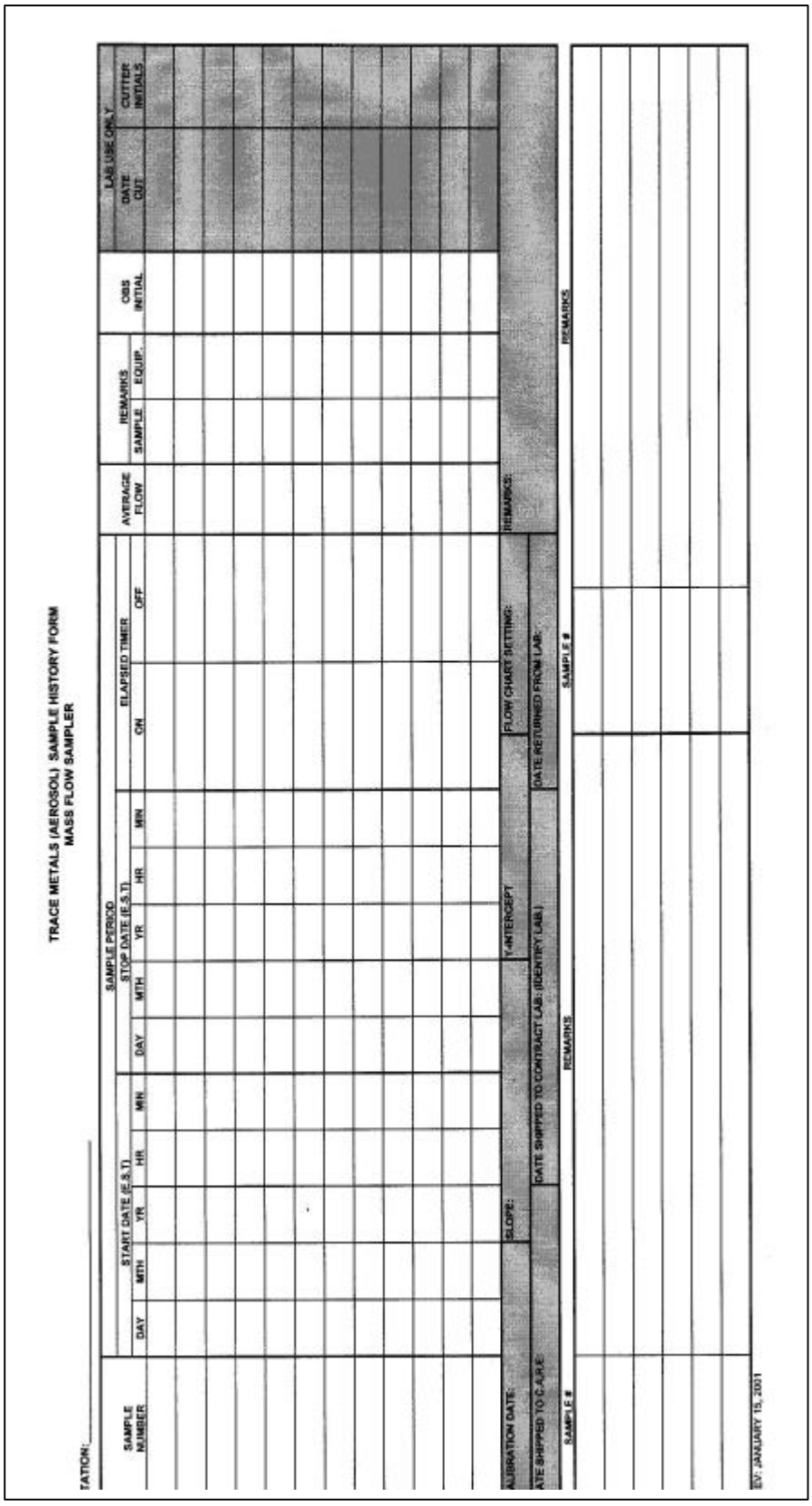
l) Reassemble the hood to the housing with eight screws and spacers.

Note: Newer models may have a variation on the above.

4.6 GASKETS

At the same time calibrations are done for the Aerosol samplers the instrument must be inspected including the gaskets on the filter paper cartridge. Check all gasket seals making sure they are not compressed. Compression leads to leaking and could render samples useless due to the loss of an accurate volume reading and the inaccurate interpretation of results. Each station is to have a supply of spares which are rotated quarterly or semi-annually as necessary.

The contract observer should routinely inspect gaskets during filter changes and take any defective gasket out of service.



TRACE METALS (AEROSOL) SAMPLE HISTORY FORM
MASS FLOW SAMPLER

TATION:_____

SAMPLE NUMBER	SAMPLE PERIOD START DATE (E.S.T.) DAY	MTH	YR	HR	MN	STOP DATE (E.S.T.) DAY	MTH	YR	HR	MN	ELAPSED TIMER ON	OFF	AVERAGE FLOW	REMARKS SAMPLE	REMARKS EQUIP.	OBS INITIAL	LAB USE ONLY DATE CUT	CUTTER INITIALS

CALIBRATION DATE: SLOPE: Y-INTERCEPT FLOW CHART SETTING: REMARKS:

DATE SHIPPED TO CLARK: DATE SHIPPED TO CONTRACT LAB: (IDENTIFY LAB:) DATE RETURNED FROM LAB:

SAMPLE #	REMARKS	SAMPLE #	REMARKS

REV: JANUARY 15, 2001

Figure 4.13 Mass Flow Sample History Form

4.7 VOLUMETRIC HIGH VOLUME SAMPLER

The volumetric high volume sampler (Figure 4.14) is similar in design to the mass flow high volume sampler with the major difference being that the air is drawn through the sampling orifice at a constant rate of 40 cfm (1.13 cm/m) and there is no adjusting for flow rate required.

Refer to section 4.2.1 for instructions on preparing the sample cassette for the volumetric hi-volume sampler.

Figure 4.14 Volumetric High Volume Sampler

4.7.1 SAMPLE INSTALLING PROCEDURES

At the sampling location the filter cassette is loaded into the Hivol sampler using the following steps: See Figure 4.15 for a schematic.

a) Unhook the 6 clips securing the PM10 size selective inlet to the instrument housing and open the lid cover of the hivol..

b) Clean any dirt or debris from the sampler using a Kimwipe and deionized water.

c) Remove the bag containing the filter cassette, from the transfer case.

d) Put on a clean pair of poly gloves. Open the bag and remove the cassette. Keep the bag for storing the cover plate.

e) Place the cassette onto the holder over the sampling orifice. Secure it in place using the four locking screws (finger tight only, overtightening compresses the gasket too much). Remove the cover plate and place it into the bag. Store the bag in the sample transfer case until needed for cassette removal.

f) Close the lid cover and secure. Remove poly gloves and retain them for proper disposal.

g) Open the lower compartment door. Open the access panel to the chart recorder mechanism. Install a new chart making sure that it is set to the correct time of day. The date, station name, sample number and type of sample (ie. Volumetric) are to be written on the chart.

   Note: The chart recorder is used only to indicate periods when the sampler was not in operation during the sampling period (i.e. power outage). It does not indicate the flow as in the mass flow hi-vol.

h) Lower pen arm and make sure pen is in contact with the paper chart. Rotate the chart to ensure the pen is recording on the chart. Close access panel and secure.

i) Open the access door to the digital timer and record the accumulated time reading from the timer in the log book, along with the day, month and year.

j) Turn ON the Hivol (Note: this is a 3 position switch so it must be pushed all the way up). Note the time ON in the log book. Using the voltage variator screw, adjust the flow to the required setting (determined from latest calibration) for 40 cfm on the flow chart. Close access and instrument door and secure.

k) Take the digital manometer and turn it on. Verify that the units are set to inches of water. Insert the chrome nozzle of the manometer hose into the stagnation port located on the right hand side of the instrument. After the instrument has been running for 2 to 3 minutes, take a manometer reading and record this as the “manometer on” reading. Remove the

manometer hose and turn the manometer off (push the "shift" and "off" keys together)

l) Return to sample handling area. Make appropriate entries on the Sample History Form (Fig. 4.16) from the log book. If a portable tape recorder is used at the sampling area, all information must be transcribed into the site Log Book as well as on the Sample History forms. The remarks section should include comments about precipitation during the sample change period.

4.7.2 SAMPLE REMOVAL PROCEDURES: AT THE SAMPLING SITE

a) Collect the plastic bag/cover plate in the sample transfer case, the site Log Book, digital thermometer, and a box of gloves. Take these out to the sampling site.

b) Turn the digital manometer on. Insert the nozzle hose into the stagnation port and take a reading. This will be the "manometer off" reading.

c) Open lower door to the hivol and the access door to the digital timer. Turn the sampler OFF. Note this time in the Log Book along with the TIMER reading.

d) Open the access panel to the chart recorder. Lift pen arm and remove chart. Note the date and time off on the back of the chart. Place it in the transfer case. Close access panel and lower door.

e) Open upper lid cover of the Hivol sampler.

f) Put on a clean pair of poly gloves.

g) Remove the cover plate from the bag and place it over the cassette, snugly.

h) Loosen the four locking screws and remove cassette. Place cassette in the bag. Fold over the top of the bag and place it in the transfer case.

i) Close upper lid and secure. Remove gloves and retain for proper disposal.

j) Return to sample handling area.

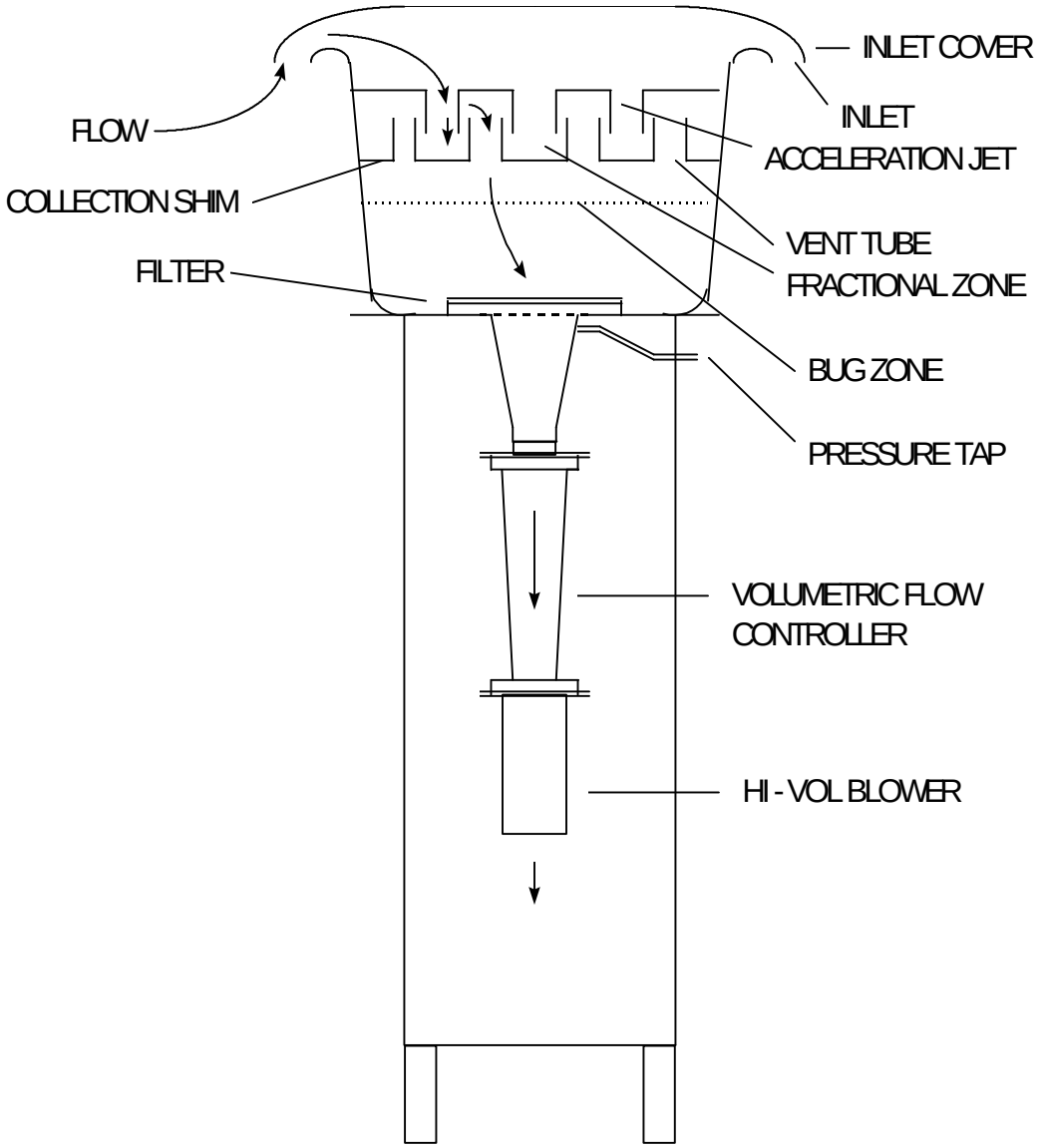


Figure 4.15 Volumetric Hi Volume Sampler Schematic

4.7.3 SIZE SELECTIVE INLET CLEANING

Refer to section 4.5

4.7.4 GASKETS

Refer to section 4.6

4.7.5 TRACE METALS FILTER CUTTING

Refer to section 4.4.1

4.7.6 MULTI-POINT FLOW CALIBRATION

The Graseby-General Metal Works VFC PM10 Sampler is used to collect trace metal samples using the same filter media and cassettes as the Sierra Anderson except that there is no requirement to adjust any flows once the power is turned on. The equipment is set for a constant airflow of 40 cfm with no adjustments necessary.

The following is a précis of the Graseby-General Metal Works multi-point calibration procedure for the VFC type PM10 high volume sampler.

Required: Ambient temperature and pressure; slope (m) and intercept (b) for the calibration orifice used (from orifice calibration chart) and the look-up tables for the particular sampler in use.

To perform a calibration use the following procedure;

a) Open the PM 10 sampler and leave open during calibration.
b) Place the calibration orifice and mounting plate (pre assemble first) on the sample platform and tighten the mounting screws till snug.
c) Connect the digital manometer to the orifice and a water or digital manometer to the stagnation port of the sampler. Open the chocks of the water manometer and zero the sliding scale. Turn the digital manometer **On** and set it to inches of water.
d) Turn the instrument **On**. Allow it to warm up for a minute then **Close** the Orifice vari-plate and leak check the instrument (the flows will be slightly positive as the Orifice does not fully seal).

e) If flows are near zero, proceed with the calibration. Open the vari-flow plate fully. Once the manometers stabilize, record the ambient pressure and temperature. Adjust the variflow plate to allow for approximately five readings within the expected operating range of the sampler (between 5 and 24 inches of water). Take readings of both manometers as test points (TP1). Repeat for test points 2 thru 5.

f) Adjust vari-flow plate and allow manometers to stabilize. Take readings of both manometers as TP2. Repeat for TP3,4, and 5.
Calculate flow rates for each TP for each manometer (formulas in section 4.7.8).

Compare flow rates (should be within +/- 10% of 1.13 cubic metres/minute); and if so (3 of 5 readings will suffice) calculate the % difference between orifice flow (Qa Orifice) and sampler flow (Qa Sampler). These should be within +/- 3%. If so, calibration is okay (% diff = ((sampler Qa - Orifice Qa)/ Orifice Qa) *100)

4.7.8 CALCULATION OF ORIFICE FLOW RATE

Qa = 1/m * (sqr delta H *(Ta / Pa) - b) (for ambient conditions)

where: m = slope (taken from calibration curve of Orifice)
b = intercept (also from calib. curve)
delta H = manometer reading (in inches of water)
Pa = ambient pressure (mm Hg)
Ta = ambient temperature (degrees Kelvin)

Calculation of Sampler Flow Rate:

calculate pressure ratio Po / Pa:

Po / Pa = 1 - (Pf / Pa)

where: Pf = pressure differential at stagnation port (convert to mm Hg)
Pa = ambient pressure (expressed as mm Hg)

Using Po / Pa and the ambient temperature (degrees C) determine Qa from the samplers look up tables (interpolate between values as necessary)

It is not necessary to convert readings from the calibration to Standard Conditions since we are verifying the Look Up tables for the samplers and these are expressed in ambient (actual) values.

ATMOSPHERIC ENVIRONMENT SERVICE
TRACE METALS (AEROSOL) SAMPLE HISTORY FORM
VOLUMETRIC SAMPLER

STATION:______________________

SAMPLE NUMBER	SAMPLE PERIOD												AIR TEMP. (°C)		STATION PRESSURE (millibars)		DIFFERENTIAL PRESS. ("H_2O)		AVG TEMP.	AVG PRESS.	REMARKS		OBS. INITIAL	LAB USE ONLY	
	START DATE (E.S.T)					STOP DATE (E.S.T)					TIMER														
	DAY	MTH	YR	HR	MIN	DAY	MTH	YR	HR	MIN	ON	OFF	ON	OFF	ON	OFF	ON	OFF			SAMP.	EQUI.		DATE CUT	CUTTER INITIALS

HI-VOL S/N:	FLOW AUDIT DATE:		REMARKS:
DATE SHIPPED TO C.A.R.E:	DATE SHIPPED TO LAB (IDENTIFY LAB):	DATE RETURNED TO C.A.R.E:	

SAMPLE #	REMARKS	SAMPLE #	REMARKS

REV: FEBRUARY 16, 2001

Figure 4.16 Volumetric Sample History Form

METEOROLOGICAL INSTRUMENTS

OPERATOR'S MANUAL

5. METEOROLOGICAL INSTRUMENTS OPERATOR'S MANUAL

5.1 PURPOSE AND DESCRIPTION

Interpretation of the air quality data obtained at the Station requires supporting meteorological measurements of temperature, relative humidity, wind speed and direction, atmospheric pressure, precipitation amount and incoming solar radiation. For this purpose, each station is instrumented with a meteorological package which is remotely monitored to a large extent.

At each site a meteorological tower is installed with an R. M. Young anemometer at the ten meter or tree top level and a Rotronics Model MP100 thermistor/hygristor combination at the 1.5 m level. These instruments are wired directly to a Campbell Scientific CR21X data logger which polls the instrument every second and calculates hourly average data for transmission, by telephone wire, to CARE, Egbert. The solar radiation data is taken by an Eppley Model PSP pyranometer which is also connected to the data logger. A Setra model 270 pressure transducer is powered by the 12VDC port of the data logger, and the measured signal is fed into the data logger input ports. Internal programming converts this signal to a value of atmospheric pressure measured in millibars. The precipitation amount is logged daily by the station operator using an AES Type B rain gauge for rain and a Nipher shielded snow gauge for snow. The final instrument is a Belfort recording rain and snow gauge, which is also connected to the data logger. The recording rain gauge has a chart record, as well, and is the only instrument in this complement which requires servicing by the Field Technician.

5.2 SITE TECHNICIAN'S DUTIES

The meteorological complement is remotely polled by telephone or via the internet to a data computer situated at the monitoring site. The SiteTechnician is required to monitor the correct operation of the instruments on a daily basis. All-weather instrument enclosures are located in the sampling compound. Sites with two enclosures contain the telephone modem in one and the other contains the data logger. If only one enclosure is present, all items are contained therein.

5.2.1 DAILY CHECK PROCEDURE

Anemometer

a) Visually observe the anemometer props and vane to note any damage and ensure they are rotatung. In winter or during periods of freezing rain check to see if the props are not frozen.

Pyranometer

a) Clear snow, ice or dirt off the dome of the pyranometer. Wipe the domes daily using a Kimwipe.

Data Logger

a) Open the door to the data logger to check instrument operations. Press ***5A** to check the time.
b) Press ***6A** to read the wind speed.
c) Press **A** repeatedly to read wind direction, temperature, relative humidity, recording rain gauge cumulative precipitation, solar radiation, atmospheric pressure, temperature inside the box and battery voltage. Although the data logger is certified to operate at minus 20°C, it is preferred to keep it above freezing. Therefore the box temperature is crucial. If the internal temperature is below 20°C, and an internal heater is in place , perform the following checks (**Note**: not all stations have an internal heater as some derive heat generated by the telephone modem and are insulated within the box enclosure). Check the thermostat wiring and carefully check the heating element (it can be very hot!). If the box is cold and the element is not heating, call the laboratory technicians.
d) If all checks out okay, press ***0** (star zero) to start the logger.

Recording Rain Gauge

a) Check the chart on the recording rain gauge to see that the pen is inking properly and that the chart mechanism has advanced to the correct time.

Type B Rain Gauge

a) The Type B Rain Gauge is checked that it is level and there are no cracks.

c) The funnel and graduated cylinder is removed from the outer holder and placed on a level surface. If there is ice present, it has to be thawed before the reading is taken. The amount of precipitation is read at the meniscus (lowest point of the curved water surface) to the nearest mark. Read to the nearest 0.1 mm for 0.2 mm and above.

c) If there is only a small amount of water present in the cylinder and the meniscus is below 0.2 mm, record the value "Trace". Measurements start at 0.2 and are in 0.1 increments.

d) If there is an overflow, read the amount in the graduated cylinder, then measure the contents of the outer cylinder. The sum of all the measurements will be the final rainfall reading for that day.

e) The precipitation is discarded and the cylinder and funnel returned to the holder.

f) Record the rainfall amount on the precipitation form provided.

Nipher Snow Gauge

a) During the winter, the Nipher Snow Gauge is used. If snow is "bridging" across the top of the container, tap the side of the container to knock it into the collector. Note this in the station log book.

b) Remove the inner container and check for dents. Check for chips and cracks in the Nipher shield.

c) Place the spare inner container in the collector.

d) The inner container with snow is taken to the sample handling area. The snow is melted, taking care that none is lost by evaporation.

e) The melted snow is measured using a graduated cylinder. Both the depth of snow on the ground to the nearest whole cm and the melted amount in mm are recorded in the station log book. The same criteria applies for measuring the liquid amount as does for the Type B Rain Gauge - section c).

g) Record the snowfall amount on the precipitation form provided.

Snow Depth

a) Use the snow ruler to measure the depth of snow on the ground to the nearest cm. Take various readings and average them. Avoid areas of obvious drifting.
h) Record the snow depth on the precipitation form provided.

Log Book

a) A log book is to be maintained to note any equipment malfunction or other items of note.

5.2.2 MONTHLY SERVICE OF RECORDING PRECIPITATION GAUGE (Belfort)

The recording gauge is essentially a scale with a lever arm which moves a pen to record the weight of precipitation in the bucket. The lever arm is calibrated to advance to 150 mm of equivalent precipitation and then reverse direction tracking downwards to 300 mm of precipitation. Although this chart is used only for backup of the more precise potentiometer readout from the gauge, which is hooked to the data logger, it is still useful as a check on the system operation. The bucket needs to be emptied when the gauge indicates that it is nearing fullness (250 - 275 mm). The contents are to be disposed of in containers provided.

TO CHANGE THE CHART (FIRST DAY OF EVERY MONTH)

a) Open the chart door.
b) Use the lever to move the pen away from the chart.
c) Remove the chart drum from the clock mechanism of the gauge.
d) Slip the spring clip up from the chart and remove the old chart.
e) Install a new chart by noting the operator name, station name and time of installation on the chart, folding over the tab at the end of the chart, slipping the spring clip over the point where the ends of the chart overlap on the drum.
f) Replace drum.
g) Advance the chart to the current date and time (usually 9 a.m on the first day of the month).

h) Lower the pen and ensure that it is inking properly. If not, change the pen.
i) Make sure you log the date and time off on the previous chart and insert it in a plastic bag for return to CARE with the next sample shipment.

TO EMPTY THE BUCKET (AS REQUIRED):

a) Rotate the head flange clockwise from the top and lift off.
b) Remove the bucket and empty contents into containers provided.
c) Using Kimwipes, wipe oily residue from inside of bucket.
d) In summer, add approximately 1/4 cup of fresh oil to the bucket. In winter add 2 parts commercial antifreeze to 1 part water for a total volume of 2 cups (500ml) to the oil .
e) Reinstall bucket and replace the top flange.
f) Make a note in the log book.

5.3 FIELD TECHNICIAN'S DUTIES - INSTRUMENTS

5.3.1 ROTRONICS TEMPERATURE/HUMIDITY GAUGE

Once a year the Rotronics should be replaced with a laboratory unit which has been recently calibrated by the manufacturer or by the procedures in the Rotronics Manual. A spare sensor is available at every site. This is a simple replacement on the tower. At that time all wiring should be checked.

5.3.2 R. M. YOUNG ANEMOMETER

Once yearly, the tower should be lowered to check the alignment of the R. M. Young vane with due north. At that time the bearings of the prop should be inspected and all wiring checked.

5.3.3 EPPLEY PYRANOMETER

Once every two years, the Eppley pyranometer should be replaced by one which has

recently been calibrated by the MSC Radiation Laboratory. Calibration data from the Radiation Laboratory should be maintained with the station records.

5.3.4 DATA LOGGER HOUSING

Check the housing for leaks and proper operation of the heaters and wiring. Check the battery level on the logger. Check that the logger time is correct (this should be updated via software as required to maintain 1 minute accuracy of the logger).

5.3.5 PRESSURE TRANSDUCER

Requires no routine maintenance. Twice yearly the pressure reading will be checked against a calibrated unit and corrective action taken if required.

5.3.6 WINTERIZING THE PRECIPITATION COLLECTOR

Twice yearly, the calibration of the gauge should be checked on the data logger readout by the use of a calibration weight in the rain gauge bucket. Normal maintenance as per the Belfort manual should be performed at this time

For the period November 1 to April 31, a Nipher shield will be added to the collector inlet. It is the field technicians responsibility to ensure it is installed. At that time, a solution of 2 parts antifreeze and one part water will be added to the bucket to prevent freeze-up of the "catch", and to aid in melting the snow. Periodic additions of antifreeze may be required as the volume of the catch increases which subsequently dilutes the antifreeze. An oil keeper of light oil (5W30 or less) is added to limit evaporation. During the winter, the bucket may fill up. At that time, inform the field technician that help is needed for servicing the collector. Two persons make the removal of the Nipher shield easier.

a) Remove the Nipher shield and flange as a unit.
b) Remove the bucket and dispose of the solution in the plastic container provided. Do not dispose of the solution on the ground. The laboratory technicians will provide for proper disposal of the chemicals.
c) Recharge the bucket with antifreeze/water solution and reinstall in the collector.

d) Reinstall the Nipher shield.

5.3.7 SUPPLIES

In addition to having a stock replacement for all instruments in the complement, adequate supplies of pens, recording charts, antifreeze solutions, waste containers, and data supplies will be maintained at CARE.

5.4 RECORDS

All installations, modifications, servicing, and instrument faults should be logged showing the date of the event and the person effecting the change or repair. This site log should be kept at the site and periodically copied to a QA/QC site log maintained at CARE, Egbert. It is very important that records be kept of any instrument change, malfunction, calibration, etc. as well as weather and other events that may be useful in performing quality assurance work on the data and performing any data analysis.

ERRATUM REPORTING, CHANGE REQUEST, AND PROTOCOL MODIFICATION PROCEDURES

6. ERRATUM REPORTING, CHANGE REQUEST AND PROTOCOL MODIFICATION PROCEDURES

6.1 ERRATUM REPORTING

While every attempt was made to ensure that this manual is correct, some procedures are still in the experimental or evolutionary stage and, therefore, are subject to error. Simple mistakes are also likely to be found. To correct problems, report errors found in this manual on the form found in Figure 6.1 (copies provided to each station). One copy should be produced for each set of errors in a given chapter. The form will be formally answered by the IADN staff and, if revision of the manual is serious, a remediation procedure will be stated. This may be a correction to be written to this version of the manual or an entire replacement of pages or sections. For this reason, this manual is kept in looseleaf format.

6.2 CHANGE REQUEST

In some cases, it may be obvious that a certain procedure can be done more efficiently or in a more scientifically correct manner. A request for a procedure change should be formally filed on the form shown in Figure 6.2 (copies provided to each station). This request will be formally answered by the Laboratory Staff. If a protocol revision is accepted, a response will be issued as in 7.3 below.

Forward any change or protocol procedure recommendations to:

Station Manager
Centre for Atmospheric Research Experiments
RR #1, Egbert, Ontario
L0L 1NO

6.3 PROTOCOL MODIFICATION PROCEDURES

The primary protocol modification process is to file the change, if the change or problem doesn't affect the scientific validity of the results, until the next revision. Corrective action of a formal sense must follow each submission of an Erratum Notice or Change Request.

The formal response will be typed on the Erratum Notice or Change Request, copied, and then returned to the person making the request. If the response calls for a modification of procedure, copies of the formal request and the response will be sent to all holders of manuals. For this reason , a record of the issuance of manuals must be recorded.

Similarly, if the request results in a modification to a manual page or section, the changed sections will be sent to all holders of the SPM Manual with the instruction to strike-through the sections effected and to add the revision sheets to their Manual. UNDER NO CIRCUMSTANCES ARE THE EXISTING SHEETS IN A MANUAL TO BE DISCARDED, EVEN IF THEY ARE SUPERSEDED BY A MODIFICATION, CORRECTION, OR DELETION.

ENVIRONMENT CANADA IADN MANUAL ERRATUM NOTICE

PERSON REPORTING ERROR:_____

PHONE:_____ DATE: _____

DETAILS OF ERROR:

PAGE #: _____ SECTION OR LINE #:_____

FAULT:

SUGGESTED CHANGE OF WORDING OR PROCEDURE:

RESPONSE:

BY:_____ PHONE:_____

DATE:_____

REVISED PAGES ENCLOSED: YES _____ NO_____

ENVIRONMENT CANADA IADN MANUAL CHANGE REQUEST

PERSON REPORTING ERROR:_____

PHONE:_____ DATE: _____

DETAILS OF CHANGE:

PAGE #: _____ SECTION OR LINE #:_____

REQUEST:

REASON:

CAN THIS CHANGE WAIT UNTIL MANUAL REVISION?

YES _____ NO _____

RESPONSE:

BY:_____ PHONE:_____

DATE:_____

REVISED PAGES ENCLOSED: YES _____ NO_____

APPENDIX A

IADN SAMPLING PROTOCOL MANUAL

LIST OF RELATED DOCUMENTS AND MANUALS

Canadian Air and Precipitation Monitoring Network (CAPMoN)

Operator's Instruction Manual - Precipitation 1985. Atmospheric Environment Service, 4905 Dufferin Street, Downsview, Ontario, April 1985.

Concord Scientific Corporation, 1988. Total Organic Carbon Analysis of Glass Filters by Combustion and CO_2 Analysis of Evolved Gases, CSC.Q053, 2 Tippet Road, Downsview, Ontario, M3H 2V2.

Martin, H.A. and Willford, W., 1990. Integrated Atmospheric Deposition Network Implementation Plan. Contact: ARQI, Atmospheric Environment Service, 4905 Dufferin St., Downsview, Ontario.

Shackleton, M.N. 1989. Technical and Operating Manual Organic Deposition Monitoring Program, Ontario Ministry of the Environment, 880 Bay Street, Toronto, Ontario, M5S 1Z8.

Sweet, C.W., 1990. Instructions for Sample Change with MIC Precipitation Samplers, Atmospheric Chemistry Section, Illinois State Water Survey, 2204 Griffith Drive, Champaign, Illinois 61820-7495.

Sweet, C.W., 1990. Instructions for Filter Change with High-Volume Samplers, Atmospheric Chemistry Section, Illinois State Water Survey, 2204 Griffith Drive, Champaign, Illinois 61820-7495.

APPENDIX B

REMARKS CODES

(To be confirmed in remarks section on form)

	SAMPLE QUALITY		EQUIPMENT
CODE	REMARK	CODE	REMARK
1	Precipitation during loading or unloading	20	Power failure
2	Organic material on filter (leaf, grass, etc.)	21	Motor unserviceable
3	Insect(s) on filter	22	Pressure chart unserviceable
4	Smoke in area	23	Magnahelic unserviceable
5	Agricultural spraying or fertilizing in area	24	Probe unserviceable
6	Agricultural cultivating or harvesting in area	25	
7	Vehicle operation near sampler	26	Fuse blown
8	Construction in area	27	Controller unserviceable
9	Sample contaminated (specify)	28	Counter unserviceable
10	Other (specify)		
		30	Filter not loaded correctly on cassette
		31	Cassette not mounted correctly on sampler
		32	Double filter
		33	Exhaust vent not open
		34	Other (specify)

APPENDIX C

DEFINITIONS

Laboratory Technician - a technician who performs the initial preparation of samples that are to be used to used for field work as well as follow up preparation for analysis.

Field Technician - a technician who oversees the operations of the monitoring sites. Duties also include equipment installation, calibration and maintenance, as well as instruction on the operation of monitoring equipment to contract operators and others.

Site Technician - a person who performs the day-to-day duties at a monitoring site. The site technician prepares samples at the monitoring station and loads and unloads samples as per pre-determined schedule or as otherwise directed. Duties also include the monitoring of meteorological equipment and some first line maintenance as directed by the field technician.

APPENDIX D

Sample Labeling Format

Samples are to be labeled as per the following format:

Site Identifier
Year
Month
Day
Type of Sampler
Sampler Identifier
Filter Identifier
Type of Sample

Eg: EGB 20020101P1SR

YYYY= 2002
MM = 01
DD = 01
P = PUF
1 = Sampler #1
S = Sample
R = Regular Sample

The above example is for a regularly scheduled sample loaded on January 1, 2002 at Egbert using hi volume samplers #1.

For the purposes of sampler labeling the following applies:

Site Identifiers:

EGB = Egbert
PPT = Point Petre
BNT = Burnt Island
ECO = ECO Buoy

Type of Samplers:

P = PUF
A = Aerosol
V = Volumetric
T = TOC

Sampler Identifier:

EGB PUF	PPT PUF	BNT PUF	ECO PUF
1 = Main Hi-Vol	1 = Main Hi-Vol	1 = Main Hi- Vol	0 = Original sampler - Manifold
2 = Backup Hi-Vol	2 = Duplicate Hi- Vol	2 = Backup Hi- Vol	1 = CARE developed - Manifold
Others as needed	3 = Toxaphene	Others as needed	8 = Cannister - Manifold
	4 = NWRI Precip.		9 = Cartridge – Hi-Vol
	Others as needed		Others as needed

EGB AEROSOL	PPT AEROSOL	BNT AEROSOL
1= Main	1 = Main	1 = Main
2 = Backup	2 = Backup	2 = Backup
Others as needed	Others as needed	Others as needed

EGB VOLUMETRIC	PPT VOLUMETRIC	BNT VOLUMETRIC
(Aerosol program)	(Aerosol program)	(Aerosol program)
1 = Main	1 = Main	1 = Main
Others as needed	Others as needed	Others as needed

EGB TOC	PPT TOC	BNT TOC
1 = Main	1 = Main	1 = Main
2 = Backup	2 = Backup	2 = Backup
Others as needed	Others as needed	Others as needed

NOTE: TOC not currently in service. (Data archived)

Filter Identifier:

S = Sample
B = Blank

Type of Sample:

R = Regularly scheduled sample
S = Special Study – (Project Studies)
X = Test Sample – (Evaluation Samples)