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STANDARD OPERATING PROCEDURE

FOR

Pb-TSP HIGH-VOLUME SAMPLERS

State of Florida
Department of Environmental Protection (DEP)
Bureau of Air Monitoring

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DOCUMENT HISTORY

Revision	Date	Responsible Person	Description of Change
0	12/30/2016	Florida PQAO	Initial Draft
0	09/01/2017	Florida PQAO	Resubmitted draft
1	07/01/2021	Florida PQAO	Removed references to PM_{10} and updated maintenance to motors
2	05/01/2023	Florida PQAO	Removed references to chart recorders and updated timer and clock requirement to ± 15 minutes

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1.0 PURPOSE

The purpose of this standard operating procedure is to guide the operator in the installation, set-up, calibration, and maintenance of a high-volume sampler (Hi-VOL) used for determining the concentration of lead in total suspended particles (Pb-TSP) for the State of Florida Ambient Air Monitoring Program. Other information such as theory of operation, servicing and microprocessor control are covered in the manufacturer's instruction manual and will be referred to as needed. Both the instrument manual and this SOP are to be kept with the instrument or be accessible in electronic format at all times.

These procedures are consistent with the data management requirements specified in the Quality Assurance Project Plan for the State of Florida Lead Ambient Air Quality Monitoring Program. The final data are verified and submitted to the Air Monitoring Verification Program (AirMVP), then uploaded by the Florida Department of Environmental Protection (FDEP) to the US EPA Air Quality System (AQS).

2.0 SCOPE AND APPLICABILITY

The Florida Department of Environmental Protection and Florida Local Air Monitoring Agencies utilize various makes and models of high-volume particulate samplers to quantify lead in suspended particulate matter (Pb-TSP). The Pb-TSP Hi-VOL samplers are designated as the Manual Reference Method, RFLA-0813-813.

Since all manual method Hi-VOL samplers in the Florida Ambient Air Monitoring Network operate under the same general principal, as described in Section 3.0, this document is intended to be used as a reference for the set-up, calibration, maintenance, and operation of a Pb-TSP Hi-VOL sampler. The proper utilization of this procedure by the operator, in conjunction with the equipment manufacturer's operation manual (and addendums), will conform to the local, state, and federal data quality objectives, the State of Florida Quality Assurance Project Plans (QAPPs), and the air monitoring regulations published in the Code of Federal Regulations (CFR). The air monitoring data generated as a result of implementing these procedures will be comparable to the National Ambient Air Quality Standards (NAAQS) and reported to the state and federal ambient air monitoring databases.

3.0 SUMMARY OF THE METHOD

Measurement of Pb-TSP is based upon active sampling using a high-volume air sampler. The ambient particles are collected on glass fiber filters. The Hi-VOL sampler uses an electric motor to draw a known volume of ambient air at a constant flow rate. The sample is collected over a 24-hour (nominal) sampling period every six days for primary samplers and every twelve days for collocated samplers. The Hi-VOL samplers utilize a volumetric flow control (VFC) system to maintain the constant flow rate through the inlet. A choked-flow venturi is operated such that the air attains sonic velocity in the throat of the device. In this "choked" mode, the flow rate is unaffected by downstream conditions such as motor speed or exit pressure and is a predictable function of upstream conditions, such as the stagnation pressure ratio and temperature. Thus, the volumetric flow is controlled without any moving parts or electronic components. In this type of flow control system, no means is provided for adjusting the controlled flow rate. See figure 14-1 in Appendix B for a generic drawing of a VFC Hi-VOL sampler.

The measurement of Pb-TSP by Hi-VOL sampling is based on the collection of TSP onto a glass fiber filter substrate, followed by analysis for Pb in TSP by Inductively Coupled Plasma Mass Spectrometry (ICP-MS) using a heated block (hot block) digester with HNO3 for filter extraction according to Appendix G to 40 CFR Part 50.

4.0 DEFINITIONS

Technical terms in this SOP are defined as they are introduced so that their meaning is made clear in context. This section explains some general terminology.

Audit – is often used in a generic way to mean check, inspect, examine, or assess, and many SOPs use the term to refer to QC procedures, such as flow checks or leak checks, that are carried out by field operators during the course of normal operations and maintenance.

Calibration – refers to the act of adjusting an instrument after comparison with a standard. When referring to the instrument software, the term "calibration" is used to indicate a procedure that would alter instrument output. A "calibration check" involves only the checking of an instrument against a standard and involves no adjustment of the instrument.

Quality Control (QC) – refers to the operational techniques and activities used to fulfill the requirements for quality.

Quality Assurance (QA) – refers to the planned or systematic activities used to provide confidence that the requirements for quality are fulfilled. An independent audit is an example of a QA activity. QA protocols determine whether the QC procedures are adequate.

Verification – is a review of interim work steps to ensure they are acceptable and to determine whether the system is consistent, adheres to standards, uses reliable techniques, and performs the selected functions in the correct manner.

Validation – determines whether the system complies with requirements, performs the functions for which it is intended, and meets the organization's goals and user needs. It is a determination of correctness of the data and is usually performed only periodically (e.g., quarterly) or at the end of a project.

Limits of Linearity – is the term for the test determining the relative percent difference between a Pb-TSP Hi-VOL sampler's VFC flow rate and the certified calibration orifice's calibration curve.

5.0 HEALTH AND SAFETY PRECAUTIONS

In any field operation, emphasis must be placed on safety. Site operators must be aware of the potential safety hazards to which they are subjected. Follow all safety protocols and equipment guidelines and be prepared for emergency situations. The site operator is responsible for his/her safety from potential hazards including but not limited to:

a) Travel: When traveling to the site be sure to check on road conditions and weather advisories. Always let someone know where you're going and when you expect to be back. Always carry a first aid kit.

b) Electrical: For obvious problems (fire, scorching, blown fuses), turn off the power for the circuit involved and notify a supervisor. Never attempt electrical repairs other than those you are certified or trained to make. Unplug the sampler before making replacements. Be especially cautious if conditions are wet.

c) Insect pests: If you are allergic to insect stings, you should carry a kit prescribed by a physician. Be especially cautious if nests or large numbers of stinging insects are present.

As with all monitoring equipment, precautions should be taken when working around electricity, power tools and elevated platforms. The individual technician needs to have a clear understanding of electrical and mechanical applications and his or her ability to perform equipment maintenance. High voltage is present as well as moving mechanical parts. Possible injury or death could occur if the proper steps are not taken. Notify a supervisor of all problems.

6.0 INTERFERENCES

Although the design of the Hi-VOL sampler inlet separates large extraneous objects such as insects from the sample stream, these may be swept onto the filter. In addition, the operator shall be aware that liquid aerosols, such as oil mists and fog droplets, are retained by the filter. If the amount of liquid collected is sizeable, the filter can become wet, and its function may be impaired.

As the filter becomes loaded with collected matter, the sampling rate is reduced. If a significant drop in flow rate occurs, the average of the initial and final flow rate will not give an accurate estimate of total flow during the sampling period. The magnitude of such errors will depend on the amount of reduction of airflow rate and on the variation of the mass concentration of dust with time during the 24-hour sampling period. As an approximate guideline, any sample should be suspect if the final flow rate is less than one-half the initial rate.

Other interferences of which the operators shall be aware of include power failures or voltage change during the sampling period which may lead to an error, depending on the extent and time duration of such failures. Also, the passive loading of the filter left in place for any time prior to or following a sampling period can introduce an error. The timely installation and removal of the filter is advisable, or a sampler with shutters may be used.

7.0 PERSONNEL QUALIFICATIONS

A basic understanding of the principles governing ambient air Hi-VOL sampling methods using a VFC system is necessary, and all field operations personnel will be familiar with environmental field measurement techniques. Those who service the analyzer in the field must be very conscientious and attentive to detail in order to report complete and high-quality environmental data. Persons qualified to perform field sampling of Pb-TSP by manual methods should perform the filter changes, installation, testing, operation, maintenance, repair, and calibration.

Operators are also required to read the manufacturer's instruction manuals supplied with the analyzer and supporting calibration equipment to become familiar with the various controls and components prior to attempting any operation described in this procedure. The manufacturer's manuals contain useful operation, maintenance, and diagnostic information that may not be contained in this SOP. Operators are trained by experienced personnel and must demonstrate proficiency and understanding of this SOP.

8.0 EQUIPMENT AND SUPPLIES

Hi-VOL sampler systems may be operated in different configurations. However, the basic principle, as described in Section 3.0, is the same for each sampler used in the Florida ambient air monitoring network. A list of the specific Hi-VOL samplers can be found in the Florida Annual Air Monitoring Network Plan[1]. The following list includes components utilized for typical Hi-VOL sampling systems field operation and calibration:

a) **Anodized aluminum shelter housing.** The housing has a pressure tap to determine differential pressure which is a measurement used in the calibration of the flow controller and blower-motor to calculate volumetric air flow.

a) **A tent-shaped inlet roof for Pb-TSP.** The sampler inlet directs the air flow onto an 8-inch by 10-inch glass fiber filter. Pb-TSP Hi-VOL samplers collect particles of less than 100 micrometers (µm) at a flow rate of 1.13-1.70 m3/min (40-60 ft3/min) using the conventional high-volume sampler, without size selection.

b) **A blower motor assembly.** The blower-motor is a combination of an electrical motor attached to a circular impeller that draws air flow into the sampler inlet, collecting any suspended particulate matter onto the filter. The air flow continues down the throat of the filter support assembly and through the critical orifice, which functions as the Volumetric Flow Control (VFC) of the sampler. The VFC controls the flow rate through the filter. The air flow passes through the blower-motor and out an orifice plate in the bottom of the blower-motor housing.

c) **A stainless-steel filter cassette.** The cassette holds the filter in place on a support that draws air through the blower motor.

NOTE: A Hi-VOL sampler may contain an automated protective lid, such as a Tisch Sampl-Saver™ covering the filter before and after the sampling period.

d) **A manual or digital sampler timer.** The timing device provides electrical power to automatically start and stop sampler operation. The manual sampler timer is 6-day, capable of being set to start and stop the sampler for a 24 hour period, ± 30 minutes; the digital sampler timer can be set to start and stop the sampler for a 24 hour period, ± 15 minutes.

e) **An elapse timer.** The elapsed timer is the indicating device that accurately records the time period that electrical power is provided to the sampler components. Unless otherwise documented, the timer is installed and operated according to the manufacturer's instructions. The elapse timer plugs inline between the sampler timer and the flow controller. The elapsed time meter is capable of measuring 24 hours (1440 minutes) with an accuracy of ± 2 minutes.

1 Pursuant to Section 58.10 of 40 CFR Part 58, the State of Florida shall submit to the US EPA Regional Administrator an annual monitoring network plan.

NOTE: The elapsed timer is used for units with manual sampler timers. The digital sampler timers record the elapsed time internally. Therefore, no additional elapsed timer mechanism is necessary.

Other supporting equipment utilized for Hi-VOL sampler data collection, calibration and audit checks include:

a) **Barometer** - used to measure the atmospheric pressure. The barometric pressure is used to calculate the air flowrates of the Hi-VOL sampler. It indicates the atmospheric pressure with a resolution of at least 5 millimeters of mercury (mmHg).

b) **Differential Water Manometer** - used to measure a pressure differential of 16" or 36" of H_2O at the calibration orifice pressure tap. The Differential Water Manometer is used as a standard to compare all digital manometers data. The manometer is identified with a unique I.D. number.

c) **Digital Manometer** - used to measure a pressure differential of 20" or 40" of a H_2O column calibrated against a NIST-traceable standard. The manometer is identified with a unique I.D. number.

d) **Flow-rate Orifice Transfer Standard** – a working standard using fixed resistance plates or a variable resistance adjustment knob to provide a known rate of air flow. The flow orifice is certified against a local primary standard (i.e. Roots Meter), annually.

e) **Thermometer** - used to measure the atmospheric temperature of the ambient air during Hi-VOL sampling.

9.0 INSTALLATION, START-UP AND OPERATION

The Pb-TSP Hi-VOL samplers are mounted on a safe and suitable monitoring platform with access to electrical power and an unobstructed airflow to the sampler inlet. For samplers used to determine compliance with the National Ambient Air Quality Standards (NAAQS) Pb concentrations, the sampler must meet the air monitoring siting requirements specified in Appendices A and E of 40 CFR Part 58. Therefore, the following conditions must be met:

a) The Hi-VOL sampler must be exposed to 270° of unobstructed airflow and the inlet at least 1 meter (m) away from any supporting structure, both vertically and horizontally.

b) The sampler inlet must be between 2 and 7 meters (m) above ground level for near-road monitoring applications and between 2m and 15m for all other applications.

c) Collocated Hi-VOL sampler inlets must be within 4m and at least 2m apart, horizontally, and less than or equal to 1m, vertically.

9.1 Hi-VOL Sampler Installation

Pb-TSP Hi-VOL samplers designated as reference or equivalent methods (FRM/FEM) will vary by manufacture and options (i.e. flow recorders, timers, automatic sample covers). Consequently, the operator(s) is required to read the manufacturer's manual(s) for the sampler and any optional components. In addition, operators must be thoroughly familiar with the various controls and components of the sampler prior to beginning operation.

9.1.1 After the initial calibration of the Hi-VOL sampler as per Section 10.0 below, carefully transport and install the sampler to the field location.

9.1.2 Following manufacturer's instructions, carefully assemble the base of the Hi-VOL sampler. The sampler must be bolted down to a secure mounting surface.

9.1.3 Assemble the sampler inlet according to the manufacturer's instructions and carefully install it on the base unit.

9.1.4 Check all tubing and power cords for crimps, cracks, or breaks.

9.1.5 Plug the power cord into a line voltage outlet. If possible, this outlet should be protected by a ground fault interrupter (GFI) for the operator's safety. The use of waterproof interlocking electrical connectors is also recommended to ensure operator safety and to avoid shorts or power interruptions. Do not allow any electrical connections to be submerged during periods of inclement weather.

9.1.6 Turn on the sampler and make sure that it is still working properly. Investigate and correct any malfunctions before proceeding. Operate the sampler for approximately 30 minutes to ensure that the motor brushes are properly seated and that the motor is operating at full performance.

9.1.7 Perform a multipoint flow-rate calibration, as described in Section 10.2.

The sampling procedure for Pb-TSP Hi-VOL samplers will vary according to the sampler model and options. However, general procedures begin with filter loading and preparation followed by sampler programming. The Hi-VOL sampler is controlled by a system timer, which is programmed to turn on the high-volume pump at midnight (00:00 hours) of the sampling day and turn off the pump at midnight (00:00 hours) of the following day. Post-sampling, the operator retrieves the exposed filter and returns it to the Pb analytical laboratory.

The following subsections prescribe the sampling procedure and the required documentation for each sampling run. The operator will need a clean glass fiber filter from the Pb analytical lab, a filter cassette, certified manometer, thermometer, and barometer, Pb-TSP Hi-VOL Flow Rate Verification form (Form No. DEP 03-18-C), and a Pb-TSP Hi-VOL Sample Record (Form No. DEP 03-18-A).

9.2 Filter Preparation

The laboratory analyst will inspect the filters according to the Environmental Protection Commission of Hillsborough County SOP for the Determination of Lead in Ambient Air by Heated Nitric Hot Block digestion and ICP-MS Analysis. The laboratory will provide the chain of custody (COC) form, DEP 03-18-E that will track clean filters prepared for field sampling.

The laboratory may supply filters individually or in batches. If the lab provides multiple filters to the field office at one time, the COC may be recorded in the *FILTER BATCH* section of Form DEP 03-18-E, instead of signing for each individual filter. The lab analyst will enter the range of filter numbers for the batch of filters; and then sign and date in the "*Released by*" field on the form. The field office will sign and date in the "*Received by*" field on the form. The *FILTER BATCH* section may be left blank if the lab releases individual tared filters; in which case, the laboratory will sign and date as the "Lab Analyst" and the field operator will sign as the "Field Operator" to document COC.

The field operator will load the filter into the Hi-VOL filter-holding cassette in a clean, indoor environment wearing a clean pair of disposable latex, vinyl, or nitrile gloves, and then complete the COC form for each filter.

9.2.1 Remove the filter from the protective box or folder, and then record the "*Field Operator*" name, "*Date Received*", and "*Site AQS#*", on the filter chain-of-custody (COC) log; DEP 03-18-E for Pb-TSP glass filters, corresponding to the filter ID number.

NOTE: The field operator or lab analyst will enter N/A in the Lab Analyst and Date Released fields if the FILTER BATCH section is complete.

9.2.2 Discard any filter it there is any notable damage and make note of the rejected filter in the "*Comments*" field on the COC log.

9.2.3 Place the filter into an open filter cassette centering the filter over the support screen. Ensure that the filter ID number is facing down.

9.2.4 Close the filter cassette by replacing the top of the frame over the filter ensuring that the gasket material covers the outer edges of the filter. Tighten the thumbscrews until the gasket material seals down firmly on the filter and bottom support.

NOTE: The seal should be firm but do not over-tighten the thumbscrews, this may damage the filter material.

9.2.5 Replace the cassette cover, which must be in place to protect the filter during transport to and from the sample site.

9.3 Filter Retrieval

The operator will attempt to retrieve exposed filters on the next working day after sampling, but no later than the day prior to the next scheduled sampling run date. Upon arrival at the monitoring site, the operator will inspect the area and notate, on the sample record any unusual activities such as, nearby road construction or paving, excavation, or land clearing. If the unusual activity near the site is significant, the operator will document the activity in the sample record comments and may include photographs.

The operator will perform the filter retrieval and installation procedures, recording the final record of sampling data on Form No. DEP-03-18-A, the Pb-TSP Hi-VOL Sample Record for the sample collected. The operator will initiate a new sample record for the filter installed.

The following items are necessary for collecting the sample and installing a clean filter for the next sampling date:

a) The Pb-TSP Hi-VOL Sample Record for the sample to be collected.
b) A manometer capable of measuring the differential pressure of 0-40 inH2O.
c) The VFC Look-Up table provided by the sampler manufacturer.
d) A computing device such as a computer or calculator.
e) Cleaning materials for the Hi-VOL sampler (e.g., cleaning rags, damp cloth).
f) A clean filter prepared according to Section 9.2 of this SOP, above.
g) A Pb-TSP Hi-VOL Sample Record for the new sample installed.

9.3.1 Verify all information recorded on the Pb-TSP Hi-VOL Sample Record, *Identification Block* and *Filter Installation Block*. Review any comments by the installation operator.

9.3.2 Record the equipment information in the *Filter Retrieval Block*.

9.3.3 Enter the first initial and last name of the technician retrieving the exposed filter, the date of removal, and the result of the [Sampler Timer Check] as “PASS” or “FAIL”. The Hi-VOL sampler’s clock must be within ± 15 minutes of the transfer standard in local standard time (EST or CST).

NOTE: Check the instrument timer to make sure it is on the correct time and the sampler ran on the correct date. If necessary, take corrective actions to adjust the instrument timer and document actions in the Retrieval Operator Comments Block.

9.3.4 Record the elapsed time on the sample record form. If the elapsed time was not 1440 ± 60 minutes, a slight adjustment of the clock may be necessary.

NOTE: Since the validation criteria for sampling duration is expressed in minutes, the operator may need to convert the units of time from hours to minutes. If the elapsed timer displays continuous time and is not resettable, the operator will use the Microsoft Excel version of the sample record form (DEP 03-18-A) which contains a conversion worksheet to document the time displayed upon filter installation and filter retrieval. The conversion worksheet will calculate the elapsed time and convert to minutes, if necessary, and must be retained as part of the sample record when utilized.

9.3.5 Reset the elapsed timer to 0000 minutes or 0.00 hours, if applicable.

9.3.6 Remove the vacuum cap, if applicable, from the stagnation port on the side of the sampler base and connect a manometer, capable of measuring the pressure differential of 0-40 inH_2O, leaving the other manometer port open to the atmosphere.

9.3.7 Inspect the manometer tubbing for crimps and check that it snugly fits the stagnation port and the manometer, and then zero the manometer according to manufacturer's instructions.

9.3.8 Turn on the sampler and allow the unit to warm-up to operating temperature for at least 5 minutes. The Hi-VOL sampler is equipped with an automatic sample cover (e.g. Tisch TE-8550 Sampl-Saver), the following steps will turn on the sampler and retract the filter cover:

a) Press [SET UP] or (F3) on the digital timer display.

b) Using the arrows, scroll to the *Diagnostics* menu and press [ENT]. and

c) Scroll to the *Motor* menu and press [ENT] to start the sampler motor and automatically retract the filter cover.

9.3.9 Record the differential pressure (ΔP) at the stagnation port in inches of H_2O for the [Final Flow] in the filter retrieval section of the sample record.

9.3.10 Record the 24-hour average ambient temperature in degrees Celsius (°C) and the 24-hour average barometric pressure in millimeters of mercury (mmHg) for the day of the sample.

NOTE: The average temperature and barometric pressure readings are obtained from the Hi-VOL sampler, other ambient monitoring, or meteorological instruments at or near the air monitoring site.

9.3.11 Turn off the sampler and tilt the sampler inlet head back so that the support brackets hold it in place. Make note, in the *Retrieval Operator Comments Block*, of any evidence of sample air leaking around the filter cassette and gasket. The Hi-VOL sampler is equipped with an automatic sample cover (e.g. Tisch TE-8550 Sampl-Saver), the following steps will turn off the motor and open the filter cover to remove the sample filter:

a) Press [SET UP] or (F3) on the digital timer display.

b) Using the arrows, scroll to the *Diagnostics* menu and press [ENT].

c) Scroll to the *Motor* menu and press [ENT] to stop the sampler motor; the filter cover will close, and

d) Manually lift the filter cover to retrieve the sample.

9.3.12 Check the exposed filter for signs of physical damage, insect parts, and the appearance of the particulate. Making notes in the *Retrieval Operator Comments Block*.

9.3.13 Remove the protective cover from the new filter (set new filter aside in clean area for installation in next step) and cover the exposed filter while it is still on the sampler.

9.3.14 Loosen the four wing nuts, diagonally and then remove the filter holder cassette from the sampler. Special care must be exercised to keep filter cassettes flat (perpendicular to gravity) during transport from the sampler to removal of the filter from the cassettes. This is necessary to prevent the dispersal (loss) of large diameter particulate from the filter surface.

9.3.15 Set the exposed filter aside, keeping it level for transport to the laboratory or refer to Section 9.6, below, for handling the collected sample.

9.3.16 Record the sample [Removal Date] and the [Number (#) of Motor Runs Completed] by the sampler's motor on the sample record form.

9.3.17 Calculate and record, in the *Calculation Block* of the sample record (DEP-03-18-A), the average differential pressure (ΔP_{AVG}) from the installation and retrieval measurements, in units of inH_2O.

NOTE: If using a U-tube manometer to determine the differential pressure, the operator must use the Conversion Worksheet attached to Form No. DEP 03-18-A to record the "high" and "low" readings observed. The conversion worksheet will calculate the differential pressure and must be retained as part of the sample record.

The Microsoft Excel version of DEP 03-18-A contains formulas to complete computations throughout the sample record. Otherwise, the operator shall complete this calculation manually and enter the results in the hardcopy version of the sample record.

9.3.18 Calculate and record the stagnation pressure ratio [P_o/P_a] according to Equation 1, below.

$$Po/Pa = \frac{P_a - P_f}{P_a}$$

Where; (EQ 1)

P_o/P_a = the pressure ratio in mmHg;

P_a = the ambient barometric pressure in mmHg;

Pf = the differential pressure across the filter converted to mmHg (Pf = 1.868 x ΔP_{AVG})

NOTE: For Pb-TSP Hi-VOL samples, divide the difference between ambient barometric pressure (P_a) and stagnation port pressure (P_f) by the average barometric pressure (mmHg) on the sample date, and then look-up the VFC flow rate using the average ambient temperature (°C) on the sample date.

9.3.19 Record the VFC flow rate from the manufacturer's VFC Look-Up Table associated with the VFC installed on the sampler and interpolate between values if necessary.

NOTE: See Appendix D for an example of linear interpolation.

9.3.20 Compare the average flow rate (Q_a) for Pb-TSP to the tolerable limits and record the [RESULT] as "PASS" or "VOID" in the *Calculation Block* of the sample record.

NOTE: The tolerable limits for Pb-TSP Hi-VOL sample flow is 1.1 -1.7 m^3/min.

9.3.21 Enter any additional comments in the *Retrieval Operator Comments Block*, and then sign the sample record and submit the form to the QA staff for review.

9.3.22 Clean the inside of the filter compartment, as well as all areas of the sampler with a damp cloth, and then enter "YES" for [Sampler Cleaning] on the sample record form. If unable to clean the sampler, enter "NO" and provide an explanation in the *Retrieval Operator Comments.*

9.3.23 Remove the manometer from the stagnation port and replace the vacuum plug, if applicable, to prepare the sampler for the next sampling run.

9.3.24 If not completed after step 9.3.15, refer to Section 9.6 for handling the collected sample.

9.4 Filter Installation

The operator records the filter installation on the Pb-TSP Hi-VOL Sample Record (Form No. DEP-03-18-A).

9.4.1 Record the [Filter Number] and all sampling information in the *Identification Block* and *Filter Installation Block* of the Pb-TSP Hi-VOL Sample Record (Form No. DEP-03-18-A).

9.4.2 Record the equipment information in the *Filter Installation Block* and enter the [Install Date].

9.4.3 Unless already completed during filter retrieval, tilt the sampler inlet head back so that the support brackets hold it in place.

9.4.4 Unless already completed during filter retrieval, clean the inside of the filter compartment.

9.4.5 Install the clean filter cassette on the Hi-VOL sampler.

9.4.6 Tighten the four wing nuts diagonally and sufficiently in order to hold the cassette filter assembly onto the lower base plate of the sampler, and then close the sampler inlet hood.

9.4.7 Unless already completed during filter retrieval, remove the vacuum cap from the stagnation port on the side of the sampler base and connect a manometer, capable of measuring the pressure differential of 0-40 inH_2O, leaving the other manometer port open to the atmosphere. Otherwise, proceed to step 9.4.9.

9.4.8 Inspect the manometer tubbing for crimps and check that it snugly fits the stagnation port and the manometer, and then zero the manometer according to the manufacturer's instructions.

9.4.9 Turn on the sampler and allow the unit to warm-up to operating temperature for at least 5 minutes.

9.4.10 The Hi-VOL sampler is equipped with an automatic sample cover (e.g. Tisch TE-8550 Sampl-Saver), the following steps will turn on the sampler:

a) Press [SET UP] or (F3) on the digital timer display.

b) Using the arrows, scroll to the *Diagnostics* menu and press [ENT]. and

c) Scroll to the *Motor* menu and press [ENT] to start the Hi-VOL sampler motor.

9.4.11 Record the differential pressure (ΔP) at the stagnation port in inches of H_2O for the filter installation field on the sample record.

NOTE: If using a U-tube manometer to determine the differential pressure, the operator must use the Conversion Worksheet attached to Form No. DEP 03-18-A to record the "high" and "low" readings observed. The conversion worksheet will calculate the differential pressure, and must be retained as part of the sample record.

The Microsoft Excel version of DEP 03-18-A contains formulas to complete computations throughout the sample record. Otherwise, the operator shall complete this calculation manually and enter the results in the hardcopy version of the sample record.

9.4.12 Turn off the sampler, disconnect the manometer, and install the plug on the stagnation port, if the port does not contain a one-way check valve.

9.4.13 If the Hi-VOL sampler is equipped with an automatic sample cover (e.g. Tisch TE-8550 Sampl-Saver), the following steps will activate the cover and turn off the sampler motor:

a) Press [SET UP] or (F3) on the digital timer display.

b) Using the arrows, scroll to the *Diagnostics* menu and press [ENT], and

c) Scroll to the *Motor* menu and press [ENT] to activate the filter cover and stop the sampler motor.

9.4.14 Verify the time and date on the sampler timer. If using a manual timer, (e.g. 6-day timer) reset the timer if necessary by rotating the dial until the correct day and time of the day appear at the red pointer. Position the "on" tripper switch to the day and time of day that the unit is to begin sampling. Position the "off" tripper to the day and time of day that the unit is to stop sampling.

9.4.15 If using a resettable elapsed timer, reset it to 0000 minutes and record it in the *Filter Installation Block* of the sample record form. Otherwise, record the elapsed timer value on the *Conversion Worksheet*.

9.4.16 Enter any additional comments in the *Installation Operator Comments Block*, and then sign the sample record and secure it for completion by the operator retrieving the sample.

NOTE: Usually, the same operator who installed the clean sample filter will retrieve the exposed sample. Therefore, "securing" the sample record form means to retain possession or control of the hardcopy or electronic version by the air monitoring agency. If a different operator retrieves the exposed sample, then the original sample record will be provided to the retrieving operator.

9.5 Post-Sampling Filter Processing

The field technician processes collected samples in a clean, indoor environment, handling the filter wearing clean, disposable gloves. The technician removes the filter from the cassette and places it into an Hi-Vol filter envelope (DEP 03-18-H) by gently folding the filter lengthwise, careful not to press the crease flat, inside a clean sheet of paper. The technician shall only touch the outer edges of the filter paper to avoid contaminating the sample.

9.5.1 Prepare a filter envelope (Form No. DEP 03-18-H) by entering the required information listed below.

9.5.2 The technician records the following items, prior to inserting the filter in the envelope:

a) Site name and AQS #
b) Filter ID number
c) Sampling Run Date
d) Elapsed Time
e) Average Flow Rate in local conditions
f) Technician's printed name and signature.

NOTE: The laboratory analyst may record any additional comments on the storage envelope as necessary.

9.5.3 Don a pair of clean, disposable latex, nitrile, or vinyl gloves and remove the protective cover on the filter cassette.

9.5.4 Remove the filter from the filter holder cassette, keeping it level. To insert the filter into the Hi-Vol filter envelope, gently fold the filter lengthwise, careful not to press the crease flat, so the exposed (dirty) side is folded inward onto itself to prevent loss of particulate matter inside a protective paper cover.

NOTE: The field ID number will be on the outside of a folded filter placed in an envelope.

9.5.5 Compare the filter ID number on the filter to the ID number on the sample record and filter envelope.

9.5.6 Insert the filter inside the protective paper cover and into the envelope. Do not squish the envelope flat or tap them down into the envelope. **(Do not seal the adhesive)**

9.5.7 Deliver the collected sample to the Pb-TSP laboratory custodian, completing the lab Chain-of-Custody (COC) Form No. DEP 03-18-G, Pb-TSP Filter Lab Delivery Log.

9.6 Field Blanks

Field Blank samples are collected once per calendar quarter. Typically, the operator obtains a field blank after retrieving a regular sample from the Hi-VOL and prior to installing a clean filter for the next sampling run. Filters used as field blanks for Pb-TSP Hi-VOL samplers are first prepared according to the filter preparation procedures in Section 9.2, above. The operator places a field blank on the Hi-VOL sampler, closing the inlet and then removes it immediately without turning on the sampler motor.

The operator will follow the filter installation and removal procedures defined in sections 9.4 and 9.3, respectively.

The operator records the field blank on a Pb-TSP Hi-VOL Sample Record (Form No. DEP-03-18-A) and will make a notation that this sample record is for a field blank in the *Installation Operator Comments* block. The procedures for collecting a field blank sample are:

9.6.1 Set-up an unexposed (clean) filter, in a clean, indoor environment, wearing a clean pair of disposable latex, vinyl, or nitrile gloves.

9.6.2 As per steps 9.2.1 through 9.2.5, load the filter into a cassette and transport it to the Hi-VOL sampler.

9.6.3 Install the field blank filter on the primary Hi-VOL sampler as per sections 9.4.1 through 9.4.5.

9.6.4 Indicate the purpose in the *Installation Operator Comments Block* on Form No. DEP 03-18-A.

9.6.5 Close the Hi-VOL sampler's inlet lid, pause, then open the lid to retrieve the field blank sample.

9.6.6 Remove the sample as per sections 9.3.15 through 9.3.17.

9.6.7 Enter any additional comments in the *Retrieval Operator Comments Block*, and then sign the sample record and submit the form to the QA staff for review.

9.6.8 Follow the Post-Sampling Filter Processing procedures in section 9.5, above.

10.0 INSTRUMENT CALIBRATION CHECKS

The flow rate calibration check for Pb-TSP Hi-VOL samplers is the relationship between the instrument flow and a known flow transfer standard. The calibration check procedures for the Hi-VOL sampler are dependent on the mechanism for controlling the sample flow. All Hi-VOL samplers in the Florida Ambient Air Monitoring Network are volumetric flow controlled (VFC).

The VFC calibration procedure relates the actual flowrate (Q_a) as indicated by the calibration orifice to the ratio calculated by the expression, P_o / P_a. This ratio is used to determine flow rates from the VFC look-up table provided by the sampler manufacturer. If the VFC look-up table's flow rates agree with the corresponding calibration orifice's flow rates within ± 5.0% of the orifice's calibration curve, then the VFC look-up table is validated and will be used to determine flow rates during subsequent sampler operation. If the VFC's flow rates are not within the stated tolerance, the operator will investigate by checking the manometer and tubing, sampler motor or replacing the sampler VFC.

Individual calibration procedures for the system clock and elapsed time recorder components are also included in this section of the SOP.

Flow rate calibration checks for Hi-VOL samplers are performed upon initial set-up and then under the following conditions:

1. Following any flow controller repairs or replacement, including the repair or replacement of the Hi-VOL blower motor, or

2. Following any routine QC flow check or flow audit which indicates the Hi-VOL sampler is out of tolerance, beyond the limits of the performance criteria.

10.1 Pre-Calibration Leak Test

The field technician performs a leak test to ensure that the volume of air flowing through the filter is not being lost due to any gaps or loose fittings in the system. Document the leak test on Form No. DEP-03-18-C, the Flow-Rate Verification forms used for a Multi-Point or 1-Point flow rate verification on the Pb-TSP Hi-VOL sampler.

10.1.1 Complete the sampler *Identification Block* information on the Flow Rate Verification form, Form No. DEP 03-18- C; paying attention to enter "Multi-Point" or 1-Point" for the [Verification Type].

10.1.2 Complete the sampler *Standards Block* information on the Flow Rate Verification form.

10.1.3 Tilt the sampler inlet head back so that the support brackets hold it in place. Remove the filter cassette or filter (if in place), and then attach the adaptor plate on top of the sampler filter support.

10.1.4 Install the orifice flow calibrator, without an orifice plate or wide open for a variable flow calibration orifice. Be sure that the calibration orifice is centered over the filter

so the gaskets will properly seal and tighten the screws sealing the flow calibrator onto the filter support screen.

10.1.5 Connect one side of a manometer, capable of measuring a differential pressure 0 – 40 inH_20, to the pressure tap on the Hi-VOL motor housing. Leave the other port on the manometer open to the atmosphere, and then zero the manometer according to the manufacturer's instructions.

10.1.6 Turn on the sampler blower motor and allow the unit to warm-up to operating temperature for at least 5 minutes. The manometer will display a pressure differential indicating a vacuum. If so, proceed to step 10.1.8.

10.1.7 If the manometer does not display a pressure differential or vacuum, turn off the sampler blower motor and perform the following checks and then repeat step 10.1.6:

a) Re-check the calibration orifice inlet holes for an obstruction. Also, examine the inside of the orifice, for any obstructions which would prevent air from entering the sampler. Remove any obstruction found during this inspection.

b) Check the tubing to ensure that it fits snugly on the manometer and on the sampler's exit plenum port. Re-attach snugly or replace with new tubing if it is found to be loose.

c) Check the entire length of the tubing to ensure that it is not crimped, cracked, or damaged. Replace the tubing if it is defective.

10.1.8 Seal the pressure tap on the calibration orifice with your thumb or close using a cap placed on the port, and then close or cover the inlet hole(s) at the top of the calibration orifice and the stagnation port with your hand or an equivalent sealing method. The stagnation port on the VFC may be equipped with a spring-loaded, one-way check valve that is in the sealed (closed) position. If not, take action to seal the stagnation port before proceeding.

10.1.9 Once the system is sealed, gently wiggle the VFC and the calibration orifice. Listen for a whistling sound that would indicate a leak from the motor and check that the manometer indicates "zero" flow, no response.

NOTE: Steps 10.1.7 through 10.1.9 must be completed in less than thirty (30) seconds. Make sure the inlet is completely sealed preventing any air flow through the flow calibrator and into the blower motor.

NOTE: The digital manometer display will go to zero and U-Tube manometers will not respond indicating no air flow or leaks in the system.

CAUTION: Running the sampler for too long (1 – 2 minutes) with the air flow blocked can increase the chance that the blower motor will overheat due to the lack of cooling air. Overheating can shorten the lifetime of the blower motor and can also result in damage to the motor's electrical insulation, which could cause a fire or electric shock to the user.

10.1.10 Turn off the sampler and remove any tape or obstructions from the calibration orifice and stagnation port. If there was a leak in the system, take corrective actions and repeat the leak check (Section 10.1) before proceeding with the sampler calibration procedure.

10.1.11 Enter "PASS" or "FAIL" for each component of the leak test in the *Leak and Voltage Check Block* in the Flow Rate Verification form.

10.2 Multi-point Flow-Rate Verification and Operational Flow Check

A multi-point flow verification must be performed upon initial installation and every 365 days, once per calendar year thereafter. In addition, the technician performs a multi-point flow rate verification whenever a single-point flow rate check indicates that the sampler flow deviates from the flow rate calibration device by more than ± 7.0%. For Pb-TSP samplers, multi-point flow verifications are performed after motor maintenance or replacement.

In addition to the multi-point flow rate verification, an operational flow check is performed to verify that the flow rate, with a clean filter installed, is within the operational range of 1.1 – 1.7 m^3/min for a Pb-TSP Hi-VOL sampler.

The multi-point verification utilizes five (5) fixed orifice plates or 5 settings on a variable flow orifice and is performed as follows:

10.2.1 Complete the sampler *Identification Block* information on the Flow Rate Verification form, Form No. DEP 03-18- C (Pb-TSP). Pay attention to enter "Multi-point" for the [Verification Type].

10.2.2 Complete the sampler *Standards Block* information on the Flow Rate Verification form, Form No. DEP 03-18- C.

10.2.3 In the *Input Data Block*, record the calibration orifice slope, intercept, and the current ambient temperature (°C) and barometric pressure (mmHg).

NOTE: The ambient pressure and barometric pressure must be obtained from the Pb-TSP sampler or from other NIST-traceable equipment or instrument using appropriate techniques.

10.2.4 Connect one side of a manometer, capable of measuring a differential pressure 0 – 40 inH_2O, to the stagnation port on the filter holder. The tap maybe plumbed to the exterior of the sampler housing. Then zero the manometer and, if installed, reconnect the Dickson recorder to the motor housing exit plenum.

10.2.5 Install the calibration orifice with the orifice flow plate or the variable flow orifice on the wide-open position, providing the highest flowrate.

NOTE: Be sure that the flow calibrator is centered over the filter support screen so the gaskets will properly seal and tighten the screws sealing the flow calibrator onto the filter support screen.

10.2.6 Connect one side of a manometer, capable of measuring a differential pressure 0 – 20 inH_2O, to the pressure tap of the calibration orifice leaving the other open to the atmosphere, and then zero the manometer according to the manufacturer's directions.

10.2.7 Turn on the sampler motor and allow a 5-minute warm up.

10.2.8 Record the fixed orifice plate number or variable flow orifice setting number on the first row of the *Calculation Block* on Form No. DEP 03-18-C.

10.2.9 Record the absolute value of the observed differential pressure on each manometer, the calibration orifice (ΔP) and the sampler stagnation port (ΔP_f).

NOTE: The absolute value is the positive value in units of inH2O for the orifice plate/flowrate setting.

10.2.10 Calculate and record the [Pressure Ratio (P_o/P_a)] according to Equation 1, above in Section 9.3.

10.2.11 Calculate and record the actual [Orifice Flow Rate (Q_a)] in m^3/min, according to Equation 3, below.

$$Q_a = \frac{1}{m}\left[\sqrt{\frac{\Delta P \; x \; T_a}{P_a}} - b\right]$$

Where; (EQ 3)

Q_a = actual flow rate as indicated by the calibration orifice in m^3/min

ΔP = differential pressure from the orifice manometer in inH_2O

T_a = ambient temperature in Kelvin, (K = °C + 273)

P_a = ambient pressure in mmHg

m = slope of the orifice calibration relationship

b = intercept of the orifice calibration relationship.

10.2.12 Using the P_o/P_a ratio and the observed ambient temperature (°C), enter the Actual Flow Rate (Q_a) from the VFC Look-Up Table associated with the VFC installed on the sampler, in the *Calculation Block*, interpolate between values if necessary. Record the flow rate in units of m^3/min.

10.2.13 Repeat steps 10.2.8 through 10.2.12, four (4) more times for Pb-TSP samplers to obtain measurements for a total of five (5) flowrate verification points.

NOTE: For a Pb-TSP Hi-VOL sampler, five (5) flow rates that include the range of 1.1 – 1.7 m^3/min which is the acceptable range for normal operation.

10.2.14 Calculate and record the percent difference between the calibration orifice flow rates and the sampler VFC flow rates using Equation 4, below.

$$\%\, Diff = \frac{Q_a(sampler) - Q_a(orifice)}{Q_a\,(orifice)}\, x\, 100$$

Where; (EQ 4)

Q_a (sampler) = actual flow rate as indicated by the sampler VFC look-up table, in m^3/min;

Q_a (orifice) = actual flow rate of the calibration orifice, in m^3/min.

NOTE: The acceptable performance criterion is ± 5.0% the limits of linearity for Pb-TSP samplers. The "limits of linearity" is the test between the VFC flow rate and the orifice's calibration curve.

If the relative percent difference is out of tolerance, then the operator will check the sampler for leaks, check the condition of the motor, and check the line voltage. If the poor performance is not resolved by the sampler checks, the VFC will be replaced.

10.2.15 Enter the [RESULT] as "PASS" or "REPLACE VFC" in the appropriate field of the *Calibration Block* on Form No. DEP 03-18-C.

10.2.16 Connect one side of a manometer, capable of measuring a differential pressure 0 – 40 inH_2O, to the stagnation port on the filter holder. The tap may be plumbed to the exterior of the sampler housing. Then zero the manometer.

Next, the technician performs an Operational Flow Check:

10.2.17 Install a clean filter on the Hi-VOL sampler and then turn on the sampler, letting it run for five (5) minutes to warm up to operating temperature.

10.2.18 Record the differential pressure reading from the manometer connected to the stagnation port of the sampler. This is recorded as a positive value with units of "inH_2O" in the *Operational Flow Check Block* on Form No. DEP 03-18-C.

NOTE: The computed values, in the steps below, will be automatically calculated throughout the flow verification when using the Microsoft Excel version of Form DEP-03-18-C. Otherwise, it is recommended that the operator complete this calculation manually and enter the results in the hardcopy version of DEP-03-18-C.

10.2.19 Calculate and record the [Pressure Ratio (P_o/P_a)] according to Equation 1, above in section 9.3.

10.2.20 Using the P_o/P_a ratio for a clean filter and the average ambient temperature (°C) for the sampling day, enter the actual flow rate [VFC (Q_a)] from the VFC Look-Up Table associated with the VFC installed on the sampler, in the *Operational Flow Check Block*, interpolate between values if necessary.

NOTE: See Appendix D for an example of interpolating between values and remember to record the flow rate in units of m3/min.

10.2.21 Turn off the sampler and remove the clean filter.

10.2.22 Calculate the relative percent difference and record the [RESULT] as "PASS" or "FAIL" in the appropriate fields of the form for the operational flow rate check.

NOTE: The performance criteria for the operational flow rate is 1.1 – 1.7 m^3/min for Pb-TSP samplers.

If the operational flow check is out of tolerance, then the operator will check the sampler for leaks, check the condition of the motor, and check the line voltage. If the poor performance is not resolved by the sampler checks, the VFC will be replaced.

Verify the Hi-VOL sampler's clock by comparing it to a NIST-traceable timepiece.

10.2.23 In the *Operational Check Block* of the flow verification form (DEP-03-18-C), record the sampler's time, either from the digital timer or from the 6-day circular timer.

10.2.24 Record the current time from a NIST-traceable timepiece, in standard time (EST or CST)

10.2.25 Verify that the sampler time is within 15 minutes (digital timer) or 30 minutes (manual timer) of the chronograph/timepiece and record the [RESULT] as "PASS" or "CALIBRATE". **If the sampler's time is out of tolerance, adjust the timer as per the manufacturer's instructions and notate the adjustment in the *Operator Comments Block*.**

10.2.26 Complete the Flow-Rate Verification form by adding any pertinent operator comments. Then sign and date the form and submit it to the QA staff for review.

10.2.27 Disassemble the calibration equipment; perform any maintenance.

10.3 1-Point Flow Rate Verification and Operational Flow Check

When performing a 1-Point Flow Rate Verification, the operator attaches the calibration orifice to the sampler. There is no filter on the sampler during this procedure.

A 1-Point Flow Rate Verification for a Pb-TSP Hi-VOL sampler is performed to compare the sampler's normal operating flow rate from the VFC table, in actual conditions (Qa), is within ± 7% of the orifice flow rate (transfer standard). It must be completed every 90 days, at a minimum.

In addition to the 1-point flow rate verification, an operational flow check is performed to verify that the flow rate, with a clean filter installed, is within the operational range of 1.1 – 1.7 m^3/min for a Pb-TSP Hi-VOL sampler.

The 1-Point flow rate verification, documented on Form No. DEP-03-18-C, is performed according to procedures 10.2.1 through 10.2.24 for Multi-point Flow Rate Verification, above, with the following exceptions:

10.3.1 During step 10.2.1, select "1-Point" as the [Verification Type] in the *Identification Block* and proceed to step 10.2.2.

10.3.2 Skip step 10.2.13 and proceed through the remaining steps.

10.3.3 In step 10.2.14, the performance criterion for a 1-point flow rate verification on a Pb-TSP Hi-VOL sampler is changed to ± 7.0% of the transfer standard.

If the result of the 1-point flow rate verification in step 10.3.3 is out of tolerance (i.e. exceeding the performance criterion), then the operator will check the sampler for leaks, check the condition of the motor, and check the line voltage. If the poor performance is not resolved by the sampler checks, the VFC will be replaced.

10.3.4 Complete the Operational Flow Check according to steps 10.2.17 through 10.2.23.

10.3.5 Verify the sampler's timer and complete the QC activity according to steps 10.2.24 through 10.2.28.

10.4 Verification of the Elapsed-Timer Meter

There are two (2) types of elapsed-timer (ET) meters used with the Hi-VOL samplers in the Florida Ambient Air Monitoring network: a mechanical minute or hour counter or a digital timer. Every 12 months (365 days) the elapsed-time meter must be checked against a calibrated time transfer standard. A gain or loss greater than 2 minutes per 24-HR period warrants adjustment or replacement of the ET meter.

The verification process requires that the chronometer transfer standard be set-up in series with the ET meter on the Hi-VOL sampler. The sampler is then set to run for 24 ±1 hour, and then the ET meter is compared to the transfer standard. The ET verification can be conducted concurrently with a scheduled sample run. The annual certification of elapsed-time meters is documented on the Elapsed Timer Calibration Log, Form No. DEP-03-18-E.

10.4.1 Install a chronometer transfer standard in series with the Hi-VOL sampler.

10.4.2 Allow the sampler to run 24 ±1 hour.

10.4.3 In the *Identification Block*, enter the current [Verification Year] and the name of your ambient air monitoring organization.

10.4.4 Enter the site [AQS#] and record the [Verification Date] of the ET calibration/verification on Form No. DEP 03-18-E.

10.4.5 Record the elapsed time from the Hi-VOL sampler's ET meter, in minutes.

10.4.6 Record the elapsed time from the chronometer transfer standard, in minutes.

10.4.7 Enter "YES" or "NO" to indicate if the [Total Time Criteria] is met.

NOTE: If the total elapsed time on both meters is 1440 ± 60 minutes, then the verification will be valid. If not, repeat ET calibration/verification.

10.4.8 Calculate and record the [Time Difference] between the Hi-VOL sampler ET and the TS elapsed time, in minutes. If the difference exceeds ±2 minutes per 24-hour period, adjustment or replacement of the ET meter is necessary.

10.4.9 Enter the [RESULT] as "PASS" or "FAIL" then sign the log with your first initial and last name.

10.4.10 Submit the Elapsed Timer Calibration Log to the QA staff for review.

10.5 Verification of the Hi-VOL Sampler Clock

The Hi-VOL sampler utilizes an automatic timer switch to begin and end the sampling period. The operator checks the clock after each sampling period to verify that it turns on the sampler and shuts off the sampler within ± 15 minutes of the time settings. The operator will make proper adjustments or replace the clock, as necessary, and will notate any adjustments in the *Comment Block* on the sample record (Form No. DEP 03-18-A).

As part of the quarterly operational checks, the operator will verify that the Hi-VOL sampler clock is ±15 minutes of the NIST-traceable chronograph/timepiece, in local standard time (EST/CST). Document the sampler clock QC check in the *Operational Check Block* on the Flow Rate Verification forms (DEP 03-18-C).

11.0 INSTRUMENT MAINTENANCE

Preventive maintenance is important to maintaining data quality as well as minimizing sampler downtime. Field operators are to use the maintenance schedule as a tool to ensure the timely completion of preventative maintenance, as required in this SOP. The extent of sampler cleaning activities may vary greatly from site to site. However, keeping the Hi-VOL sampler clean ensures the quality of the sample.

The operator will record all sampler maintenance, scheduled preventative maintenance or unscheduled corrective actions, on Pb-TSP Hi-VOL Sampler Maintenance Log, Form No. DEP-03-18-D. Table 11-1 summarizes the routine, preventative maintenance activities.

Table 11-1: Preventive Maintenance Schedule for PM_{10}/Pb-TSP Hi-VOL Sampler

Section	Item	Schedule
11.1	Inspect and service the Hi-VOL Sampler Shelter	Annually (365 days)
11.2	Clean the filter mounting area and gaskets	Each Sample Run
11.3	Replace and rebuild the sampler blower motor	Every 400 hours (16 runs)

11.1 Hi-VOL Sample Shelter

Service the Hi-VOL shelter body, wiring and tubing at least annually, every 365 days.

11.1.1 Inspect the shelter body for excessive ware or loose parts. Ensure secure mounting to the platform or base.

11.1.2 Check the power cords for crimps, cracks, and frayed or exposed wiring. Repair or replace power cords with cracked cord casings sas soon as possible after discovery. Do not allow the potential for power cords to be immersed in water; if necessary, raise the power cords above the ground by taping them to the legs of the shelter.

11.1.3 Replace tubing to the stagnation port.

11.1.4 Clean and grease inlet hinges.

11.2 Filter Mounting Area and Gaskets

The filter mounting area and all gaskets are inspected and cleaned, as needed, prior to each sample run.

11.2.1 Inspect and clean with a damp cloth or paper towel, as needed, the area of the Hi-VOL sampler where the filter cassette is mounted.

11.2.2 Inspect the gaskets for tears or wear that may cause flow leaks; replace gaskets, as needed.

11.2.3 Enter "YES" in the *Sampler Cleaning* block on the sample record form (DEP 03-18-A). Enter "NO" if unable to complete the inspection and cleaning, and then explain in the *Retrieval Operator Comments* block.

11.3 Hi-VOL Blower Motor

The technician will replace the blower motor on a Hi-VOL sampler with an operational spare, or rebuilt motor every 400 hours (16 runs), or whenever the flow rate fails to meet the performance criteria specified in Table 12-1, below. The technician will remove the blower motor according to the following procedures:

11.3.1 Remove the exposed filter as per Section 9.3, above.

11.3.2 Open the shelter door and unplug the sampler motor.

11.3.3 While supporting the motor housing with one hand, loosen the screws that attach the motor to the bottom of the VFC. Inspect the VFC flange gasket for wear and replace if necessary.

11.3.4 Remove the motor and motor housing from the sampler.

11.3.5 Inspect the filter-holder-to-VFC gasket and replace if necessary.

11.3.6 Release the power cord by turning the cap of the power cord connector counterclockwise.

11.3.7 Install the new motor reversing steps 11.3.1 thru 11.3.6, above.

11.3.8 Install a clean filter according to Section 9.4, above.

The operator will rebuild the blower motor every 400 hours (16 runs) of operation. The motor will be removed from service after two (2) brush replacements (approximately 1200 total hours of operation). This should not be done in the field.

To rebuild a motor:

11.3.9 Carefully let the motor slide from the housing exposing brushes.

11.3.10 Inspect the armature for excess wear. Replace the entire motor if necessary.

11.3.11 Inspect the rubber motor cushion. Replace if it is worn out or no longer “springy.”

11.3.12 Inspect the power cord for cracks or damaged insulation. Replace or repair cord if necessary.

11.3.13 Remove the brush holder clamp and release the expended brush.

11.3.14 Insert a new brush and replace the clamp. Repeat for the second brush. Be sure brushes being installed are designed specifically for the type of motor in use.

11.3.15 Inspect the pressure tap orifice for debris and/or obstruction and clean if necessary.

11.3.16 Slide the motor back into the housing while slowly pulling the power cord back out of the motor housing to the desired length. Make sure none of the wires are pinched during reassembly.

11.3.17 Secure the power cord by tightening the connector cap.

11.3.18 Properly set the new brushes according to the motor manufacturer’s instructions at a reduced voltage of 60-80 VAC for at least thirty (30) minutes.

12.0 QUALITY ASSURANCE & QUALITY CONTROL

Quality assurance is a system of management activities designed to ensure that the data produced by the operation will be of the type and quality needed and expected by the data user. Quality control defines the procedures implemented to assure that acceptable precision, bias, completeness, representativeness, and comparability are obtained and maintained in the generated data set. This section details the frequency of quality control (QC) checks and instrument calibrations required to meet the measurement quality objectives specified in the Florida Lead QAPP.

The operator performs a QC check on the sample's elapsed time and the Hi-VOL sampler's average volumetric flow rate for each sample run. The Pb-TSP Sample Record (Form No. DEP 03-18-A) is a record of the daily QC checks. In addition, the operator performs 1-point flow rate verifications and operational checks each calendar quarter (every 90-days) and a multi-point flow rate validation/calibration, annually (every 365-days).

The Quality Assurance (QA) staff reviews each sample record, maintenance log, 1-point flow rate verification, and multi-point flow rate validation/calibration. The QA staff reviews the original sampling record, paper or electronic, used to transfer information onto an electronic form or hardcopy log such as COC forms or filter storage envelopes and folders.

Table 12-1 lists the QA/QC checks performed on Pb-TSP Hi-VOL samplers.

Table 12-1: QA/QC Schedule

Parameter	Frequency	Acceptance Criteria
Average Flow Rate in local conditions for Pb-TSP	Every sample run	1.1 – 1.7 m^3/min for Pb-TSP
Sample Elapsed Time	Every sample run	1440 ± 60 minutes
Hi-VOL Sampler Clock	Every sample run	±15 mins of the pre-set on/off time (midnight to midnight)
Hi-VOL Sampler Clock	Every 90-days (Quarterly)	± 15 minutes of the NIST-traceable transfer standard
1-pt. Flow Rate Verification for Pb-TSP in local conditions	Every 90-days (Quarterly)	± 7.0% of the NIST-traceable standard
Operational Flow Rate Check	Every 90-days (Quarterly)	1.1 – 1.7 m^3/min for Pb-TSP
Multi-point Flow Rate Verification for Pb-TSP in local conditions	Every 365-days (Annual)	± 5% of the best fit linear regression line

Parameter	Frequency	Acceptance Criteria
Elapsed Timer Verification	Every 365-days (Annual)	1440 ± 60 minutes; ± 2 mins per 24-hour verification

13.0 DATA ACQUISITION AND RECORDS MANAGEMENT

The sample record and QA/QC forms document measurement data for the State of Florida Pb-TSP Hi-VOL sampling network. The local laboratories utilize the flowrates and sample volumes, provided on the sample record, to analyze filters, calculate and then report Pb-TSP concentrations to the Ambient Air Monitoring QA staff. All original records are kept within the local air program record management system for the document retention times specified in the Lead QAPP.

It is the responsibility of QA staff to further validate the Pb-TSP Hi-VOL sample concentrations and then submit concentrations, as well as QA/QC checks into the AirMVP database according to the Florida Statewide Data Handling and Data Validation SOP, DEP 18-27.

14.0 REFERENCES

1. Code of Federal Regulations Title 40, Chapter I, Subchapter C, Appendix B to Part 50, Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method)

2. Code of Federal Regulations Title 40, Chapter I, Subchapter C, Appendix G to Part 50, Reference Method for the Determination of Lead in Total Suspended Particulate Matter.

3. Code of Federal Regulations Title 40, Chapter I, Subchapter C, Appendix J to Part 50, Reference Method for the Determination of Particulate Matter as PM_{10} in the Atmosphere

4. Quality Assurance Handbook, Vol II, Part II, EPA Method 2.11, PM_{10} High Volume Sampling, September 1997.

5. Quality Assurance Handbook, Vol II, Part II, EPA Test Method, Section 2.2, Reference Method for the Determination of Suspended Particulates in the Atmosphere (High Volume Method), EPA-600/4-77-027a, January 1983.

6. DEP 18-27, Florida Statewide Data Handling and Data Validation SOP, FDEP OAM, June 2016.

7. Sampling of Ambient Air for Total Suspended Particulate Matter and PM_{10} Using High Volume Sampler, Compendium Method IO-2.1, USEPA Office of Research and Development, June 1999, EPA/625/R-96/010a.

8. DEP-16-22 Standard Operating Procedure for the Determination of PM_{10} Particulates in Ambien Air by High Volume Filter Analysis, Rev. No. 0, July 2016.

9. Determination of Lead in Ambient Air by Heated Nitric Hot Block digestion and ICP-MS Analysis, Revision 2.1, Environmental Protection Commission of Hillsborough County, July 2014.

10. Quality Assurance Project Plan for the State of Florida Ambient Air Quality Lead and PM_{10} Particulate Monitoring Plan (FDEP QAPP-004, Rev. 0), Florida Department of Environmental Protection, September 17, 2014.

APPENDIX A - **Forms**

1. Form No. DEP 03-18-A –Pb-TSP Sample Record
2. Form No. DEP 03-18-C - Pb-TSP Flow Rate Verification Form
3. Form No. DEP 03-18-D - Pb-TSP Maintenance Log
4. Form No. DEP 03-18-E – Elapsed Timer Verification Log
5. Form No. DEP 03-18-F – Pb-TSP Filter COC Log
6. Form No. DEP 03-18-G – Pb-TSP Filter Lab Delivery Log
7. Form No. DEP 03-18-H – Hi-VOL Filter Envelope

Form No. DEP 03-18-A –Pb-TSP Sample Record

Form No. DEP 03-18-A **Pb-TSP Sample Record** Effective on: May 2023

Identification Block				
Filter Number:				
Sample Date:	Site Name:	AQS #:	Parameter:	Lead
Instrument Mfr:	Model:	ID/Serial #:	Verification Date:	
Elapsed Timer Mfr:	Model:	ID/Serial #:	Date Calibrated:	
VFC Mfr:	Model:	ID/Serial #:	Date Calibrated:	
Motor Mfr:	Model:	ID/Serial #:	Date Installed:	

Filter Installation Block			
Flow Device Mfg:	Model:	ID/Serial #:	Date Verified:
Timepiece Mfg:	Model:	ID/Serial #:	Date Verifed:

Install Tech Name	Install Date	**Initial Flow** Pstg H2O"	**Elapsed Timer** Start Time

Installation Operator Comments:

Installation Tech Signature: Date:

Filter Retrieval Block			
Flow Device Mfg:	Model:	ID/Serial #:	Date Verified:
Temp. Mfg:	Model:	ID/Serial #:	Date Verified:
BP Mfg:	Model:	ID/Serial #:	Date Verified:
Timepiece Mfg:	Model:	ID/Serial #:	Date Verified:

Removal Tech Name	Removal Date	**Sampler Clock Check**	Limits (Min)
			EST Time ± 15

Sampler Cleaning

# Motor Runs Completed	**Final Flow** Pstg H2O"	**Elapsed Time**	Limits (Min)	Result	**Sample Date** Amb Temp	**Sample Date** Amb Press
			1440 ± 60			

Calculation Block					
△P AVG	Po/Pa	Qa (m^3/min)	Q_{STD} (m^3/min)	Limits (m3/Min)	Results
				1.1-1.7	

Retrieval Operator Comments:

Retrieval Tech Signature: Date:

QA Comments:

Verified by: Date:

Instructions:

This form is an electronic spreadsheet used to record the sampling event for Pb-TSP Hi-VOL instruments. The operator may print and make entries on a hardcopy of this form.

Upon installation of a new filter:

1. In the *Identification Block*, enter the [Filter Number] printed on the glass fiber sample filter, and then enter the [Sample Date]; the scheduled date of sampling.
2. Enter the [Site Name] and [AQS#].
3. In the *Identification Block*, enter the manufacturer, model number, serial number or ID# and date of verification against a NIST-traceable transfer standard for the Hi-VOL sampler, elapsed timer, and VFC.
4. In the *Identification Block*, enter the motor manufacturer, model number, serial number, or ID# and date of installation into the Hi-VOL sampler.
5. In the *Filter Installation Block*, the technician installing the filter enters the manufacturer, model number, serial number, or ID# and date of verification against a NIST-traceable transfer standard for the calibration orifice and the timepiece transfer standard.
6. Enter the first initial and last name of the technician installing the tared filter, the date of installation, the pressure differential from the stagnation port as the [Initial Flow] and then the reading indicated on the elapsed timer.
7. The technician installing the filter enters any comments *Installation Operator Comments Block*, then signs and dates the form.

Upon retrieval of an exposed (sampled) filter:

8. In the *Filter Retrieval Block*, the technician picking up the exposed filter enters the manufacturer, model number, serial number, or ID# and date of verification against a NIST-traceable transfer standard for the calibration orifice, the ambient temperature and barometric pressure instruments, and the timepiece transfer standard. If the barometric pressure instrument is a primary standard, enter "N/A" in the corresponding [Date Verified] field.
9. Enter the first initial and last name of the technician retrieving the exposed filter, the date of removal, and the result of the [Sampler Clock Check] as "PASS" or "FAIL". The MS Excel version of this form contains a drop-down menu for entries in the [Sampler Clock Check] field.
10. Record the number of sampling runs on the sampler's motor.
11. Record the [Elapsed Time], the ambient temperature and barometric pressure on the sampling date.
12. Enter the pressure differential from the stagnation port as the [Final Flow].
13. In the Calculation Block, enter the average differential pressure, [ΔP_{AVG}] and the [Po/Pa] ratio.
14. Enter the [AVG Flow] rate from the manufacturer's VFC Flow-rate table, and then indicate the [Result] of the flow rate check.
15. Enter either "YES" or "NO" in the *Sampler Cleaning Block.*
16. The technician retrieving the exposed filter enters any comments in the *Retrieval Operator Comments Block*, then signs and dates the form.

Once the form is complete, the operator will submit it to the QA officer for verification and data validation review. The QA officer may add comments in the [QA Comment] box, then sign and date the report/log.

Form No. DEP 03-18-C – Pb-TSP Flow Rate Verification Form

Form No. DEP 03-18-C **Pb-TSP Flow Rate Verification Form** Effective on: May 2023

Identification Block

Date Performed:		Site Name:		AQS #:		Parameter:	Lead
Instrument Mfr:		Model:		ID/SN:		Verification Type:	Multi-point Verification
VFC ID/SN:		Date Calibrated:					

Standards Block

Orifice Mfr:		Model:		ID/SN:		Date Certified:	
Temp. Standard Mfr:		Model:		Serial #:		Date Certified:	
BP Standard Mfr:		Model:		Serial #:		Date Certified:	
DVM Mfr:		Model:		Serial #:		Date Certified:	
Orif. Manometer Mfr:		Model:		Serial #:		Date Certified:	
Stag. Port Manometer Mfr:		Model:		Serial #:		Date Certified:	

Input Data Block

Orifice Slope:		Temperature Conversion	
Orifice Intercept:		273 DEG K	
Ambient Temp. (°C):			
Ambient Press. (mmHg):			

Leak and Voltage Check

Orifice Manometer Leak Check:	
Stag. Port Manometer Leak Check:	
Clean Filter Leak Check:	
Voltage (v):	

Calculation Block

Plate # or Flow Setting	Orifice ΔP	Stag. Port ΔPf	Po/Pa	Orifice Flow Rate (Qa)	VFC (Qa)	Percent Difference	Limits	RESULT
							± 5% of Linear Reg.	
							± 5% of Linear Reg.	
							± 5% of Linear Reg.	
							± 5% of Linear Reg.	
							± 5% of Linear Reg.	
							± 5% of Linear Reg.	

Operational Flow Check Note: This is to be performed using a clean filter.

Stag. Port ΔPf	Po/Pa	VFC (Qa)	Corrected Operational Flow Rate	Limits	RESULT	Clock Check	Limit	RESULT
				1.1 - 1.7 m^3/min			± 15 mins	

Operator Comments:

Performed by: Date:

QA Comments:

Verified by: Date:

Instructions:

This form is an electronic spreadsheet used to record the 1-Point or Multipoint Flow Rate verification and Operational Check for a Pb-TSP Hi-VOL sampler. The operator may print and make entries on a hardcopy of this form.

1. In the *Identification Block*, enter the date this flow rate verification is performed, the [Site Name], [AQS#], and the [Parameter] as "Lead".
2. In the *Identification Block*, enter the Hi-VOL sampler manufacturer, model number, serial number, or ID# and the [Verification Type] as "1-Point Verification" or "Multi-point Verification". The MS Excel version of this form contains a drop-down menu to make entries in this field.
3. In the *Identification Block*, enter the VFC ID or Serial number and the date of its most recent verification/calibration with a NIST-traceable calibration orifice.
4. In the *Standards Block*, enter the manufacturer, model number, serial number, or ID# and date of instrument certification against a NIST-traceable transfer standard for each piece of equipment used as a transfer standard.
5. In the *Input Data Block*, enter the slope and intercept of the calibration curve for the calibration orifice, and then enter the ambient temperature and barometric pressure.
6. Enter "PASS" or "FAIL" for each *Leak and Voltage Check*. The MS Excel version of this form contains a drop-down menu to make entries in these fields.
7. In the *Calculation Block*, enter the [Plate # or Flowrate Setting] for the calibration orifice, and then for each calibration point, enter the pressure differential across the orifice and the stagnation port.
8. Record the [Po/Pa] ratio, the [Orifice Flow Rate], and the [VFC] flow rate from the manufacturer's Look-Up tables for each calibration point.
9. Enter the relative [Percent Different] and the [RESULT] as "PASS" or "REPLACE VFC'.
10. In the *Operational Check Block*, enter the pressure differential across the stagnation port with a tared (clean) filter installed.
11. Enter the [Po/Pa] ratio [VFC] flow rate from the manufacturer's Look-Up table.
12. Enter the [Corrected Operational Flow Rate] and the [RESULT] as "PASS" or "FAIL".
13. Enter "YES" or "NO" for the [Clock Check] and the [RESULT] as "PASS" or "ADJUST". The MS Excel version of this form contains a drop-down menu for the [Clock Check] field.
14. Enter any comments in the *Operator Comments Block*, then sign and date the form.

Once the form is complete, the operator will submit it to the QA officer for verification and data validation review. The QA officer may add comments in the [QA Comment] box, then sign and date the report/log.

Form No. DEP 03-18- D - Pb-TSP Maintenance Log

Form No. DEP 03-18-D **Pb-TSP Monitor Maintenance Log** Effective on: February 2022

Identification Block					
Log Year:		Site Name:	AQS #:	Parameter:	Lead
Instrument Mfr:		Model:	ID/Serial #:	Date Verified:	
Elapsed Timer Mfr:		Model:	ID/Serial #:	Date Verified:	
VFC Mfr:		Model:	ID/Serial #:	Date Verified:	

Maintenance Activity		Motor Replaced	1-point Flow Rate Verification	Inspect/Service Hi-VOL Sampler Shelter	Replace Stagnation Port Tubing	Multipoint Flow Rate Verification	Elapsed Timer Verification		
Frequency		Every 16 runs	Quarterly	Annual	Annual	Annual	Annual		
Maintenance Date	Operator							QA Reviewer	Review Date

Operator Comments:

QA Comments:

Instructions:

This form is an electronic spreadsheet used to record the maintenance performed on a Pb-TSP Hi-VOL sampler. The operator may print and make entries on a hardcopy of this form and submit it to the QA staff for review each calendar quarter, no more than every 90 days.

1. In the *Identification Block*, enter the [Log Year], [Site Name], [AQS#], and [Parameter] collected with this sampler.
2. In the *Identification Block*, enter the Hi-VOL sampler manufacturer, model number, serial number, or ID# and date the sampler was verified.
3. Enter the ET and VFC manufacturer, model number, serial number, or ID# and the verification date.
4. For each maintenance event, enter the [Maintenance Date] and the [Operator] first initial and last name.
5. Enter "YES", "NO", or "NOT DUE" as a response for each maintenance item. The MS Excel version of this form contains a drop-down menu for the response to each maintenance item.

The operator will submit it to the QA staff for review and verification. The QA Reviewer signs by adding their first initial with last name and the date the review is complete. If using the MS Excel version of this form, the QA Reviewer will lock each row of maintenance events to prevent altering the record.

Form No. DEP 03-18-E – Elapsed Timer Verification Log

Form No. DEP 03-18-E **Elapsed Timer Verification Log** Effective on: February 2022

Identification Block			
Verification Year:		Monitoring Organization:	

Criteria: ± 2 Minutes in 24 Hours/1380-1500 Minutes Total **NOTE: Use Local Primary Standard Time Reference**

AQS #	Verification Date	Sampler ET ID	Sampler Elapsed Time (mins)	Transfer Stamdard ID	Transfer Standard Certifation Date	Transfer Std. Elapsed Time (mins)	Time Difference (ET-TS)	Meets Total Time Criteria	RESULT	Operator Name	QA Reviewer Name

Operator Comments:

QA Comments:

Instructions:

This form is an electronic spreadsheet used to document and record the annual certification of the sampler's elapsed timer compared with a NIST-traceable transfer standard.

1. In the Identification Block, enter the current [Verification Year] and the name of your ambient air monitoring organization
2. Enter the site [AQS#] and record the [Verification Date] of the ET calibration/verification on Form No. DEP 03-18-E.
3. Record the elapsed time from the Hi-VOL sampler's ET meter, in minutes.
4. Record the elapsed time from the chronometer transfer standard, in minutes.
5. Enter "YES" or "NO" to indicate if the [Total Time Criteria] is met.
6. Calculate and record the [Time Difference] between the Hi-VOL sampler ET and the TS elapsed time, in minutes.
7. Enter the [RESULT] as "PASS" or "FAIL" then sign the log with your first initial and last name.
8. Enter any comments in the *Operator Comments Block.*

9. Submit the ET Verification Log to the QA staff for review.
10. The QA reviewer will enter their first initial and last name for each ET verification and then enter any comments in the *QA Comments Block.*
11. If using the MS Excel version of this form, the QA reviewer will lock each row to prevent altering the record.

Form No. DEP 03-18-F – Pb-TSP Filter COC Log

Form No. DEP 03-18-F			**Pb-TSP FIlter COC Log**					Effective on: July 2021
FILTER BATCH	Filter Range		Signatures	Date		QA Review	Signature	Date
FROM:		Released by:						
TO:		Received by:						

Filter #	Lab Analyst	Date Released	Field Technician	Date Received	Site AQS#	Comments

Instructions:
This form is an electronic spreadsheet used to document and record the Chain-Of-Custody for filters. The lab analyst or field technician may print and make entries on a hardcopy of this form and then submit it to the ambient monitoring field QA staff no later than each calendar quarter; every 90 days, for review and recordkeeping.

1. Enter the [Filter #] for each filter provided to the field technician(s) from the lab.
2. If the lab analyst provides multiple filters by the batch, enter the range of filter ID numbers in the [Filter Range] field, and then sign and date the [Released by] field. The recipient from the ambient air monitoring field office signs and dates the [Received by] field; skip step #3.
3. If tared filters are provided individually, the lab analyst signs for each filter and enters the [Date Released].
4. The field technician signs for each filter and enters the [Date Received].
5. For each filter, enter the site AQS# of the sampling location.
6. Enter any necessary comments pertaining to the filter.

Once the form is complete, the operator will submit it to the QA officer for verification and data validation review. The QA officer will sign and date the report/log.

Form No. DEP 03-18-G – Pb-TSP Filter Lab Delivery Log

Form No. DEP 03-18-G	Pb-TSP FIlter Lab Delivery Log			Effective on: July 2021
Submitting Field Operator	Date Submitted	Receiving Lab Analyst	Date Received	

Filter #	Station Name	Sample Date	Comments	Lab Sample ID #

Instructions:

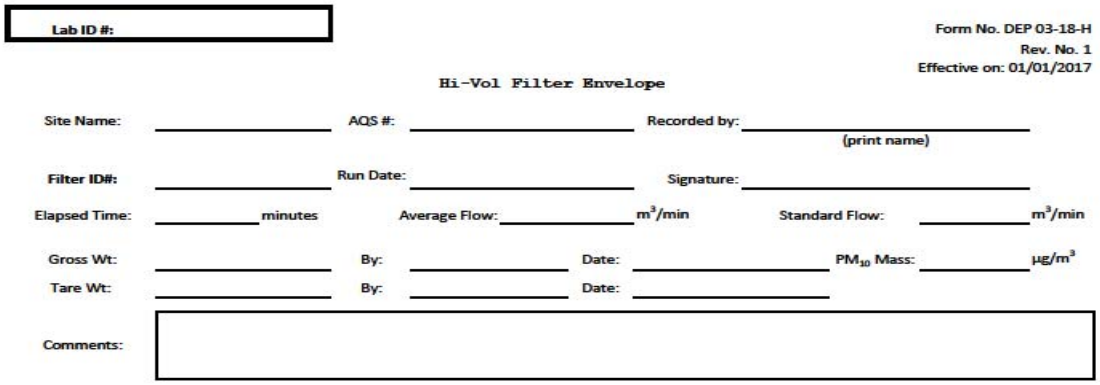
This form is used to enter the exposed filters collected from the field and delivered to the lab for analysis.

1. The field technician will enter their first initial and last name under "Submitting Field Operator" and enter the date the filters were submitted to the lab.

2. The field technician will list each filter number under the "Filter #" column, the "Station Name", the "Sample Date", and any comments associated with the filter.

3. The lab analyst will enter their name under "Receiving Lab Analyst" along with the "Date Received" and the "Lab Sample ID #".

Form No. DEP 03-18-H – Filter Envelope



Lab ID #:

Form No. DEP 03-18-H
Rev. No. 1
Effective on: 01/01/2017

Hi-Vol Filter Envelope

Site Name: _____ AQS #: _____ Recorded by: _____ (print name)

Filter ID#: _____ Run Date: _____ Signature: _____

Elapsed Time: _____ minutes Average Flow: _____ m^3/min Standard Flow: _____ m^3/min

Gross Wt: _____ By: _____ Date: _____ PM_{10} Mass: _____ $\mu g/m^3$

Tare Wt: _____ By: _____ Date: _____

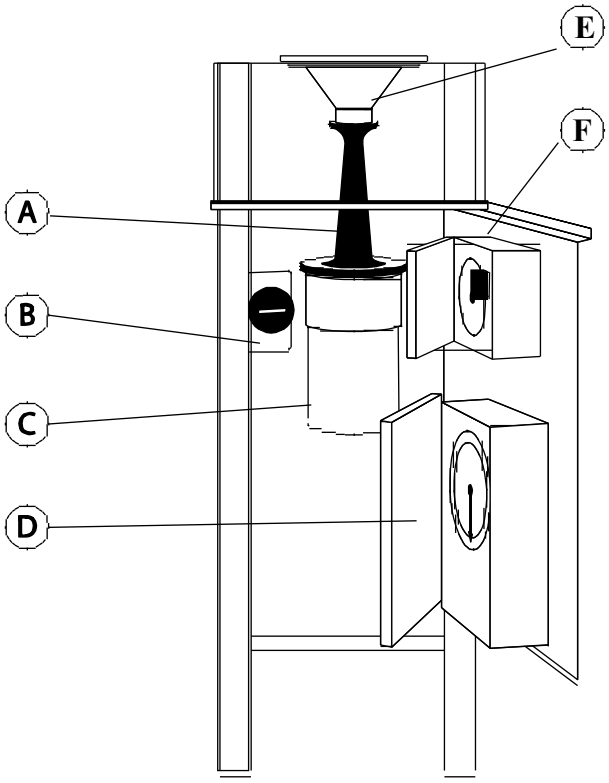
Comments:

Instructions:

This form records pertinent information on the Pb-TSP Hi-VOL filter envelopes used for transfer and storage of Pb-TSP Hi-VOL samples.

1. The field technician or lab analyst will enter the “Site Name”, “AQS”, “Filter ID#”, “Run Date”, “Elapsed Time”, “Average Flow” and/or the “Standard Flow”, and then enter their first initial and last name as “Recorded by”.
2. Sign on the line designated for “Signature”.
3. The lab analyst will enter the “Gross Wt.”, the name of the lab analyst who weighed the filter on the line designated “By”, and then the “Date” of gross weighing.
4. The lab analyst will enter the “Tare Wt.”, the name of the lab analyst who weighed the filter on the line designated “By”, and then the “Date” of tare weighing.
5. Either the field technician or the lab analyst may add any pertinent comments in the “Comment” box.

APPENDIX B - Example Lower Section of Hi-Vol Sampler



A- Volumetric Flow Controller (VFC)
B- Elapsed Timer
C- Blower Motor Housing
D- Sampler Timer
E- Filter Holder
F- Chart Recorder

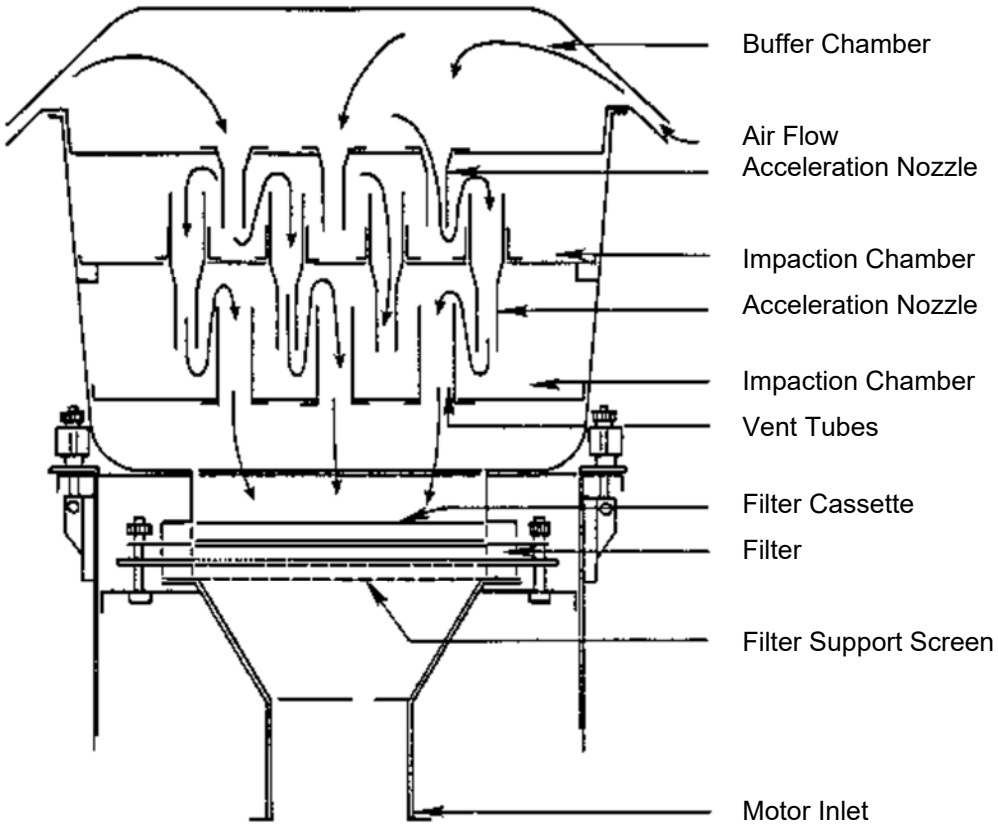


Figure 14-1: Schematic of a PM_{10} Impaction Inlet

APPENDIX C - Glossary

AirMVP	-	Air Monitoring Verification Program
CFR	-	Code of Federal Regulations
COC	-	Chain of Custody
DAS	-	Data Acquisition System
DEP	-	Florida Department of Environmental Protection
EPA	-	U. S. Environmental Protection Agency
FEM	-	Federal Equivalent Method
FRM	-	Federal Reference Method
Hi-VOL	-	High Volume
m^3/min	-	cubic meters per minute
NAAQS	-	National Ambient Air Quality Standards
NIST	-	National Institute of Standards and Technology
Pb-TSP	-	Lead measured in Total Suspended Particles
PQAO	-	Primary Quality Assurance Organization
QA	-	Quality Assurance
QAPP	-	Quality Assurance Project Plan
QC	-	Quality Control
SOP	-	Standard Operating Procedure
VFC	-	Volumetric Flow Controlled
VAC	-	Voltage Alternating Current

APPENDIX D - **Linear Interpolation Between Two Data Points**

VFC manufacturers provide a table of actual flow rates with each VFC which cover the range of Po/Pa ratios for various temperatures. The operator will usually need to interpolate the actual flow rate between two temperatures.

This is an example of interpolating data from a VFC Look-Up Table given the average ambient temperature during the sampling day was 31°C and the Po/Pa ratio was 0.932. The image below is an excerpt from a VFC Look-Up Table.

Page 3 of 8 LOOKUP TABLE FOR VFC S/N P07639

TEMPERATURE °C Flow rate m3/min (actual)

Po/Pa	16	18	20	22	24	26	28	30	32	34
0.930	1.200	1.203	1.207	1.211	1.215	1.218	1.222	1.226	1.229	1.233
0.931	1.201	1.205	1.209	1.212	1.216	1.220	1.223	1.227	1.231	1.234
0.932	1.202	1.206	1.210	1.214	1.217	1.221	1.225	1.228	1.232	1.236
0.933	1.204	1.208	1.211	1.215	1.219	1.222	1.226	1.230	1.233	1.237
0.934	1.205	1.209	1.213	1.216	1.220	1.224	1.227	1.231	1.235	1.238

In this example, the sampling day temperature, 31°C, falls between two values in the table, 30°C and 32°C. Therefore, the flow rate falls between 1.228 and 1.232, respectively. Linear interpolation is the proportional differences among the values and can be expressed by the following equation:

$$\frac{(x - 1.228)}{(1.232 - 1.228)} = \frac{(31°C - 30°C)}{(32°C - 30°C)}$$

Solving for x, we get:

$$x = 1.228 + \left(\frac{1}{2}\right)(1.232 - 1.228) = 1.230$$

Thus, the resulting flow rate is 1.230 m^3/min.