STANDARD OPERATING PROCEDURES

TE-5170V Total Suspended Particulate VFC High Volume Air Sampler For Metals

AMBIENT AIR MONITORING PROGRAM
for the
130 LIBERTY STREET
DECONSTRUCTION PROJECT

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VFC High Volume Air Sampler For Metals

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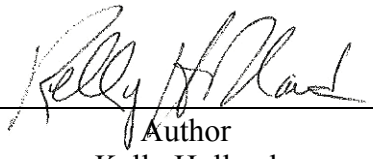

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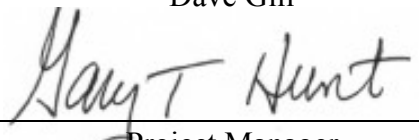

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1.0 PURPOSE OF SOP

This SOP was designed to describe the procedures used to sample for metals in ambient air using the EPA reference method, 40 CFR Part 50, Appendix B, *Reference Method for the Determination of Suspended Particulate Matter in the Atmosphere (High-Volume Method).*

2.0 EQUIPMENT DESCRIPTION

The TE-5170V Total Suspended Particulate (TSP) sampler is a complete system designed to collect suspended airborne particulates. The operator will refer to the manufacturer's operation manual for pictorials and additional information to aid in performing maintenance and operations.

2.1 Parts of the TE-5170V TSP Sampler

The system is made up of seven primary parts: Anodized aluminum shelter, 7-Day Mechanical Timer, Flow Volumetric Flow Controller TSP, VFC Blower Motor Assembly, VFC TSP Stainless Steel Filter Holder, Filter Holder Gasket, Magnehelic Gauge and Gabled Roof.

3.0 EQUIPMENT OPERATION

In order to operate the TE-5170V TSP sampler, it is necessary to assemble the instrument.

3.1 Equipment Assembly

Shelter Box Assembly

1. Open the shelter box and remove Anodized Aluminum Shelter.
2. Open the VFC box and remove gabled roof, filter holder with gasket, water manometer, and VFC blower motor assembly with VFC attached.
3. Screw the volumetric flow controller TSP and blower motor assembly onto the filter holder (tubing, power cord, and hole in filter holder collar to the right); make sure gasket is in place.
4. Lower filter holder, VFC, and blower motor down through top support pan on shelter.
5. Connect clear tubing from bulkhead fitting to the pressure tap on the side of the filter holder. Connect the magnehelic gauge to the outside end of the bulkhead fitting, replacing the quick disconnect fitting.
6. Place assembled gabled roof assembly onto shelter.

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 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. Plug the VFC blower motor (male plug) into the elapsed time indicator female side.
2. Place the male side of the ETI cord set plugs into the 7-day mechanical timer female cord set which 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-5170V TSP sampler is assembled correctly according to this section and connected to a power supply, the instrument is ready for operation.

3.2 Verifying Flow Rate

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 1000 L/min.)

3.3 Sampling

The TSP sampler may be operated at ground level or on rooftops. The sampler should be operated for 24 hours in order to obtain average daily levels of airborne metals. 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 four wing bolts on the filter holder and allow the brass bolts and washers to swing out of the way. Shift frame to one side and remove.
2. Wipe any dirt accumulation from around the filter holder with a clean cloth or brush.
3. Perform orifice check as follows: Place calibration orifice and top loading plate on top of filter holder.
4. Turn on sampler and set sampler magnehelic to 21" and let it warm up to normal operating temperature.

5. Follow Steps 3 and 4 of Sec. 4.1.
6. Read and record both the orifice manometer and sampler magnehelic.
7. Remove orifice.
8. Using nitrile and/or cotton gloves, install a clean quartz fiber filter on the support screen. Properly align the filter, on the screen so that when the frame is in position the gasket will form an airtight seal on the outer edges of the filter. (NOTE: The quartz fiber filters (8 x 10 inch) will be supplied and pre-certified by the analytical laboratory.)
9. Secure the filter with the frame, brass bolts, and washers with sufficient pressure to avoid air leakage at the edges (make sure the plastic washers are on top of the frame).
10. Close shelter lid carefully and secure with the "S" hook.
11. Make sure all cords are plugged into their appropriate receptacles and the clear tubing between the filter holder pressure tap and the bulkhead fitting is connected (be careful not to pinch tubing when closing door).
12. Manually trip timer switch on.
13. Record the magnehelic reading ($\Delta H_{sampler}$ in inches H_2O), located on the side of the shelter, 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 the Volume Calculation spreadsheet.
14. Manually stop the 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.)
15. Carefully remove the exposed filter from the supporting screen by holding it gently at the ends (not at the corners). Fold the filter in half so that the exposed surfaces (with visible particulate) make contact and place in its envelope.
16. Label the envelope and transport it to the analytical laboratory.
17. Calculate the average magnehelic gauge reading ($\Delta H_{sampler}$ in inches H_2O) for sampling period using the start and end readings.
18. Calculate the relative percent difference (RPD) between the start and end sampler readings. The RPDs should be ≤ 20. If the RPD is > 20, associated data will be flagged.
19. Record the average temperature (T_{av}, K) and average barometric pressure (P_{av}, mm Hg) for the sampling period on the Volume Calculation spreadsheet.
20. Using the slope (m_s) and intercept (b_s) calculated in step 12 of Section 4.1, calculate the average flow rate (L/min) for the sampling period (corrected for the average temperature and barometric pressure for the sampling period) using the average magnehelic reading ($\Delta H_{sampler}$ in inches H_2O).

    Average flow rate (L/min) = $(m_s * (\Delta H_{sampler\ average} * \text{sqrt}\ T_{av}/P_{av}) + b_s) * 100$

21. Calculate the total sample time in minutes.

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

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

Actual sample volume (m^3) = Average 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 orifice manometer reading recorded in Step 6 of Section 3.3, calculate the Qact using the formula in Step 7 of Section 4.1.
2. Using the sampler magnehelic reading recorded in Step 6 of Section 3.3, calculate the sampler flow using the calibration curve generated from the procedure performed in Section 4.1.
3. Calculate the %D between the Qact and sampler flow rate as follows:

$$\%D = \{(\text{Sampler flow rate from calibration} - \text{Qact})/\text{Qact}\} \times 100$$

4. The %D must be $\leq$20. If not, associated data will be flagged if %D was not calculated prior to start of sampling. If determined to be >20 prior to the start of sampling, reperform orifice check prior to sampling to verify problem. If problem still exists, re-calibrate sampler.

4.0 CALIBRATION

The TE-5170V TSP Sampler should be calibrated:

1. Upon installation
2. After motor maintenance
3. At least once every quarter
4. If orifice check deviates by >20

4.1 Calibration Procedure

1. Install the Calibrator (orifice) and top loading plate on top of the Filter Holder. Tighten and make sure there are no leaks. NOTE: No filters used during calibration procedure.
2. Turn on sampler and allow it to warm up to its normal operating temperature.
3. 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.
4. 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.
5. Record the manometer reading from the orifice (ΔH_o) and the magnehelic reading from the side of the sampler ($\Delta H_{sampler}$). Both readings are in inches of water. Repeat this step for 5 points total by adjusting the orifice to 5 different positions between 10 and 25 on the magnehelic gauge.

6. 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_{act} slope and Q_{act} intercept
    f. Date orifice last certified
    g. Date of calibration
    h. Station location
    i. Operator's initials

7. Convert the orifice readings (ΔH_o) to actual air flow (Q_{act}) using the following equation:

    $Q_{act} = 1/m_o[Sqrt((\Delta H_o)(T_a / P_a))-b_o]$

    m_o = Orifice Q_{act} slope
    ΔH_o = orifice manometer reading during calibration (in. H_2O)
    T_a = ambient temperature during calibration (K)
    Degrees K = 273 + ºC
    P_a = ambient barometric pressure during calibration (mm Hg)
    mm Hg = 25.4 * in. Hg
    b_o = Orifice Q_{actual} intercept
    Q_{actual} = actual flow rate indicated by the calibrator orifice (m^3/min)

    This must be performed for all five calibration points and recorded on the calibration form. Ensure at least 3 of the 5 points are between 10 to 25 on the magnehelic.

8. Convert the sampler readings ($\Delta H_{sampler}$) to mm Hg and record as P_f using the following equation:

    $P_f = 25.4$ (in. H_2O/13.56)

    P_f = mm Hg
    in H_2O = sampler reading during calibration ($\Delta H_{sampler}$)

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

9. Calculate P_o/P_a in order to locate the sampler calibration air flows in the Look Up Table for the sampler of interest. Use the following equation:

    $P_o/P_a = 1- (P_f/P_a)$

    P_f = mm Hg (calculated in step 8 above)
    P_a = ambient barometric pressure during calibration (mm Hg)

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

10. Find the actual flow rate in the associated Look Up Table using P_o/P_a and the ambient temperature during calibration. Record these flows on the calibration form. This must be performed for all five calibration points.
11. Calculate the percent difference between the calibrator flow rates (Q_{act} calculated in step 7 above) and the sampler flow rate (obtained from the Look Up Table in step 10) using the following equation:

    % Difference = [Look Up Flow – Q_{act})/Q_{act}]* 100

    Look Up Flow = Flow found in Look Up Table (step 10), m^3/min
    Q_{act} = orifice flow during calibration (calculated in step 7 above), m^3/min

    Ensure that the % differences are ≤ 4% for each of the 5 calibration points and record the % difference on the calibration form for each point. If greater than 4% difference, a leak may be present and the sampler should be recalibrated.
12. Plot Q_{act} (m^3/min) versus sampler readings ($\Delta H_{sampler}$ in inches H_2O). 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.
13. Enter the slope (m_s) and intercept (b_s) calculated in step 7 into the Volume Calculation spreadsheet which will be used for samples subsequently collected using the calibrated pump.

    NOTE: Steps 5 through 13 must be preformed for each 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. TSP Sampler - Power cords should be checked for crimps, cracks or exposed junctions each sample day. Inspect 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 armature.

3. Motor Brush Replacement - Ensure all power is disconnected from the TSP Sampler prior to opening the motor housing and unplug the motor power cord.
    a. Remove the VFC device by removing the eight bolts. This will expose the flange gasket and the motor.
    b. Turn assembly on side, loosen the cord retainer and then push cord into housing and at the same time let motor slide out exposing the brushes.
    c. Carefully pry the brass quick disconnect tabs away from the expended brushes and toward the armature.
    d. With a screwdriver remove brush holder and release brushes.
    e. With new brushes, carefully slide quick disconnect tabs firmly into tab slot until seated.
    f. Push brush carbon against armature until brush housing falls into brush slot on motor.
    g. Replace brush holder clamps onto brushes.
    h. Assemble motor after brush replacement by placing housing over and down on the motor (at the same time pull power cord out of housing), being careful not to pinch any motor wires beneath the motor spacer ring.
    i. Secure power cord with the cord retainer cap.
    j. Replace VFC device on top of motor making sure to center gasket.