STANDARD OPERATING PROCEDURES

TE-1000 Poly-Urethane Foam (PUF) High Volume Air Sampler For PAHs and Dioxins/Furans

AMBIENT AIR MONITORING PROGRAM
for the
130 LIBERTY STREET
DECONSTRUCTION PROJECT

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Standard Operating Procedures

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1.0 PURPOSE OF SOP

This SOP was designed to describe the procedures used to sample polycyclic aromatic hydrocarbons (PAHs) and polychlorinated dibenzodioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs) in ambient air using EPA Methods TO-13A and TO-9A, respectively.

2.0 EQUIPMENT DESCRIPTION

The TE-1000 PUF Poly-Urethane Foam sampler is a complete system designed to simultaneously collect suspended airborne particulates as well as trap airborne PAH and PCCD/PCDF vapors at flow rates up to 280 liters per minute. The operator will refer to the manufacturer's operation manual for pictorials and additional information to aid in performing maintenance and operations.

2.1 Operating Principle

The TE-1000 PUF sampler is a dual chambered aluminum-sampling module that contains airborne particulates and vapor contamination from PAHs and PCCD/PCDF compounds. The upper chamber supports the airborne particulate filter media in a circular filter holder. The lower chamber encapsulates a glass cartridge, which contains the Polyurethane Foam (PUF) or PUF/XAD-2 for vapor entrapment. The dual chambered sampling module is designed for easy access to both upper and lower media. The threaded lower canister is removed with the cartridge intact for immediate exchange. Filter support screens and module components are equipped with gaskets providing a leak proof seal during the sampling process.

2.2 Parts of the TE-PUF Sampler

The system is made up of eight primary parts: PUF Anodized aluminum shelter, 7-Day Mechanical Timer, Flow Venturi & Calibration Valve, Motor Voltage Control, PUF Blower Motor Assembly, Dual Sampling Module, Exhaust Hose, Magnehelic Gauge and Gabled Roof.

3.0 EQUIPMENT OPERATION

In order to operate the TE-1000 PUF sampler, it is necessary to assemble the instrument.

3.1 Equipment Assembly

<u>Shelter Box Assembly</u>

1. Open the shelter box and remove Anodized Aluminum Shelter.
2. Inside of the shelter is the exhaust hose. Unwrap and insert end with speed clamp on end of blower motor discharge. Tighten with a flat edge screwdriver and put end of hose downwind of sampler.
3. Enclosed in the bottom of the shelter is the Dual Sampling Module. Remove from box.

4. Take out rubber plug that is in quick disconnect on shelter. Insert Dual Sampling Module and lock in place by pushing rings down for a tight seal.
5. Take off cover that is on top of 4” filter holder. NOTE: Turning motor on with cover in place will damage motor.
6. Open lid box and remove Gabled Roof.

Gabled Roof Assembly

1. Secure front catch to the shelter using 2 10-24 pan head screws with stop nuts.
2. Secure roof back catch to the back of the shelter using a 10-24 pan head screw with a stop nut.
3. Secure rear lid hasp inside the lid with the slotted end angled up using 2 10-24 pan head screws with stop nuts.
4. Remove 4 – 10-24 x ½ pan nutserts in back of shelter.
5. Attach the lid to the shelter by placing the lid hinge plates on the “OUTSIDE” of the shelter top and tighten the 4 –10-24 x ½ pan head screws into the nutserts.
6. Adjust the front catch to be sure that the lid slot lowers over it when closing the lid. NOTE: The rear lid hasp should align with the roof back catch when the lid is open.
7. Attach the chain and the “S” hook assembly to the side of the shelter with a 6-32 pan head screw and nut.
8. The lid can be secured in an open or closed position with the “S” hook.

Electrical Hook-Up

(NOTE: An electrical source of 110 volts, 15 amps is required.)

1. The PUF Blower Motor male cord set plugs into the Motor Voltage Control Female cord set.
2. The male cord set of the Motor Voltage Control plugs into the 7-Day Mechanical Timer female cord set that is on the left side of the timer.
3. The other female cord set on the timer (on the right) is hot all the time and is an extra plug.
4. The male cord set of the timer plugs into the line voltage.

Once the TE-1000 PUF sampler is assembled correctly according to this section and connected to a power supply, the instrument is ready for operation.

3.2 Verifying Flow Rates

The flow rates are set with a Variac (voltage regulator) which controls the motor speed. Flow rates are recorded before and after sampling as discussed in Section 3.3. (NOTE: For the 130 Liberty Street ambient air program, the desired flow rate is 200 L/min.)

3.3 Sampling

The TE-1000 PUF Sampler may be operated at ground level or on rooftops. The exhaust hose should be stretched out in a downwind direction if possible. The sampler should be operated for 24 hours in order to obtain average daily levels of airborne PAHs and PCCD/PCDFs. NOTE: On and off times and weather conditions during sampling periods should be recorded. Air concentrations may fluctuate with time of day, temperature, humidity, wind direction, and velocity.

1. Release the three swing bolts on the 4" filter holder and remove the triangle cover (cover must be off when sampler is "ON") and hold down ring.
2. Perform orifice check as follows:
    - Install calibrator orifice on top of the filter holder and follow Steps 2 and 3 of Section 4.1.
    - Adjust ball valve so that sampler magnehelic reads 60.
    - Read and record both the orifice manometer and sampler magnehelic.
    - Remove orifice and replace with sample media.
    - Perform orifice check calculation as described in Section 3.4.
3. Using clean gloves, install a clean 102 mm diameter glass fiber filter on the support screen in between the Teflon gaskets and secure it with the hold down ring and swing bolts. (NOTE: The 102 mm diameter micro glass fiber filters will be supplied and pre-certified by the analytical laboratory.)
4. Screw together the 4" filter holder and sampling module cap leaving the module tube in place with the glass cartridges exposed.
5. Using clean nitrile or cotton gloves, load the glass cartridge with foam and or foam/granular solids and replace in the module tube. Fasten the glass cartridge with the module cap and 4" filter holding assembly while making sure that the module assembly, 4" filter holder and all fittings are snug.
   NOTE: The laboratories will supply all sampling media. For PCDD/PCDF, sampling media will consist of a glass cylinder containing a PUF plug and will be pre-cleaned and certified. For PAHs, sampling media will consist of the glass cylinder containing PUF and XAD-2® resin in a "sandwich" configuration, and will be pre-cleaned and certified.
6. Start pump by turning it on, adjust ball valve so that magnehelic reading is between 50-55.
7. Record the magnehelic gauge reading and timer position at the start of the sampling period and at the end of the sampling period. Enter these values on the Station Sampling Form and Volume Calculation spreadsheet.
8. Prior to the end of the sampling period, note and record on the Station Sampling Form the magnehelic gauge reading.
9. Manually stop pump after desired sampling period by turning it off. (NOTE: For the 130 Liberty Street ambient air program, the desired sampling period is 24 hours.)
10. Cap the sample module by placing the triangle cover over the inlet of the module and securing it with the swing bolts.
11. Remove the sample module from the sampler and bring it to the office for

recovery.

12. Perform orifice check following steps described above.
13. Unscrew the filter holder from the module tube and remove the PUF cylinder.
14. Loosen the swing bolts on the filter holder and remove the triangle cover and hold down ring exposing the glass fiber filter.
15. Fold filter in half and in half again, then place the filter inside the glass cartridge. The glass cartridge should be removed from the sampler with clean-gloved hands and immediately placed in a sealed container for transport to the laboratory.
16. Wrap the glass cartridge with aluminum foil and place back in the original shipping container.
17. Label the container and place it in a cooler on ice (4ºC ± 2ºC) and transport it to the analytical laboratory.
18. Calculate the average magnehelic gauge reading for the sampling period using the start and end readings.
19. Calculate the relative percent difference (RPD) between the start and end magnehelic gauge readings. The RPDs should be ≤ 20. If the RPD is >20, associated data will be flagged.
20. Record the average temperature (T_{av}, K) and average barometric pressure (P_{av}, mm Hg) for the sampling period on the Volume Calculation spreadsheet.
21. Using the slope (m_s) and intercept (b_s) calculated in step 11 in section 4.1, calculate the standardized average flow rate (L/min) for the sampling period using the average magnehelic gauge reading adjusted to standard pressure and temperature.

    Standardized Average flow rate (L/min) = $1/m_s$ * ([Sqrt(magn)(P_{av}/760)(298/T_{av})]-b_s)

22. Convert the standardized average flow rate (L/min) to reflect actual conditions.

    Actual flow rate (L/min) = Standardized average flow rate * [(760/P_{av})*(T_{av}/298)]

23. Calculate the total sample time in minutes.

    Total sample time (min) = (End Time – Start Time) * 60

24. Calculate the actual volume sampled in m^3.

    Actual sample volume (m^3) = Actual flow rate (L/min) * Total sample time (min)/1000

3.4 Orifice Check Calculation

The orifice check verifies that the sampler is still in calibration.

1. Using the manometer reading from the orifice recorded in Step 2 in Section 3.3 calculate the Qstd according to Step 9, Section 4.1.
2. Using the sampler magnehelic reading recorded in Step 2 of Section 3.3, calculate the sampler flow rate using Steps 10 of Section 4.1 and the calibration curve

generated from Section 4.1. (Note flow rate must be corrected to standard conditions.)

3. Calculate the %D as follows:

$$\%D = \{(\text{flow rate from curve} - Qstd) / Qstd\} \times 100$$

4. The %D must be $\leq$10. If not, associated data will be flagged if %D was not calculated prior to start of sampling. If determined to be >10 prior to the start of sampling, re-perform orifice check prior to sampling to verify problem. If problem still exists, re-calibrate sampler.

4.0 CALIBRATION

The TE-1000 PUF Sampler should be calibrated:

1. Upon installation
2. After motor maintenance
3. At least once every quarter
4. If orifice check deviates by >10

4.1 Calibration Procedure

1. Calibration of the PUF Sampler is performed WITHOUT a foam plug or filter paper in the sampling module. However, the empty glass cartridge must remain in the module to insure a good seal through the module.
2. Install the Calibrator (orifice) on top of the 4" Filter Holder. Conduct a leak test by covering the holes on top of the orifice and pressure tap on the orifice with your hands. Listen for a high-pitched squealing sound made by escaping air. If this sound is heard, a leak is present and the top loading adaptor hold-down nuts need to be re-tightened. Avoid running sampler for longer than 30 seconds at a time with the orifice blocked.
3. Open both ports on top of the manometer and connect tubing from the manometer port to the pressure tap on the orifice. Leave the opposite side of the manometer port open to the atmosphere.
4. Open the ball valve fully (handle should be straight up); this is located inside of shelter directly above the blower motor.
5. Turn the system on by tripping the manual switch on the timer. Allow a few minutes for the motor to warm-up.
6. Adjust and tighten the voltage control screw (variac) on the orifice to obtain a reading of 80 inches on the dial of the magnehelic gauge. Do not change until completion of calibration.
7. Record the orifice manometer reading (ΔH, inches of water) after adjusting the magnehelic gauge to the desired reading. Repeat this step for 4 other points by adjusting the ball valve to 4 different positions. The five positions of the magnehelic gauge used during calibration are 40, 50, 60, 70, and 80.

8. Record the following information on the calibration sheet:

    a. Ambient air temperature (ºC)
    b. Ambient barometric pressure (in. Hg)
    c. Sampler serial number
    d. Orifice serial number
    e. Orifice Q_{std} slope and Q_{std} intercept
    f. Date orifice last certified
    g. Date of calibration
    h. Station location
    i. Operator's initials

9. Convert the orifice readings (ΔH) to standard air flow (Q_{std}) using the following equation:

    $Q_{std} = 1/m_o[Sqrt((\Delta H_o)(P_a/760)(298/T_a))-b_o] * 1000$

    m_o = Orifice Q_{std} slope
    ΔH = orifice manometer reading during calibration (in. H_2O)
    T_a = ambient temperature during calibration (K)
    Degrees K = 273 + ºC
    298 = standard temperature (K)
    P_a = ambient barometric pressure during calibration (mm Hg)
    mm Hg = 25.4 * in. Hg
    760 = standard barometric pressure (mm Hg)
    b_o = Orifice Q_{std} intercept
    Q_{std} = standard flow rate indicated by the calibrator orifice (L/min)

    This must be performed for all five calibration points and recorded on the calibration form.

10. Convert the magnehelic gauge readings taken during calibration to current meteorological conditions using the following equation and record the corrected flows on the calibration form:

    Corrected magnehelic reading (Ic) = $Sqrt((magn)(P_a/760)(298/T_a))$

    Ic = magnehelic gauge readings corrected to current T_a and P_a
    magn = magnehelic gauge readings during calibration
    T_a = ambient temperature during calibration (K)
    Degrees K = ºC + 273
    298 = standard temperature (K)
    P_a = ambient barometric pressure during calibration (mm Hg)
    mm Hg = 25.4 * in. Hg
    760 = standard barometric pressure (mm Hg)

    This must be performed for all five calibration points.

11. Plot Ic vs. Q_{std} (L/min). Calculate the slope and intercept of this curve. Calculate the Pearson coefficient. The Pearson coefficient should be ≥ 0.99. If < 0.99, recalibration should be performed as there may be a suspect air leak during calibration.
12. Enter the slope (m_s) and intercept (b_s) calculated in step 11 into the Volume Calculation spreadsheet which will be used for samples subsequently collected using the calibrated pump.
    NOTE: Steps 7 through 12 must be performed for each sampler.
13. Manually turn off sampler.

5.0 MAINTENANCE

Most of the routine maintenance items can be done in the field. If more time is needed to fix or troubleshoot a problem, replace the whole unit with a spare and finish working on it in the repair lab. This will minimize the station down time. All work on the equipment will be documented in the site equipment log, signed, and dated by the person performing the work.

5.1 Preventative Maintenance

1. TE-1000 PUF Sampler- Power cords should be checked for crimps, cracks or exposed junctions each sample day. Inspect the Dual Sampling Module for (a) all gaskets are sealing properly; replace if necessary, (b) clean any dirt that is built up around the module and filter holder and (c) make sure quick disconnect is working correctly by making a good seal.
2. Blower Motor Assembly - Inspect and replace the motor flange gasket and motor cushion routinely and replace the motor carbon brushes every 400 to 500 hours of operation. It is imperative that the brushes be replaced before the brush shunt touches the motor commutator.
3. Motor Brush Replacement – Ensure all power is disconnected from the TE-PUF Sampler prior to opening the motor housing and unplug the motor power cord.
    a. Remove the Motor Mounting Cover by removing the four bolts. This will expose the flange gasket and the motor. Turn motor over.
    b. Remove ground wires from backplate and carefully lift the metal housing from the motor.
    c. With a screwdriver carefully remove the plastic fan cover by prying in between brush and cover until both sides pop loose.
    d. With a screwdriver carefully pry the brass quick disconnect tabs from the expended brushes.
    e. With a screwdriver remove brush holder and release brushes.
    f. With new brushes, carefully slide quick disconnect tabs firmly into tab slot until seated.
    g. Push brush carbon against commutator until plastic brush housing falls into place on commutator end bracket.
    h. Replace brush holder clamps onto brushes.
    i. Assemble motor after brush replacement: snap plastic fan cover into place, feed ground wires back through backplate, put housing back on

motor, pull cord set back to normal position, fasten ground wires to backplate, turn motor over, tighten flange on top of housing and gasket. NOTE: Make sure wires do not get smashed between metal ring and housing.