

SUMMARY SHEET 5
Particulate Matter

Method (Circle) 5 5B 5D 17

Run #1

Run #2

Run #3

Avg

Client/Plant Name FDS 5
 Job No. FDS 5
 Sampling Location FDS 5
 Run ID # FDS 5

Test Date FDS 5
 Run Start Time FDS 5
 Run Finish Time FDS 5

Net Traverse Points FDS 1
 Traverse Matrix (Rectangular) FDS 1
 Net Run Time, min θ FDS 5

Nozzle Diameter, in. D_n FDS 5
 Dry Gas Meter Calibration Factor Y CDS 5
 Average ΔH (orifice meter), in. H_2O ΔH FDS 5

Barometric Pressure, in. Hg P_b FDS 5
 Stack Static Pressure, in. H_2O P_g FDS 5
 Abs Stack Pressure ($P_b + P_g/13.6$), in. Hg P_s SS 5

Average Stack Temperature, °F t_s FDS 5
 Avg Abs Stack Temperature ($t_s + 460$), R T_s SS 5

Carbon Dioxide, % dry $\%CO_2$ FDS 3
 Oxygen, % dry $\%O_2$ FDS 3
 Carbon Monoxide + Nitrogen, % dry $\%(CO+N_2)$ FDS 3
 Dry Molecular Weight, lb/lb-mole M_d FDS 3

Average DGM Temperature, °F t_m FDS 5
 Volume of Metered Gas Sample, dcf V_m FDS 5
 Volume of Metered Gas Sample, dscf $V_{m(std)}$ SS 5

Volume Water Condensed, mL V_{lc} FDS 5
 Volume of Water Vapor, scf $V_{w(std)}$ SS 5
 Moisture Content, fraction B_{ws} SS 5

Pitot Tube Coefficient C_p CDS 2a
 Average Velocity Pressure, in. H_2O Δp FDS 5
 Average $[(t_{si} + 460) \Delta p]^{1/2}$ $[T_{si} \Delta p]^{1/2}$ FDS 5
 Velocity, ft/sec v_s SS 5

Stack Area, ft² A FDS 1
 Volumetric Flow Rate, dscfh Q_{sd} SS 5
 Volumetric Flow Rate, wscfh Q_{sw} SS 5

Isokinetic Sampling Rate, % $\%I$ SS 5

Acetone Blank, mg W_a LDS 5
 Total Particulate Mass (Blank Corr.), mg m_n LDS 5
 Particulate Concentration, g/dscf c_s SS 5

Run #1	Run #2	Run #3	Avg
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Post-test Calibration Checks
 Temperature and Barometer
 Differential Pressure Sensor
 Metering System

CDS 2d
 CDS 2d
 CDS 5

$$V_{m(std)} = 17.64 V_m Y \frac{\left(P_b + \frac{\Delta H}{13.6}\right)}{T_m}$$

$$V_{w(std)} = 0.04707 V_c$$

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

$$v_s = 85.49 C_p \frac{(\sqrt{T_s \Delta p})_{avg}}{\sqrt{P_s M_s}}$$

$$Q_{sd} = 17.64 (3600) (1 - B_{ws}) v_s A \frac{P_s}{T_{s(avg)}}$$

$$\%I = \frac{0.09450 T_s V_{m(std)}}{P_s v_s A_n \theta (1 - B_{ws})}$$

$$Q_{sw} = \frac{Q_{sd}}{(1 - B_{ws})}$$

$$c_s = 0.001 \frac{m_n}{V_{m(std)}}$$

FIELD PROCEDURE 5
Isokinetic Sampling Trains

A. Pretest Preparation

1. Weigh several 200- to 300-g portions of silica gel in air-tight containers to ± 0.5 g. Record the total weight of the silica gel plus container on each container.
2. Check filters visually against light for irregularities and flaws or pinhole leaks. Label the filters on the back side near the edge using numbering machine ink.
3. Desiccate the filters at $20 \pm 5.6^\circ\text{C}$ and ambient pressure for ≥ 24 hr, and weigh at intervals of ≥ 6 hr to a constant weight, i.e., ≤ 0.5 mg change from previous weighing; record results to ± 0.1 mg. During each weighing, do not expose the filter to the laboratory atmosphere for > 2 min and a relative humidity $> 50\%$.

B. Preliminary Determinations

1. Select the sampling site and the number of sampling points (see FP 1).
2. Determine the stack pressure, temperature, and the range of velocity heads (see FP 2).
3. *Optional:* Leak-check the pitot lines (see FP 2a).
4. Determine the moisture content (see FP 4a).
5. Determine or estimate the dry molecular weight (see FP 3).
6. Select a nozzle size. *Do NOT change nozzle size during the sampling run.*
7. Select the proper differential pressure gauge (see FP 2).
8. Select a suitable probe liner and probe length such that all traverse points can be sampled.
9. Select the total sampling time and standard sample volume specified in the test procedures for the specific industry. Select equal sampling times of ≥ 2 min per point.

C. Preparation of Collection Train

1. During preparation and assembly of the sampling train, keep all openings covered to avoid contamination. Use either ground-glass stoppers, plastic caps, or serum caps to close the openings.
2. See Figure F5-1. Prepare impingers as follows:
 - a. Impingers 1 and 2: 100 mL water in each.
 - b. Impinger 3: Empty.

- c. Impinger 4: 200 to 300 g of preweighed silica gel.

3. Place the silica gel container in a clean place.
4. Using a tweezer or clean disposable surgical gloves, place filter in the filter holder. Check the filter for tears after assembly.
5. Mark the probe with heat resistant tape (or other) to denote the proper distance into the stack or duct for each sampling point.
6. Set up the train. Turn on and set probe and filter box heaters. Place crushed ice around the impingers.
7. *Optional:* Leak-check the sampling train (see FP 5a and FP 5b).

D. Sampling

1. Record data shown in FDS 5. Record the initial dry gas meter (DGM) reading.
2. Level and zero the manometer.
3. Clean the portholes.
4. Remove the nozzle cap, verify that the filter and probe heating systems are up to temperature, and check pitot tube, temperature gauge, and probe alignments and clearances.
5. Close the coarse adjust valve. If necessary to overcome high negative stack pressure, turn on the pump. Position the nozzle at the first traverse point. Immediately start the pump, and adjust the flow to isokinetic conditions.
6. When the probe is in position, block off the openings around the probe and porthole.
7. Traverse the stack cross-section. Conduct leak-checks, as required (see FP 5a). *Do not bump the probe nozzle into the stack walls.*
 - a. Keep the temperature around the filter holder (probe outlet or filter outlet, if applicable) at the proper level.
 - b. Add more ice and, if necessary, salt to maintain a temperature of $< 68^\circ\text{F}$ at the condenser/silica gel outlet.
 - c. Periodically check the level and zero of the manometer.
 - d. Record DGM readings at the beginning and end of each sampling time increment, before and after each leak-check, and when sampling is halted.

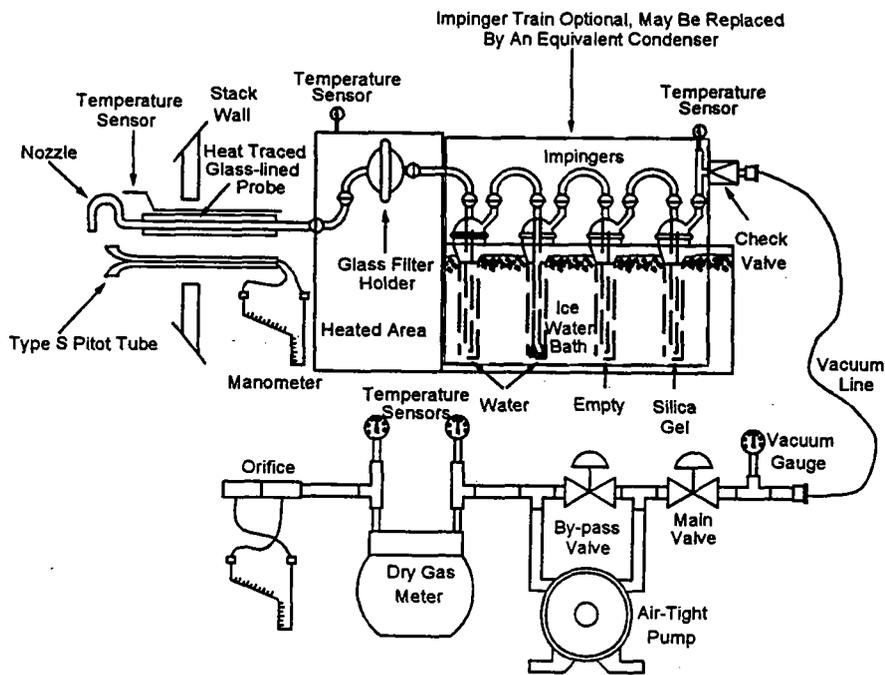


Figure F5-1. Particulate Sampling Train.

- e. Take other readings shown in FDS 5 at least once at each sample point during each time increment and additional readings when significant changes (20% variation in Δp readings) necessitate additional adjustments in flow rate.
8. At the end of the sample run, turn off the coarse adjust valve, remove the probe and nozzle from the stack, turn off the pump, record the final DGM meter reading.
9. **Mandatory:** Leak-check the sampling train (see FP 5a). **Optional:** See FP 5b.
10. **Mandatory:** Leak-check the pitot lines (see FP 2a).
11. Allow the probe to cool. Then, wipe off all external PM near the tip of the probe nozzle, and place a cap over it.
12. Before moving the sampling train to the cleanup site, remove the probe from the sampling train, wipe off the silicone grease, and cap the open outlet of the probe. Do not lose any condensate that might be present. Wipe off the silicone grease from the filter inlet, and cap it.
13. Remove the umbilical cord from the last impinger, and cap the impinger. After wiping off the silicone grease, cap off the filter holder outlet and impinger inlet.
14. Transfer the probe and filter-impinger assembly to the cleanup area that is clean and protected from the wind.

E. Sample Recovery

1. Place 200 mL acetone from the wash bottle being used for cleanup in a glass sample container labeled "acetone blank."
2. Inspect the train prior to and during disassembly, and note any abnormal conditions.
3. **Container No. 1** (Filter)
 - a. Using a pair of tweezers and/or clean disposable surgical gloves, carefully remove the filter from the filter holder, and place it in its identified petri dish container. If necessary, fold the filter such that the PM cake is inside the fold.
 - b. Using a dry Nylon bristle brush and/or a sharp-edged blade, carefully transfer to the petri dish any PM and/or filter fibers that adhere to the filter holder gasket. Seal the container.

4. **Container No. 2** (Acetone Rinses)

Recover particulate matter from the probe nozzle, Swagelok fitting, probe liner (use a funnel to aid in transferring liquid washes to the container), front half of the filter holder, and (if applicable) the cyclone, and recover all rinses in a glass container as follows;

- a. Before cleaning the front half of filter holder, wipe clean all joints of silicone grease.
- b. Rinse with acetone, brush with a Nylon bristle brush, and rinse with acetone until there are no visible particles. Make a final acetone rinse.
- c. For probe liner, repeat rinse, brush, rinse sequence at least three times for glass liners, and six times for metal liners.
- d. Make a final rinse of the brush with acetone.
- e. After completing the rinse, tighten the lid on the sample container. Mark the height of the fluid level. Label the container.

5. **Container No. 3** (Silica Gel)

- a. Determine whether silica gel has been completely spent, and note on FDS its condition.
- b. Using a funnel, transfer the silica gel from impinger 4 to its original container, and seal. Use a rubber policeman (do not use any liquid), if necessary, to remove the silica gel from the impinger.
- c. If a balance is available, weigh the spent silica gel to the nearest 0.5 g.

6. **Impinger Water**

- a. Note on FDS any color or film in the liquid catch.
- b. Measure the liquid volume in impingers 1, 2, and 3 to within ± 1 mL (with a graduated cylinder) or weigh liquid to within ± 0.5 g.
- c. Discard the liquid, unless analysis of the impinger catch is required. Store as is appropriate.

7. Whenever possible, ship sample containers in an upright position.

F. Variations

1. If high pressure drop across the filter causes difficulty in maintaining isokinetic sampling, replace the filter. Suggestion: Use another complete filter assembly rather than changing the filter itself. Before installing a new filter assembly, conduct a leak-check (see FP 5a). Add the filter assembly catches for the total PM weight.
2. Use a single train for the entire sample run, except when simultaneous sampling is required in two or more separate ducts or at two or more different locations within the same duct, or, in cases where equipment failure necessitates a change of trains. In all other situations, obtain approval from the Administrator before using two or more trains.
3. When two or more trains are used, analyze separately the front-half and (if applicable) impinger catches from each train unless identical nozzle sizes were used on all trains. In this case, the front-half catches from the individual trains may be combined (as may the impinger catches) and one analysis of front-half catch and one analysis of impinger catch may be performed. Consult with the Administrator for details concerning the calculation of results when two or more trains are used.
4. Use more silica gel in impinger 4, if necessary, but ensure that there is no entrainment or loss during sampling.
5. If a different type of condenser (other than impingers) is used, measure the amount of moisture condensed either volumetrically or gravimetrically.
6. If the total particulate catch is expected to exceed 100 mg or when water droplets are present in the stack gas, use a glass cyclone between the probe and filter holder.
7. If a flexible line is used between the first impinger or condenser and the filter holder, disconnect the line at the filter holder, and let any condensed water or liquid drain into the impingers or condenser.

G. Alternatives

1. Sampling trains using metering systems designed for higher flow rates than 1 cfm may be used.

2. For moisture content, weigh the silica gel and its impinger or sampling holder before and after sampling to the nearest 0.5 g.
3. Rather than labeling filters, label the shipping containers (glass or plastic petri dishes), and keep the filters in these containers at all times except during sampling and weighing.
4. Rather than successive desiccations, oven dry the filters at 105°C for 2 to 3 hr, desiccate for 2 hr, and weigh.
5. Deionized distilled water may be used instead of acetone when approved by the Administrator and shall be used when specified by the Administrator; in these cases, save a water blank, and follow the Administrator's directions on analysis.
6. Acceptable alternatives to glass liners are metal liners (e.g., 316 stainless steel, Incoloy 825 or other corrosion resistant metals) made of seamless tubing.

H. Suggestions

1. Use either borosilicate or quartz glass probe liners for stack temperatures up to about 900°F. Use quartz liners for temperatures between 900 and 1,650°F. The softening temperature for borosilicate is 1,508°F, and for quartz it is 2,732°F.
2. Whenever practical, make every effort to use borosilicate or quartz glass probe liners. Metal liners may bias results high.
3. Nomographs to aid in the rapid adjustment of the isokinetic sampling rate without excessive computations are available (see APTD-0576 for details). Limitations: Type S pitot tube $C_p = 0.85 \pm 0.02$ and $M_d = 29 \pm 4$.
4. For large stacks, consider sampling from opposite sides of the stack to reduce the length of probes.
5. Center and place the gasket properly to prevent the sample gas stream from circumventing the filter.
6. Do not cap off the probe tip tightly while the sampling train is cooling down as this would create a vacuum in the filter holder, which may draw water from the impingers into the filter holder.

Method _____

FIELD DATA SHEET 5
Isokinetic Sampling Trains

Client/Plant Name _____ Date _____ Job # _____

City/State _____ Test Location _____

Personnel _____ Run # _____

Equipment Checks		Equipment ID#'s				Leak-Checks			
Pitot Leak-Chk: Pre _____ Post _____		Rgnt Box _____		Samp'g Box # _____		Vac., in. Hg _____		DGM init, cf _____	
Nozzle: Pre _____ Post _____		Meter Box _____ Y _____		Umbilical _____		DGM finl, cf _____		Leak Rate, cfm _____	
TC: Pre _____ Post _____		Pitot _____ C _p _____		Tedlar Bag _____		(≤ 0.02 cfm or 4% of sampling rate?)			
Orsat system _____		Noz'l _____ D _n _____		Orsat Pump _____					
		TC Readout _____		TC Probe _____					

Filter #	Tare Wt.	Isokinetic Set-Up Data							
_____	_____	ΔH_{g} _____	_____	_____	_____	Time: Start _____	End _____		
_____	_____	Metr temp _____	_____	_____	_____	Barometric P _b _____	Static P _g _____		
_____	_____	Est %H ₂ O _____	_____	_____	_____	Amb temp _____			
_____	_____	Stk temp _____	_____	_____	_____	Probe Liner _____	Htr sett'g _____		
_____	_____	Ref Δp _____	_____	_____	_____	Fyrites, %: _____			
_____	_____	C factor _____	_____	_____	_____	Total Moisture Catch: _____ g.			
_____	_____	K factor _____	_____	_____	_____				

LINE	Sample Point	Clock Time	DGM			Pitot ΔP (in. H ₂ O)	Stack Temp. (°F)	Orifice (in. Hg)		Gauge Vacuum (in. Hg)	Filter Temp. (°F)	Impinger Exit (°F)
			Reading (cf)	t _i (°F)	t _o (°F)			Actual	Ideal			
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
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24												
26												

FINAL

QA/QC Check
Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____ Personnel (Signature/Date) _____ Team Leader (Signature/Date) _____

Method _____

FIELD DATA SHEET 5 (continued)
Isokinetic Sampling Trains

Client/Plant Name _____

Job # _____

Test Location _____

Run # _____

LINE	Sample Point	Clock Time	DGM			Pitot ΔP (in. H ₂ O)	Stack Temp. (°F)	Orifice (in. Hg)		Gauge Vacuum (in. Hg)	Filter Temp. (°F)	Impinger Exit (°F)
			Reading (cf)	t _i (°F)	t _o (°F)			Actual	Ideal			
26												
27												
28												
29												
30												
31												
32												
33												
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65												
FINAL												

QA/QC Check

Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____

Personnel (Signature/Date)

Team Leader (Signature/Date)

LABORATORY PROCEDURE 5
Particulate Matter

A. Analysis**1. Container No. 1 (Filter)**

- a. Leave the contents in the shipping container or transfer the filter and any loose PM from the sample container to a tared glass weighing dish.
- b. Desiccate for 24 hr in a desiccator (anhydrous calcium sulfate).
- c. Weigh to a constant weight, and report the results to the nearest 0.1 mg.
"Constant weight" means a difference of no more than 0.5 mg or 1% of total weight less tare weight, whichever is greater, between two consecutive weighings, with no less than 6 hr of desiccation time between weighings.

2. Container No. 2 (Acetone Rinses)

- a. Note the level of liquid in the container, determine loss (if any), and note loss on LDS 5.
- b. Measure the liquid either to ± 1 mL or weigh the liquid to ± 0.5 g.
- c. Transfer the contents to a tared 250-mL beaker, and evaporate to dryness at ambient temperature and pressure.
- d. Desiccate for 24 hr, and weigh to a constant weight.
- e. Report the results to the nearest 0.1 mg.

3. Container No. 3 (Silica Gel)

- a. If not done in the field, weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g.

4. "Acetone Blank" Container

- a. Measure the acetone in this container either volumetrically or gravimetrically.
- b. Transfer the acetone to a tared 250-mL beaker, and evaporate to dryness at ambient temperature and pressure.
- c. Desiccate for 24 hr, and weigh to a constant weight.
- d. Report the results to the nearest 0.1 mg.

B. Alternative**1. Container No. 1**

- a. Oven dry the sample at 105°C for 2 to 3 hr, and cool in a desiccator.
- b. Weigh the sample and use this weight as a final weight.

2. Container No. 2 and Acetone Blank

- a. Evaporate at temperatures higher than ambient, but below the boiling point of the solvent.
- b. To prevent "bumping," closely supervise the evaporation process; swirl occasionally the contents of the beaker to maintain an even temperature.
- c. Use extreme care, as acetone is highly flammable and has a low flash point.

LABORATORY DATA SHEET 5
Particulate Matter

Client/Plant Name _____ Job # _____

City/State _____ Analyst _____

Barometric Pressure _____ " Hg Lab Ambient Temp. _____ °F Relative Humidity in Lab _____ (≤50%?)

Analytical balance I.D. # _____ Density of Acetone _____ g/ml Date _____

Run Identification			
Container No. 1 (Filter) ID#			
Filter ID#			
Wgt #1: Date/time _____ (mg)			
Wgt #2: Date/time _____ (mg)			
Wgt #3: Date/time _____ (mg)			
Filter tare wgt (mg)			
Container tare wgt (mg)			
PM on filter, m_f (mg)			
Container No. 2 (Acetone Rinse) ID#			
Volume/wgt, V_{aw} (___ Any Loss ?) (ml/g)			
Tare wgt (if applicable) (g)			
Difference (if applicable), W_{aw} (g)			
Wgt #1: Date/time _____ (mg)			
Wgt #2: Date/time _____ (mg)			
Wgt #3: Date/time _____ (mg)			
Container tare wgt (mg)			
Difference, m_{aw} (mg)			
Acetone Blank ID#			
Volume/weight, V_a (ml/g)			
Tare weight (if applicable) (g)			
Difference (if applicable), A_a (g)			
Wgt #1: Date/time _____ (mg)			
Wgt #2: Date/time _____ (mg)			
Container tare wgt (mg)			
Difference, m_a (mg)			
$C_a = m_a / [(V_a \rho_a) \text{ or } A_a] (\leq 0.001\% ?)$ (mg/g)			
Acetone blank, $W_a = C_a [V_{aw} \rho_a \text{ or } W_{aw}]$ (mg)			
Total wgt of PM, $m_n = m_f + m_{aw} - W_a$ (mg)			
Sample Appearance			

QA/QC Check

Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____ Personnel (Signature/Date) _____ Team Leader (Signature/Date) _____

**FIELD PROCEDURE 5a
Leak-Check of Isokinetic Sampling Train**

A. From Probe Nozzle

1. After assembling the sampling train, turn on and set the filter and probe heating systems to the desired operating temperatures. Allow time for the temperatures to stabilize.
2. Plug the nozzle. Fully open the bypass valve and close the coarse adjust valve. Then start the pump.
3. Slowly close the bypass valve until the desired vacuum is reached. Do not reverse direction of bypass valve; this will cause water to back up into the filter holder. If the desired vacuum is exceeded, either leak-check at this higher vacuum or end the leak-check as shown in step A5, and start over.
4. Allow the flow rate to stabilize, then determine the leakage rate using DGM readings and a watch. Record the leakage rate.
5. End the leak-check as follows: first slowly remove the plug from the inlet to the probe, and immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the filter holder and silica gel from being entrained backward into the third impinger.

B. Specifications

1. Vacuum: ≥ 15 in. Hg or \geq maximum vacuum reached during test run.
2. Leakage Rate: ≤ 0.02 cfm or $\leq 4\%$ of average sampling rate, whichever is less.

C. Alternative Procedure for Asbestos String Connection

Leak-check as in section A at 15 in. Hg, or as follows:

1. Do not connect the probe to the train during the leak-check.

2. First, leak-check the train from the inlet to the filter holder (cyclone, if applicable) at 15 in. Hg vacuum.
3. Then, connect the probe to the train, and leak-check from the probe nozzle at about 1 in. Hg vacuum.

D. Leak-Checks During Sample Run

1. If, during the sampling run, a component (e.g., filter assembly or impinger) change becomes necessary, leak-check the train immediately before the change is made at \geq maximum vacuum recorded up to that point in the test run.
2. Immediately after component changes, leak-checks are optional.

E. Metering System with Diaphragm Pump

1. Make a 10-min calibration run at 0.02 cfm (see CP 5).
2. At the end of the run, determine the difference of the measured wet test meter and DGM volumes, and divide by 10 to obtain the leak rate.

F. From Other Train Components

Follow section A, except leak-check from the inlet of the specified component, e.g., inlet to the filter holder or inlet to the first impinger.

FIELD PROCEDURE 5b
Leak-Check of Metering System (After Pump)

1. Close the main valve on the meter box (see Figure F5b-1).
2. Insert a one-hole rubber stopper with rubber tubing attached into the orifice exhaust pipe.
3. Disconnect and vent the low side of the orifice manometer.
4. Close off the low side orifice tap. Blow into the rubber tubing and pressurize the system to 5 to 7 in. H₂O.
5. Pinch off the tubing, and observe the manometer for one minute.
6. If there is a loss of pressure on the manometer, correct leak in the metering system.

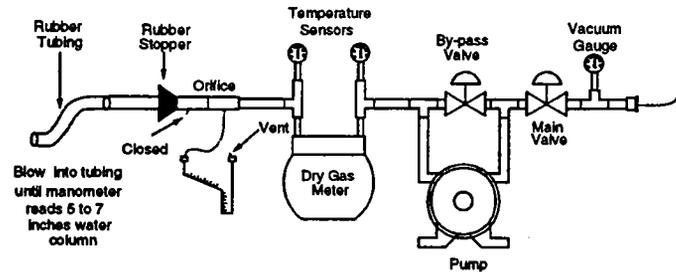


Figure F5b-1. Leak check of meter box.

QUALITY CONTROL PROCEDURE 5
Metering System/Orifice Check

A. Procedure 1 - Y_c Check

1. Operate the metering system (i.e., pump, volume meter, and orifice) at ΔH_{atm} (from CDS 5) for 10 min.
2. Record the volume collected, the DGM temperature, and the barometric pressure.
3. Calculate a DGM calibration check value, Y_c , as follows:

$$Y_c = \frac{10}{V_m} \left[\frac{0.0319 (\bar{t}_d + 460)}{P_b} \right]^{1/2}$$

where:

Y_c = DGM calibration check value, dimensionless.

10 = Run time, min.

V_m = Volume of gas sample as measured by DGM, dcf.

\bar{t}_d = Average DGM temperature, °F.

P_b = Barometric pressure, in. Hg.

0.0319 = (0.0567 in. Hg/°R)(0.75 cfm)²

4. Divide Y_c by Y . If the ratio is not within 0.97 to 1.03, check the metering system before beginning the test.

B. Procedure 2 - Critical Orifice

1. Insert the critical orifice, calibrated against a wet test meter or spirometer, into the inlet of the sampling meter box.
2. Follow the procedure described in CP 5d.

CALIBRATION PROCEDURE 5
Metering System

A. Initial

1. **Optional:** Leak-check the metering system (see FP 5a). Any leaks are calibrated into the DGM calibration factor (Y); the post-test calibration checks for any changes.
2. Connect the metering system inlet to the outlet of a wet test meter (WTM). See Figure C5-1.
3. Run the metering system pump for about 15 min at the $\Delta H_{@}$ value.
4. Select the highest and lowest orifice settings to bracket the expected field operating range of the orifice. Then select at least a third orifice meter setting.
5. Pass an exact quantity of gas (at least 5 cf) through the WTM.
6. Record the volume indicated by the DGM and the other information as shown in CDS 5.
7. Calculate calibration factor Y and $\Delta H_{@}$, the orifice calibration factor, at each orifice setting.

8. Use the average of the Y values as the DGM calibration factor.

B. Post-Test

1. Perform three calibration runs at a single, intermediate orifice setting (based on the previous field test), with the vacuum set at the maximum value reached during the test series.
2. To adjust the vacuum, insert a valve between the WTM and the inlet of the metering system.
3. Calculate the average value of the DGM calibration factor.
4. If the value has changed $\geq \pm 5\%$ from the previous section A calibration, recalibrate the meter as detailed in section A.

C. Alternative

For an alternative post-test calibration procedure see "EMTIC GD-26, Alternate Method-5 Post-test Calibration."

CALIBRATION DATA SHEET 5
Metering System

Metering System ID# _____ Date _____

Barometric Pressure, P_b _____ in. Hg Personnel _____

Initial Calibration ____ Recalibration ____ Capacity: WTM = _____ (≥ 1 cf/rev?) Spirometer: _____ (≥ 14 cf?)

**** If a spirometer is used, modify data sheet accordingly.**

Flow Rate of Max Cap	WTM		Metering System					Time θ (min)	Y_i	$\Delta H_{@i}$
	V_w (cf)	t_w ($^{\circ}F$)	V_d (cf)	t_i ($^{\circ}F$)	t_o ($^{\circ}F$)	Avg \bar{t}_d ($^{\circ}F$)	Δp (in. H ₂ O)			
0.5	5									
1.0	5									
1.5	10									
2.0	10									
3.0	10									
4.0	10									
Avg										

ΔH (in. H ₂ O)	$Y_i = \frac{V_w P_b (t_d + 460)}{V_d (P_b + \frac{\Delta H}{13.6}) (t_w + 460)}$	$\Delta H_{@i} = \frac{0.0319 \Delta H (P_b + \frac{\Delta H}{13.6})}{(t_d + 460)} \left[\frac{(t_w + 460) \theta^2}{V_w P_b} \right]$
0.5		
1.0		
1.5		
2.0		
3.0		
4.0		

Note: If there is only one thermometer on the DGM, record the temperature under t_d .

_____ $Y_i \leq \pm 0.02$ from average?

_____ $\Delta H_{@} \leq \pm 0.20$ from average?

QA/QC Check

Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____ Personnel (Signature/Date) _____ Team Leader (Signature/Date) _____

CALIBRATION PROCEDURE 5a
Metering System Using Critical Orifices

A. Initial

1. Record the barometric pressure.
2. Calibrate the metering system using CP 5d and record the information listed in CDS 5d.
3. Calculate DGM volume [$V_{m(std)}$], critical orifice volume [$V_{cr(std)}$], and DGM calibration factor (Y).
4. Average the DGM Y_i values for each of the flow rates. $Y_i \leq \pm 2\%$ from average.

B. Recalibration

1. Compare the DGM Y factors obtained from two adjacent orifices each time a DGM is calibrated; e.g., when checking orifice 13/2.5, use orifices 12/10.2 and 13/5.1.
2. If any critical orifice yields a DGM Y factor differing $> \pm 2\%$ from the others, recalibrate the critical orifice (see CP 5d).

CALIBRATION PROCEDURE 5b
Probe Nozzle Diameter

A. Initial Calibration

1. Using a micrometer, measure the inside diameter of the nozzle to the nearest 0.001 in.
2. Make three separate measurements using different diameters each time.
3. Average the measurements.
4. Permanently and uniquely identify each nozzle.

B. Recalibration

1. When nozzles become nicked, dented, or corroded, reshape and sharpen.
2. Recalibrate as in section A.

CALIBRATION PROCEDURE 5c
Dry Gas Meter as a Calibration Standard

Note: A dry gas meter (DGM) may be used as a calibration standard for volume measurements in place of the wet test meter (WTM) specified in section 5.3 of Method 5. Do not use the standard DGM in the field, and if transported, care for it as any other laboratory instrument.

A. Initial

1. Set up the components as shown in Figure C5c-1. A spirometer instead of the WTM may be used.
2. Run the system at 1 cfm. The Δp at the inlet side of the DGM must be < 4 in. H_2O . If not, use larger diameter tubing connections and straight pipe fittings to lower the Δp .
3. Run the pump for ≥ 5 min at about 0.35 cfm.
4. Collect the data as shown in the CDS 5c. Use at least five different flow rates over the range of 0.35 to 1.2 cfm or over the operating range. Make triplicate runs at each of the flow rates.
5. Calculate flow rate, Q , and the DGM coefficient, Y_{ds} , for each run.
6. Average the three Y_{ds} values at each flow rate.
7. Plot Y_{ds} versus Q for the DGM. Use this curve as a reference to calibrate other DGM's and to determine whether its recalibration is required.

B. Recalibration

Recalibrate the standard DGM against a WTM or spirometer annually or after every 200 hr of operation, whichever comes first.

C. Alternative

As an alternative to full recalibration (section A), a two-point calibration check may be made as follows:

1. Follow the same procedure and equipment arrangement as for a full recalibration, but run the meter at only two flow rates, e.g., 0.5 and 1.0 cfm).
2. Calculate Y_{ds} for these two points.
3. Compare each Y_{ds} values with Y_{ds} values from the meter calibration curve. If the two coefficients are within 1.5% of the calibration curve values at the same flow rate, the meter need not be recalibrated until the next date for a recalibration check.

D. Method 6 Applicability

A DGM may be used as a calibration standard for volume measurements in place of the WTM specified in section 5.1 of Method 6. Follow the same steps as that in section A, except for the following:

1. Calibrate the DGM at 1 L/min against a WTM ($\pm 1\%$) having a capacity of 1 L/rev or 3 L/rev.
2. Calibrate the Method 6 meter box at 1 L/min.

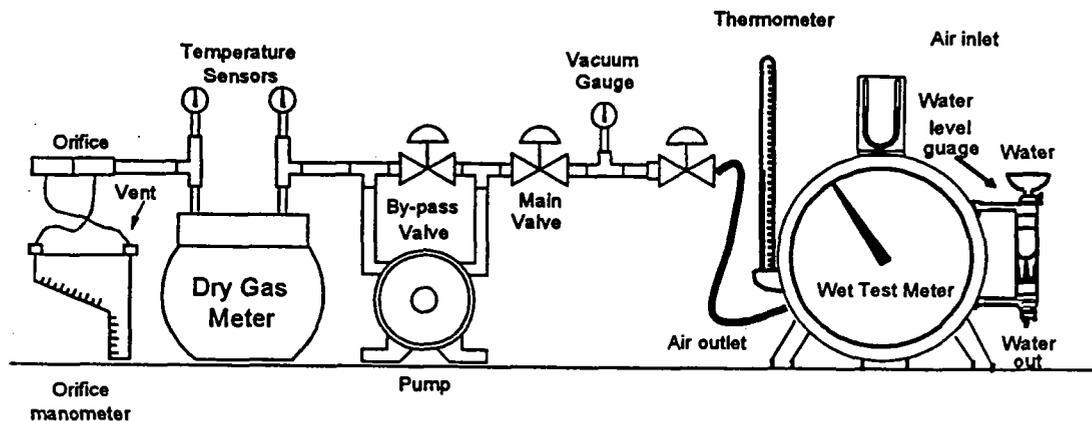


Figure C5c-1. Sample meter system calibration setup.

CALIBRATION DATA SHEET 5c
Dry Gas Meter as a Calibration Standard

Dry Gas Meter ID# _____ Date _____

Barometric Pressure, P_b _____ in. Hg Personnel _____

Initial Calibration ____ Recalibration ____ Capacity: WTM = _____ (≥ 1 cf/rev?) Spirometer: _____ (≥ 14 cf?)

Nom. Q (cfm)	WTM		DGM				Time θ (min)	FR Q (cfm)	Meter Coeff.	
	V_w (cf)	t_w ($^{\circ}F$)	V_{ds} (cf)	t_i ($^{\circ}F$)	t_o ($^{\circ}F$)	Avg \bar{t}_{ds} ($^{\circ}F$)			Δp (in. H_2O)	Y_{ds}
0.40										
0.60										
0.80										
1.00										
1.20										

$$Q = 17.64 \frac{V_w}{\theta} \frac{P_b}{(t_w + 460)}$$

$$Y_{ds} = \frac{V_w}{V_{ds}} \frac{(t_{ds} + 460)}{(t_w + 460)} \frac{P_b}{\left(P_b + \frac{\Delta p}{13.6}\right)}$$

____ For each flow rate, Y_{ds} (maximum - minimum) ≤ 0.030 for 3 successive runs?

____ At 1 cfm, $\Delta p \leq 4.0$ in. H_2O ?

____ Each $Y_{ds} = 1.00 \pm 0.05$?

____ If alternative recalibration, recalibration \bar{Y}_{ds} within $\pm 1.5\%$ of initial calibration \bar{Y}_{ds} at each flow rate?

QA/QC Check

Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____ Personnel (Signature/Date) _____ Team Leader (Signature/Date) _____

CALIBRATION PROCEDURE 5d
Critical Orifices as Calibration Standards

A. Selection of Critical Orifices

1. Select five critical orifices to cover the range between 0.35 and 1.20 cfm or the expected operating range. Two of the critical orifices must bracket the expected operating range.
2. Use three of these five critical orifices to calibrate the DGM. Save the other two as spares and to better bracket the range of operating flow rates. Hypodermic needle sizes and tubing lengths shown below give the following approximate flow rates:

Approximate Sizes/Flow Rates for Critical Orifices			
Gauge/in.	cfm	Gauge/in.	cfm
12/3.0	1.15	14/1.0	0.69
12/4.0	1.06	14/2.0	0.61
13/1.0	0.91	14/3.0	0.57
13/2.0	0.83	15/1.25	0.50
13/3.0	0.79	15/3.0	0.41
13/4.0	0.73	15/4.0	0.37

3. To adapt these needles to a Method 5 type sampling train, do the following:
 - a. Insert a serum bottle stopper, 13- by 20-mm sleeve type, into a 1/2-in. Swagelok quick connect.
 - b. Insert the needle into the stopper as shown in Figure C5d-1.
4. Determine suitability and the appropriate operating vacuum of the critical orifices as follows:
 - a. Turn on the pump, fully open the coarse adjust valve, and adjust the by-pass valve to give a vacuum reading corresponding to about half of atmospheric pressure.

- b. Observe the meter box orifice manometer reading, ΔH . Slowly increase the vacuum reading until a stable reading is obtained on the meter box orifice manometer.
- c. Record the critical vacuum for each orifice. *Do not use orifices that do not reach a critical value.*

B. Critical Orifice Calibration

1. Leak-check the Method 5 metering system (see FP 5a) from its inlet. The leakage rate must be zero, i.e., no detectable movement of the DGM dial for 1 min.
2. Leak-check that portion of the sampling train between the pump and the orifice meter (see FP 5b).
3. Calibrate the metering system (see CP 5), and record the DGM calibration factor, Y.
4. Insert the critical orifice into the inlet of the metering system. Do not use any connections at the inlet of the orifice.
5. Warm up the system for 15 min.
6. Leak-check the system (see FP 5a) from the inlet of the critical orifice.
7. Record the information listed in CDS 5d.
8. Conduct duplicate runs at a vacuum of 1 to 2 in. Hg above the critical vacuum. Run for at least 5 min each, using complete revolutions of the DGM. *(As a guideline, duplicate runs should not differ by more than 3.0 sec to achieve $\pm 0.5\%$ in K' .)*

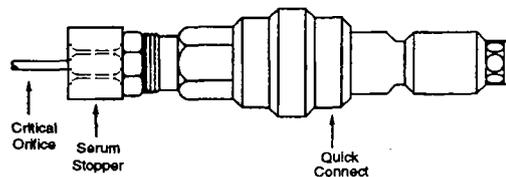


Figure C5d-1. Critical Orifice Adaptation to Method 5 metering system.

CALIBRATION DATA SHEET 5d
Critical Orifice/Metering System

Check (✓) Initial Calibration _____ Recalibration _____ Date _____

Check (✓) Critical Orifices _____ Metering System _____ Personnel _____

Crit. Orifice/Meter Box ID#						
Run No.						
Meter Box Inlet: Leak = 0?						
Cr. Orifice Inlet: Leak = 0?						
Cr. Orifice Inlet: Leak						
DGM Final Rdg (cf)						
DGM Initial Rdg (cf)						
Difference, V _m (cf)						
DGM Inlet/Outlet Temp						
Initial (°F)	/	/	/	/	/	/
Final (°F)	/	/	/	/	/	/
Average, t _m (°F)						
Time (Diff ≤ 3 sec?) (min/sec)	/	/	/	/	/	/
Time, θ (min)						
Orifice ΔH (in. H ₂ O)						
Bar Pressure, P _b (in. Hg)						
Amb Temp., t _{amb} (°F)						
Pump Vacuum (in. Hg)						
K' Factor						
Average K' Factor						
Diff ≤ ±0.5% from avg?						
V _{m(std)} (cf)						
V _{cr(std)} (cf)						
DGM Calib. Factor, Y _i						
Y _i ≤ ± 0.02 from avg?						
ΔH _@						
ΔH _@ ≤ 0.02 from avg?						

$$K' = \frac{17.64 V_m Y \left(P_b + \frac{\Delta H}{13.6} \right) \sqrt{(t_{amb} + 460)}}{P_b (t_m + 460) \theta}$$

$$V_{m(std)} = 17.64 V_m \frac{P_b + \frac{\Delta H}{13.6}}{t_m + 460}$$

$$V_{cr(std)} = K' \frac{P_b \theta}{\sqrt{(t_{amb} + 460)}}$$

$$Y = \frac{V_{cr(std)}}{V_{m(std)}}$$

$$\Delta H_{@} = \left(\frac{0.75 \theta}{V_{cr(std)}} \right)^2$$

QA/QC Check

Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____ Personnel (Signature/Date) _____ Team Leader (Signature/Date) _____

SUMMARY SHEET 5A
Particulate Matter

		Run #1	Run #2	Run #3	Avg
Client/Plant Name		FDS 5			
Job No.		FDS 5			
Sampling Location		FDS 5			
Run ID #		FDS 5			
Test Date		FDS 5			
Run Start Time		FDS 5			
Run Finish Time		FDS 5			
Net Traverse Points		FDS 1			
Traverse Matrix (Rectangular)		FDS 1			
Net Run Time, min	θ	FDS 5			
Nozzle Diameter, in.	D_n	FDS 5			
Dry Gas Meter Calibration Factor	Y	CDS 5			
Average ΔH (orifice meter), in. H ₂ O	ΔH	FDS 5			
Barometric Pressure, in. Hg	P_b	FDS 5			
Stack Static Pressure, in. H ₂ O	P_g	FDS 5			
Abs Stack Pressure ($P_b + P_g/13.6$), in. Hg	P_s	SS 5			
Average Stack Temperature, °F	t_s	FDS 5			
Avg Abs Stack Temperature ($t_s + 460$), R	T_s	SS 5			
Carbon Dioxide, % dry	%CO ₂	FDS 3			
Oxygen, % dry	%O ₂	FDS 3			
Carbon Monoxide + Nitrogen, % dry	%(CO + N ₂)	FDS 3			
Dry Molecular Weight, lb/lb-mole	M_d	FDS 3			
Average DGM Temperature, °F	t_m	FDS 5			
Volume of Metered Gas Sample, dcf	V_m	FDS 5			
Volume of Metered Gas Sample, dscf	$V_{m(std)}$	SS 5			
Volume Water Condensed, mL	V_{lc}	FDS 5			
Volume of Water Vapor, scf	$V_{w(std)}$	SS 5			
Moisture Content, fraction	B_{ws}	SS 5			
Pitot Tube Coefficient	C_p	CDS 2a			
Average Velocity Pressure, in. H ₂ O	Δp	FDS 5			
Average $[(t_{si} + 460) \Delta p]^{1/2}$	$[(T_{si} \Delta p)]^{1/2}$	FDS 5			
Velocity, ft/sec	v_s	SS 5			
Stack Area, ft ²	A	FDS 1			
Volumetric Flow Rate, dscfh	Q_{sd}	SS 5			
Volumetric Flow Rate, wscfh	Q_{sw}	SS 5			
Isokinetic Sampling Rate, %	%I	SS 5			
Acetone Blank, mg	W_t	LDS 5A			
Total Particulate Mass (Blank Corr.), mg	m_n	LDS 5A			
Particulate Concentration, g/dscf	c_s	SS 5			

Run #1 Run #2 Run #3 Avg

Post-test Calibration Checks
Temperature and Barometer
Differential Pressure Sensor
Metering system

CDS 2d
CDS 2d
CDS 5

FIELD PROCEDURE 5A
Particulate Matter from Asphalt Roofing Operations

Note: The sampling procedure is the same as that in FP 5, except for the items noted below:

A. Pretest Preparation

1. Thoroughly clean each component with soap and water followed by at least three 1,1,1-trichloroethane (TCE) rinses. Use the probe and nozzle brushes during at least one of the TCE rinses (refer to **step E4 of FP 5** for rinsing technique). Cap or seal the open ends of the probe liners and nozzles to prevent contamination during shipping.
2. When the stack gas moisture is $> 10\%$, use a precollector cyclone. Do not use the cyclone under other, less severe conditions.

B. Preparation of Collection Train

1. Set up the sampling train as shown in Figure F5-1 and, if used, place the precollector cyclone between the probe and filter holder. If stack gas temperatures are $> 480^\circ\text{F}$, water-cooled probes may be required to control the probe exit temperature to $108 \pm 18^\circ\text{F}$.
2. Do not use stopcock grease on ground glass joints unless grease is insoluble in TCE.
3. Install a temperature gauge to measure to within $\pm 5.4^\circ\text{F}$ the sample gas at the exit end of the filter holder.

C. Sampling and Sample Recovery

1. Maintain the gas temperature exiting the filter at $108 \pm 18^\circ\text{F}$. Maintain the temperature of the precollector cyclone, if used, at $108 \pm 18^\circ\text{F}$.
2. The sample recovery is the same as that in FP 5, except for the following additions and deviations:
 - a. Use TCE (in glass wash bottles) instead of acetone to recover the sample into Container No. 2. Measure the total amount of TCE used in the rinses.
 - b. Include the rinses of the cyclone and cyclone collection flask (if used) in this container.
 - c. Save a portion of the TCE used for cleanup as a blank. Take 200 mL of this TCE directly from the wash bottle being used, and place it in a glass sample container labeled "TCE Blank."
 - d. Use as sample storage containers, chemically resistant, borosilicate glass bottles, with rubber-backed Teflon screw cap liners or caps that are constructed so as to be leak-free, and resistant to chemical attack by TCE, 500-mL or 1,000-mL.

LABORATORY PROCEDURE 5A
Particulate Matter from Asphalt Roofing Operations

A. Analysis1. Container No. 1 (Filter)

- a. Transfer the filter from the sample container to a tared glass weighing dish, and desiccate for 24 hr in a desiccator (anhydrous calcium sulfate).
- b. Rinse Container No. 1 with a measured amount of TCE, and analyze this rinse with the contents of Container No. 2.
- c. Weigh the filter to a constant weight, i.e., a difference of no more than 10% or 2 mg (whichever is greater) between two consecutive weighings made 24 hr apart.
- d. Report the "final weight" to the nearest 0.1 mg as the average of these two values.

2. Container No. 2 (Probe to Filter Holder)

- a. Before adding the rinse from Container No. 1 to Container No. 2, determine loss (if any), and note loss on LDS 5A.
- b. Measure the liquid in this container either volumetrically to ± 1 mL or gravimetrically to ± 0.5 g.
- c. If the volume of condensed water present in the TCE rinse (look for a boundary layer or phase separation) appears > 5 mL, separate the oil-TCE fraction from the water fraction using a separatory funnel. Measure the volume of the water phase to the nearest mL; add this amount to step E6 of FP 5. Extract the water phase with several 25 mL portions of TCE until, by visual observation, the TCE does not remove any additional organic material.
- d. Evaporate the remaining water fraction to dryness at 200°F, desiccate for 24 hr, and weigh to the nearest 0.1 mg.

- e. Combine the TCE from step 1 with the TCE from step 2c, which includes the TCE from the water phase extractions.
- f. Transfer the TCE and oil to a tared beaker, and evaporate the TCE at ambient temperature and pressure (may take several days).
- g. Do not desiccate the sample until the solution reaches an apparent constant volume or until the odor of TCE is not detected.
- h. When it appears that the TCE has evaporated, desiccate the sample, and weigh it at 24-hr intervals to obtain a "constant weight." Report the results to the nearest 0.1 mg.

3. Container No. 3 (Silica Gel)

If not done in the field, weigh the spent silica gel (or silica gel plus impinger) to the nearest 0.5 g using a balance.

4. "TCE Blank" Container

- a. Measure the TCE in this container either volumetrically or gravimetrically.
- b. Transfer the TCE to a tared 250-mL beaker, and evaporate to dryness at ambient temperature and pressure.
- c. Desiccate for 24 hr, and weigh to a constant weight. Report the results to the nearest 0.1 mg.

B. Alternative

TCE liquid samples may be dried in a controlled temperature oven at temperatures up to 100°F until the TCE is evaporated.

LABORATORY DATA SHEET 5A
Particulate Matter

Client/Plant Name _____ Job # _____

City/State _____ Analyst _____

Barometric Pressure _____ " Hg Lab Ambient Temp. _____ °F Relative Humidity in Lab _____ (≤50%?)

Analytical balance I.D. # _____ Density of TCE _____ g/ml Date _____

Run Identification				
Container No. 1 (Filter) ID#				
Filter ID#				
Wgt #1: Date/time _____ (mg)				
Wgt #2: Date/time _____ (mg)				
Wgt #3: Date/time _____ (mg)				
Avg of last 2 within 10% or 2 mg (mg)				
Filter tare wgt (mg)				
Container tare wgt (mg)				
PM on filter, m_f (mg)				
Container No. 2 (TCE Rinse) ID#				
Volume/wgt, V_{tw} (___ Any Loss ?) (ml/g)				
Tare wgt (if applicable) (g)				
Difference (if applicable), W_{tw} (g)				
Wgt #1: Date/time _____ (mg)				
Wgt #2: Date/time _____ (mg)				
Wgt #3: Date/time _____ (mg)				
Avg of last 2 within 10% or 2 mg (mg)				
Container tare wgt (mg)				
Difference, m_{tw} (mg)				
TCE Blank ID#				
Volume/weight, V_t (ml/g)				
Tare weight (if applicable) (g)				
Difference (if applicable), A_t (g)				
Wgt #1: Date/time _____ (mg)				
Wgt #2: Date/time _____ (mg)				
Container tare wgt (mg)				
Difference, m_t (mg)				
$C_a = m_t / [(V_t \rho_t) \text{ or } A_t] (\leq 0.001\% ?)$ (mg/g)				
TCE blank, $W_t = C_t [V_{tw} \rho_t \text{ or } W_{tw}]$ (mg)				
Total wgt of PM, $m_n = m_f + m_{tw} - W_t$ (mg)				
Sample Appearance				

QA/QC Check

Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____ Personnel (Signature/Date) _____ Team Leader (Signature/Date) _____

**FIELD PROCEDURE 5B
Nonsulfuric Acid Particulate Matter**

Note: *The sampling procedure is identical to FP 5 except for the following (use FDS 5):*

1. Initial Filter Tare

- a. Oven dry the filter at $320 \pm 10^\circ\text{F}$ for 2 to 3 hr, cool in a desiccator for 2 hr, and weigh.
- b. Desiccate to constant weight to obtain the initial tare weight.

2. Probe and Filter Temperatures

Maintain the probe outlet and filter temperatures at $320 \pm 25^\circ\text{F}$.

LABORATORY PROCEDURE 5B
Nonsulfuric Acid Particulate Matter

Note: This laboratory procedure is the same as that in LP 5, except for the following (use LDS 5):

1. Dry the probe sample at ambient temperature.
2. Then oven dry the probe and filter samples at a temperature of $320 \pm 10^{\circ}\text{F}$ for 6 hr.
3. Cool in a desiccator for 2 hr, and weigh to constant weight.

FIELD PROCEDURE 5D
Particulate Matter from Positive Pressure Fabric Filters

Note: This procedure uses FP 5, except for identifying appropriate alternative locations and procedures for sampling the emissions from positive pressure fabric filters (use FDS 5).

A. Determination of Measurement Site

1. Stacks Meeting Method 1 Criteria. See FP 1.
2. Short Stacks Not Meeting FP 1 Criteria. Use either of the following:
 - a. Stack extensions and FP 1.
 - b. Flow straightening vanes of the "egg-crate" type (see Figure F5D-1). Locate the measurement site downstream of the straightening vanes $\geq 2 D_o$ of the largest vane opening and $>0.5 D_o$ of the stack diameter upstream of the stack outlet.
3. Roof Monitor or Monovent (e.g., peaked roof monitor and ridge vent). See Figure F5D-2. Use a measurement site at the base of the monovent and upstream of any exhaust point (e.g., louvered vent).
4. Compartment Housing. Sample immediately downstream of the filter bags directly above the tops of the bags as shown in the examples in Figure F5D-2. Depending on the housing design, use sampling ports in the housing walls or locate the sampling equipment within the compartment housing.

B. Determination of Number and Location of Traverse Points

Because a performance test consists of ≥ 3 test runs and because of the varied configurations of positive pressure fabric filters, there are several schemes for combining the number of traverse points and the three test runs.

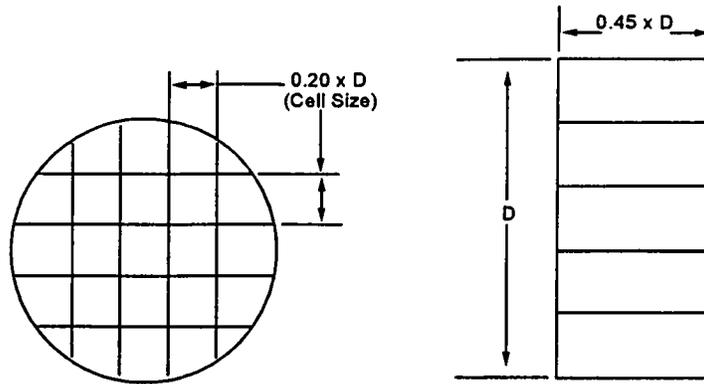
1. Single Stacks Meeting Method 1 Criteria.
 - a. Use FP 1.
 - b. Sample all traverse points for each test run.
2. Other Single Measurement Sites.
 - a. Use ≥ 24 traverse points (this includes roof monitor or monovent and single compartment housing. For example, for a rectangular measurement site, such as a monovent, use a balanced 5 x 5 traverse point matrix.
 - b. Sample all traverse points for each test run.

3. Multiple Measurement Sites. Sampling from two or more stacks or measurement sites may be combined for a test run, provided the following guidelines are met:

- a. For ≤ 12 measurement sites, sample all sites. For > 12 measurement sites, sample 12 or 50% of the sites, whichever is greater. Evenly, or nearly evenly, distribute the measurement sites sampled among the available sites; if this cannot be done, sample all sites.
- b. Sample the same number of measurement sites for each test run.
- c. Use ≥ 24 traverse points (sum of traverse points from tested measurement sites) per test run, except when a test run is combining two stacks that FP 1 specifies fewer than 12 points.
- d. If the 24 traverse points per test run criterion is met, the number of traverse points per measurement site may be reduced to eight.
- e. **Alternative:** Conduct a test run for each measurement site individually using the criteria in step B1 or B2 for number of traverse points (≥ 3 runs are required for a performance test). If more than three measurement sites are sampled, the number of traverse points per measurement site may be reduced to eight as long as ≥ 72 traverse points are sampled for all the tests.

C. Examples

1. **Example 1:** Nine circular measurement sites of equal areas.
 - a. Each of three test runs - traverse three measurement sites using four points per diameter (eight points per measurement site).
 - b. Run #1 - sample sites 1, 2, and 3; run #2 - sample sites 4, 5, and 6; and run #3 - sample sites 7, 8, and 9.
 - c. **Alternative:** For each run, test separately all nine measurement sites using eight points per site.



NOTE: Position Straighteners So That Cell Sides Are Located Approximately 45° From Traverse Diameters.

Figure F5D-1. Example of Flow Straightening Vanes.

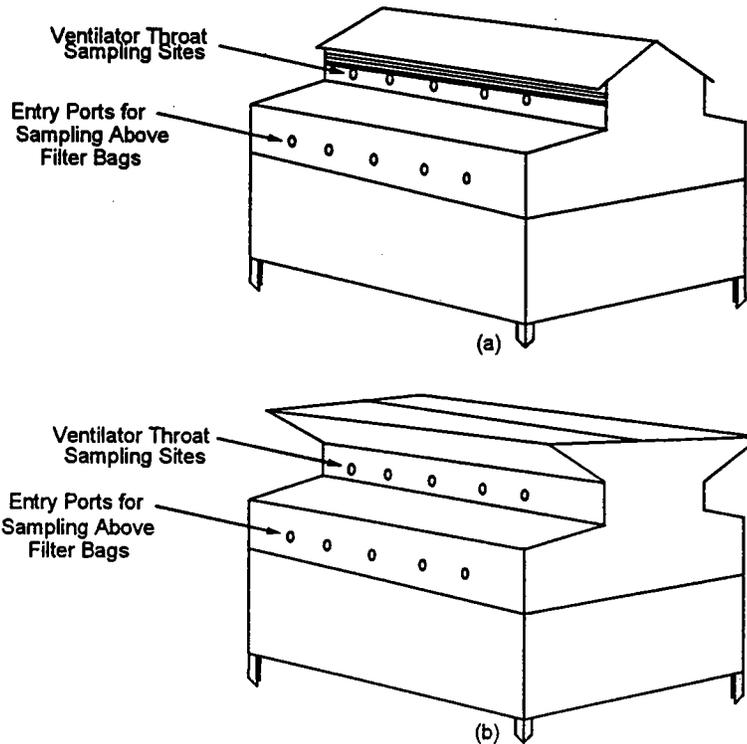


Figure F5D-2. Acceptable Sampling Site Locations for (a) Peaked Roof; and (b) Ridge Vent Type Fabric Filters.

2. **Example 2:** Thirty rectangular measurement sites of equal areas. At least 50% or 15 sites must be sampled.
 - a. Each of three test runs - traverse five measurement sites using a 3 x 3 traverse point matrix for each site.
 - b. Number the sites consecutively from 1 to 30 and sample all the even numbered (or odd numbered) sites.
 - c. **Alternative:** Sample separately each of 15 measurement sites using step B1 or B2 to determine the number and location of traverse points.
3. **Example 3:** Two measurement sites of equal areas.
 - a. Each of three test runs - traverse both measurement sites using step B3 to determine number of traverse points.
 - b. **Alternative:** Conduct two full emission test runs of each measurement site using step B1 or B2 to determine the number of traverse points.

4. **Note:** For other test schemes, such as random determination of traverse points for a large number of measurement sites, consult with the Administrator.

D. Velocity Determination

1. If velocities at the measurement site is too low to measure accurately (i.e., velocity head < 0.05 in. H_2O), measure the gas flow rate at the fabric filter inlet following the procedures in FP 2.
2. Calculate the average gas velocity at the measurement site using the information from step D1, and use this velocity to determine and maintain isokinetic sampling rates.
3. **Note:** Block and make leak-tight all sources of gas leakage, into or out of the fabric filter housing between the inlet measurement site and the outlet measurement site.

SUMMARY SHEET 5E
Particulate Matter

		Run #1	Run #2	Run #3	Avg
Client/Plant Name		FDS 5			
Job No.		FDS 5			
Sampling Location		FDS 5			
Run ID #		FDS 5			
Test Date		FDS 5			
Run Start Time		FDS 5			
Run Finish Time		FDS 5			
Net Traverse Points		FDS 1			
Traverse Matrix (Rectangular)		FDS 1			
Net Run Time, min	θ	FDS 5			
Nozzle Diameter, in.	D_n	FDS 5			
Dry Gas Meter Calibration Factor	Y	CDS 5			
Average ΔH (orifice meter), in. H ₂ O	ΔH	FDS 5			
Barometric Pressure, in. Hg	P_b	FDS 5			
Stack Static Pressure, in. H ₂ O	P_g	FDS 5			
Abs Stack Pressure ($P_b + P_g/13.6$), in. Hg	P_s	SS 5			
Average Stack Temperature, °F	t_s	FDS 5			
Avg Abs Stack Temperature ($t_s + 460$), R	T_s	SS 5			
Carbon Dioxide, % dry	%CO ₂	FDS 3			
Oxygen, % dry	%O ₂	FDS 3			
Carbon Monoxide + Nitrogen, % dry	%(CO + N ₂)	FDS 3			
Dry Molecular Weight, lb/lb-mole	M_d	FDS 3			
Average DGM Temperature, °F	t_m	FDS 5			
Volume of Metered Gas Sample, dcf	V_m	FDS 5			
Volume of Metered Gas Sample, dscf	$V_{m(std)}$	SS 5			
Volume Water Condensed, mL	V_{lc}	FDS 5			
Volume of Water Vapor, scf	$V_{w(std)}$	SS 5			
Moisture Content, fraction	B_{ws}	SS 5			
Pitot Tube Coefficient	C_p	CDS 2a			
Average Velocity Pressure, in. H ₂ O	Δp	FDS 5			
Average $[(t_{si} + 460) \Delta p]^{1/2}$	$[T_{si} \Delta p]^{1/2}$	FDS 5			
Velocity, ft/sec	v_s	SS 5			
Stack Area, ft ²	A	FDS 1			
Volumetric Flow Rate, dscfh	Q_{sd}	SS 5			
Volumetric Flow Rate, wscfh	Q_{sw}	SS 5			
Isokinetic Sampling Rate, %	%I	SS 5			
Acetone Blank, mg	W_a	LDS 5			
Water Blank, mg	W_w	LDS 5E			
M5 Particulate Mass (Blank Corr.), mg	m_n	LDS 5			
TOC Particulate Mass, mg	m_c	LDS 5E			
Water Rinse Particulate Mass, mg	m_{ww}	LDS 5E			
M5E Particulate Mass, (Blnk Corr.), mg	m_n	SS 5E			
M5E Particulate Concentration, g/dscf	c_s	SS 5E			

Run #1	Run #2	Run #3	Avg
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Post-test Calibration Checks
Temperature and Barometer
Differential Pressure Sensor
Metering System

CDS 2d
CDS 2d
CDS 5

$$m_n (\text{M5E}) = m_n (\text{M5}) + m_{\text{ww}} - W_w + m_c$$

$$c_s = 0.001 \frac{m_n}{V_{m(\text{std})}}$$

LABORATORY DATA SHEET 5E
Particulate Matter

Client/Plant Name _____ Job # _____

City/State _____ Analyst _____

Analytical balance I.D. # _____ Density of Water _____ g/mL Date _____

Note: This is a supplement to LDS 5 for the analysis of PM in the water rinse. In using LDS 5 for Method 5E, relabel Container No. 2 as Container No. 3. Calculate the total PM weight as shown below.

Run Identification				
Container No. 2 (Water Rinse) ID#				
Volume/wgt, V_{ww} (___ Any Loss ?) (mL/g)				
Tare wgt (if applicable) (g)				
Difference (if applicable), W_{ww} (g)				
Wgt #1: Date/time _____ (mg)				
Wgt #2: Date/time _____ (mg)				
Wgt #3: Date/time _____ (mg)				
Container tare wgt (mg)				
Difference, m_{ww} (mg)				
Water Blank ID#				
Volume/weight, V_w (mL/g)				
Tare weight (if applicable) (g)				
Difference (if applicable), W_w (g)				
Wgt #1: Date/time _____ (mg)				
Wgt #2: Date/time _____ (mg)				
Container tare wgt (mg)				
Difference, m_w (mg)				
$C_w = m_w / [(V_w \rho_w) \text{ or } W_w]$ (mg/g)				
H ₂ O blk, $W_w = C_w [V_{ww} \rho_w \text{ or } W_{ww}]$ (mg)				
Total wgt of PM, m_n^* (mg)				
Sample Appearance				

* Calculate the total weight of PM from Method 5E as follows:

$$m_n \text{ (Method 5E)} = m_n \text{ (Method 5)} + m_{ww} - W_w + m_c \text{ (LDS 5Ea)}$$

QA/QC Check

Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____

Personnel (Signature/Date)

Team Leader (Signature/Date)

LABORATORY DATA SHEET 5E (Continued)
Particulate Matter - Wool Fiberglass Industry

Client/Plant Name _____ Job # _____ Date _____

TOC Analyzer ID# _____ Calibration Date _____ Analyst _____

Temp. of total carbon column _____ °F Temp. of inorganic carbon column _____ °F Time _____

		Working Stds, (mg/L)	10	20	30	40	50	60	80	100
Total Carbon Port	Injection 1									
	Injection 2									
	Average									
Inorganic Carbon Port	Injection 1									
	Injection 2									
	Average									

Note: The acidification and warming steps are not necessary for preparation of the standard curve. Correct peak heights for blank.

_____ Plot of calibration curve attached?

Run No.	Sample Vol., mL (V _s)	Injection Vol., μL (V _i)	Total Carbon Peak Height, mm (T _c)				Inorganic Carbon Peak Height, mm (I _c)				Total Organic Carbon, mg/L [T _c -I _c] (C _{toc})	Condensed PM, mg (m _c)	
			1	2	3	Avg	1	2	3	Avg			
NaOH Blank													

Notes: a. Repeat the injections until three consecutive peaks are obtained within ± 10% of the average.
 b. Correct peak heights for blank before determining concentrations.

Calculate the mass of condensed PM as follows:

$$m_c = 0.001 C_{toc} V_s$$

_____ Sample concentrations blank corrected?

_____ Appropriate dilution factor applied to samples that were diluted?

QA/QC Check

Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____
 Personnel (Signature/Date) Team Leader (Signature/Date)

SUMMARY SHEET 5F
Particulate Matter

		Run #1	Run #2	Run #3	Avg
Client/Plant Name		FDS	5		
Job No.		FDS	5		
Sampling Location		FDS	5		
Run ID #		FDS	5		
Test Date		FDS	5		
Run Start Time		FDS	5		
Run Finish Time		FDS	5		
Net Traverse Points		FDS	1		
Traverse Matrix (Rectangular)		FDS	1		
Net Run Time, min	θ	FDS	5		
Nozzle Diameter, in.	D_n	FDS	5		
Dry Gas Meter Calibration Factor	Y	CDS	5		
Average ΔH (orifice meter), in. H ₂ O	ΔH	FDS	5		
Barometric Pressure, in. Hg	P_b	FDS	5		
Stack Static Pressure, in. H ₂ O	P_g	FDS	5		
Abs Stack Pressure ($P_b + P_g/13.6$), in. Hg	P_s	SS	5		
Average Stack Temperature, °F	t_s	FDS	5		
Avg Abs Stack Temperature ($t_s + 460$), R	T_s	SS	5		
Carbon Dioxide, % dry	%CO ₂	FDS	3		
Oxygen, % dry	%O ₂	FDS	3		
Carbon Monoxide + Nitrogen, % dry	%(CO + N ₂)	FDS	3		
Dry Molecular Weight, lb/lb-mole	M_d	FDS	3		
Average DGM Temperature, °F	t_m	FDS	5		
Volume of Metered Gas Sample, dcf	V_m	FDS	5		
Volume of Metered Gas Sample, dscf	$V_{m(std)}$	SS	5		
Volume Water Condensed, mL	V_{lc}	FDS	5		
Volume of Water Vapor, scf	$V_{w(std)}$	SS	5		
Moisture Content, fraction	B_{ws}	SS	5		
Pitot Tube Coefficient	C_p	CDS	2a		
Average Velocity Pressure, in. H ₂ O	Δp	FDS	5		
Average $[(t_{si} + 460) \Delta p]^{1/2}$	$[T_{si} \Delta p]^{1/2}$	FDS	5		
Velocity, ft/sec	v_s	SS	5		
Stack Area, ft ²	A	FDS	1		
Volumetric Flow Rate, dscfh	Q_{sd}	SS	5		
Volumetric Flow Rate, wscfh	Q_{sw}	SS	5		
Isokinetic Sampling Rate, %	%I	SS	5		
Water Blank, mg	m_{wb}	LDS	5F		
Mass Ammonium Sulfate, mg	m_s	LDS	5F		
Mass Particulate in Residue, mg	m_r	LDS	5F		
Mass Particulate (Blnk Corr.), mg	m_n	SS	5F		
M5E Particulate Concentration, g/dscf	c_s	SS	5F		

Run #1	Run #2	Run #3	Avg
--------	--------	--------	-----

Post-test Calibration Checks

Temperature and Barometer

CDS 2d

Differential Pressure Sensor

CDS 2d

Metering System

CDS 5

$$m_n = m_r - m_{wb} - m_s$$

$$c_s = 0.001 \frac{m_n}{V_{m(std)}}$$

FIELD PROCEDURE 5F
Nonsulfate Particulate Matter

Note: The procedure is the same as that in FP 5, except for the following:

1. Maintain the probe outlet and filter temperatures $320^{\circ} \pm 25^{\circ}\text{F}$.
2. Recover the sample using water instead of acetone.

LABORATORY PROCEDURE 5F
Nonsulfate Particulate Matter

A. Reagent Preparation

The reagents are the same as that for LP 5 with the following exceptions:

1. Stock Standard Solution, 1 mg $(\text{NH}_4)_2\text{SO}_4/\text{mL}$. Dry enough primary standard grade $(\text{NH}_4)_2\text{SO}_4$ at 105 to 110°C for ≥ 2 hr. Then dissolve exactly 1.000 g dried $(\text{NH}_4)_2\text{SO}_4$ in water in a 1 L volumetric flask, and dilute to 1 L. Mix well.
2. Working Standard Solution, 25 μg $(\text{NH}_4)_2\text{SO}_4/\text{mL}$. Pipet 5 mL stock standard solution into a 200-mL volumetric flask. Dilute to 200 mL with water.
3. Standards. Prepare a blank and five standards by adding 0.0, 1.0, 2.0, 4.0, 6.0, and 10.0 mL of working standard solution (25 $\mu\text{g}/\text{mL}$) to a series of six 50-mL volumetric flasks (masses equal 0, 25, 50, 100, 150, and 250 μg , respectively). Dilute each flask to volume with water, and mix well.
4. Eluent Solution, 0.0024 M $\text{Na}_2\text{CO}_3/0.003$ M NaHCO_3 . Weigh 1.018 g Na_2CO_3 and 1.008 g NaHCO_3 , and dissolve in 4 L water.
5. Phenolphthalein Indicator. Dissolve 0.05 g 3,3-Bis(4-hydroxyphenyl)1-(3H)-isobenzofuranone in 50 mL ethanol and 50 mL water.

B. Sample Preparation

1. Cut the filter into small pieces, and place it in a 125-mL Erlenmeyer flask with a ground glass joint equipped with an air condenser. (Run a blank with an unused filter from the same lot as that of the sample through the same procedure, except for the obviously inapplicable parts.)
2. Rinse the shipping container with water, and pour the rinse into the flask. Add water to the flask until it contains about 75 mL.
3. Place the flask on a hot plate. Gently reflux the contents for 6 to 8 hr. Then cool.
4. Transfer solution to a 500-mL volumetric flask. Rinse the Erlenmeyer flask with water, and transfer the rinsings to the volumetric flask including the pieces of filter.
5. Transfer the probe rinse to the same 500-mL volumetric flask with the filter sample. Rinse the sample bottle with water, and add the rinsings to the volumetric flask. Dilute the sample to exactly 500 mL with water.
6. Allow the sample to settle until all solid material is at the bottom of the volumetric

flask. If necessary, centrifuge a portion of the sample.

7. Pipet 5-mL of the sample into a 50-mL volumetric flask, and dilute to 50-mL with water.

C. Sulfates Analysis

1. Analyze the blank and standards; subtract the blank from each value. Measure peak heights, if symmetrical; otherwise, calculate peak areas. See LDS 5F.
2. Prepare or calculate a linear regression plot of μg versus peak heights/areas, and determine the slope and its reciprocal. Resultant concentrations must $\leq 7\%$ from each known standard mass (i.e., 25, 50, 100, 150, and 250 μg).
3. Analyze a set of duplicate samples, and then a second set of standards as previously. Use the same injection volume for both standards and samples. Average the sample results (must agree within $\pm 5\%$ of their mean). Perform this duplicate analysis sequence on the same day.
4. Dilute any sample and the blank with equal volumes of water if the concentration exceeds that of the highest standard.
5. Document each sample chromatogram by listing the following: injection point, injection volume, sulfate retention time, flow rate, detector sensitivity setting, and recorder chart speed.

D. Sample Residue Analysis

1. Quantitatively transfer the remaining contents of the volumetric flask to a tared 250-mL beaker. Add the water rinsings to the tared beaker. Use LDS 5Fa.
2. Run a water blank in parallel (volume equal to that of the sample).
3. Evaporate the water in an oven at 105°C until about 100 mL of water remains. Remove the beakers from the oven, and allow them to cool.
4. Add five drops of phenolphthalein indicator, and add conc. NH_4OH until solution turns pink.
5. Return the samples to the oven at 105°C, and evaporate the samples to dryness. Cool the samples in a desiccator, and weigh the samples to constant weight.

LABORATORY DATA SHEET 5F (Continued)
Nonsulfate Particulate Matter (Sample Residue Determination)

Client/Plant Name _____ Job # _____

City/State _____ Analyst _____

Barometric Pressure _____ " Hg Lab Amb Temp. _____ °F Relative Humidity in Lab _____ (≤ 50%)

Analytical balance I.D. # _____ Date _____

Run Identification				
Sample ID#				
Volume, V_w (___ Any Loss ?) (mL)				
Filter tare wgt, m_f (mg)				
Wgt #1: Date/time _____ (mg)				
Wgt #2: Date/time _____ (mg)				
Wgt #3: Date/time _____, m_t (mg)				
Beaker tare wgt, m_{bk} (mg)				
Mass in residue ($m_t - m_f - m_{bk}$), m_r (mg)				
Blank ID				
Volume, V_b (mL)				
Filter tare wgt (g)				
Wgt #1: Date/time _____ (mg)				
Wgt #2: Date/time _____ (mg)				
Wgt #3: Date/time _____ (mg)				
Beaker tare wgt (mg)				
Difference, m_w (mg)				
$C_w = m_w/V_b$ (mg/mL)				
* Mass in Blank ($C_w V_s$), m_{wb} (mg)				
Sample Appearance				

* V_s is the volume of sample evaporated = 495 mL.

$$m_n = m_r - m_{wb} - m_s$$

QA/QC Check

Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____
 Personnel (Signature/Date) _____ Team Leader (Signature/Date) _____

SUMMARY SHEET 5Fa
Particulate Matter

		Run #1	Run #2	Run #3	Avg
Client/Plant Name		FDS 5			
Job No.		FDS 5			
Sampling Location		FDS 5			
Run ID #		FDS 5			
Test Date		FDS 5			
Run Start Time		FDS 5			
Run Finish Time		FDS 5			
Net Traverse Points		FDS 1			
Traverse Matrix (Rectangular)		FDS 1			
Net Run Time, min	θ	FDS 5			
Nozzle Diameter, in.	D_n	FDS 5			
Dry Gas Meter Calibration Factor	Y	CDS 5			
Average ΔH (orifice meter), in. H ₂ O	ΔH	FDS 5			
Barometric Pressure, in. Hg	P_b	FDS 5			
Stack Static Pressure, in. H ₂ O	P_g	FDS 5			
Abs Stack Pressure ($P_b + P_g/13.6$), in. Hg	P_s	SS 5			
Average Stack Temperature, °F	t_s	FDS 5			
Avg Abs Stack Temperature ($t_s + 460$), R	T_s	SS 5			
Carbon Dioxide, % dry	%CO ₂	FDS 3			
Oxygen, % dry	%O ₂	FDS 3			
Carbon Monoxide + Nitrogen, % dry	%(CO+N ₂)	FDS 3			
Dry Molecular Weight, lb/lb-mole	M_d	FDS 3			
Average DGM Temperature, °F	t_m	FDS 5			
Volume of Metered Gas Sample, dcf	V_m	FDS 5			
Volume of Metered Gas Sample, dscf	$V_{m(std)}$	SS 5			
Volume Water Condensed, mL	V_{lc}	FDS 5			
Volume of Water Vapor, scf	$V_{w(std)}$	SS 5			
Moisture Content, fraction	B_{ws}	SS 5			
Pitot Tube Coefficient	C_p	CDS 2a			
Average Velocity Pressure, in. H ₂ O	Δp	FDS 5			
Average $[(t_{si} + 460) \Delta p]^{1/2}$	$[T_{si} \Delta p]^{1/2}$	FDS 5			
Velocity, ft/sec	v_s	SS 5			
Stack Area, ft ²	A	FDS 1			
Volumetric Flow Rate, dscfh	Q_{sd}	SS 5			
Volumetric Flow Rate, wscfh	Q_{sw}	SS 5			
Isokinetic Sampling Rate, %	%I	SS 5			
Water Blank, mg	m_{wb}	LDS 5F			
Mass Ammonium Sulfate, mg	m_s	LDS 5Fa			
Mass Particulate in Residue, mg	m_r	LDS 5F			
Mass Particulate (Blnk Corr.), mg	m_h	SS 5F			
M5E Particulate Concentration, g/dscf	C_s	SS 5F			

Run #1

Run #2

Run #3

Avg

Post-test Calibration Checks

Temperature and Barometer

CDS 2d

Differential Pressure Sensor

CDS 2d

Metering System

CDS 5

$$m_n = m_r - m_{wb} - m_s$$

$$c_s = 0.001 \frac{m_n}{V_{m(std)}}$$

LABORATORY PROCEDURE 5Fa
Nonsulfate Particulate Matter (Alternative)

Note: This procedure is an alternative to that in LP 5F.

A. Reagent Preparation

The reagents are the same as that for LP 6, except for the addition of 1 M HCl.

HCl, 1 M. Add 8.3 mL conc. HCl (12 M) to 50 mL water in a 100-mL volumetric flask. Dilute to 100 mL with water.

B. Ion Exchange Column Preparation

1. Slurry the resin with 1 M HCl in a 250-mL beaker, and allow to stand overnight.
2. Place glass wool, 1-in. deep, in the bottom of the glass column. Rinse the slurried resin twice with water. Resuspend the resin in water, and pour sufficient resin into the column to make a bed 2 inches deep. Eliminate air bubbles in the resin or glass wool. If necessary, stir the resin with a glass rod to remove air bubbles.
3. Place a 1 in. plug of glass wool on top of the resin. Do not let the liquid level fall below the top of the upper glass wool plug.
4. Rinse the column with water until the eluate gives a pH ≥ 5 (use pH paper).
5. Regenerate or replace resin after 20 sample aliquots or if end point of the titration becomes unclear.

C. Sample Extraction and Residue

1. Extract the sample using LP 5F, step B, except do not dilute the sample to 500 mL.
2. Treat and tare filters as follows:
 - a. Place at least one clean glass fiber filter for each sample in a Buchner funnel, and rinse the filters with water.
 - b. Remove the filters from the funnel, dry them in an oven at $105 \pm 5^\circ\text{C}$, and cool in a desiccator.
 - c. Weigh each filter to a constant weight, and record weight to nearest 0.1 mg.
3. Filter the extracted sample as follows:
 - a. Assemble the vacuum filter apparatus, and place one of the clean, tared glass fiber filters in the Buchner funnel.
 - b. Decant the liquid portion of the extracted sample through the tared filter into a clean, dry, 500-mL filter flask.

- c. Rinse all the particulate matter remaining in the volumetric flask onto the filter with water. Rinse the particulate matter with more water.
 - d. Transfer the filtrate to a 500-mL volumetric flask, and dilute to 500 mL with water.
 - e. Dry the filter and filtered material overnight at $105 \pm 5^\circ\text{C}$, cool in a desiccator, and weigh to the nearest 0.1 mg.
4. Determine solids in filtrate as follows:
 - a. Dry a 250-mL beaker at $75 \pm 5^\circ\text{C}$, and cool in a desiccator; then weigh to constant weight to nearest 0.1 mg.
 - b. Pipette 200 mL of the filtrate that was saved into the tared 250-mL beaker; add five drops of phenolphthalein indicator and sufficient concentrated ammonium hydroxide to turn the solution pink.
 - c. Carefully evaporate the contents of the beaker to dryness at $75 \pm 5^\circ\text{C}$. Check for dryness every 30 min. Do not continue to bake the sample once it has dried.
 - d. Cool the sample in a desiccator, and weigh to constant weight to nearest 0.1 mg.

D. Analysis

1. Adjust the flow rate through the ion exchange column to 3 mL/min.
2. Pipette a 20 mL aliquot of the filtrate onto the top of the ion exchange column, and collect the eluate in a 50-mL volumetric flask. Rinse the column with two 15-mL portions of water. Stop collection of the eluate when the volume in the flask reaches 50-mL.
3. Run duplicates. Pipette a 20-mL aliquot of the eluate into a 250-mL Erlenmeyer flask, add 80 mL 100% isopropanol and two to four drops of thiorin indicator, and titrate to a pink end point using 0.0100 N barium perchlorate.
4. Run a water blank with each series of samples. Blank values must be ≤ 5 mg.
5. Duplicate analyses must agree within $\pm 1\%$ or ± 0.2 mL, whichever is larger. Duplicates through resin must agree within $\pm 5\%$.

LABORATORY DATA SHEET 5Fa
Nonsulfate Particulate Matter - Alternative

Client/Plant Name _____ Job No. _____
 City/State _____ Sampling Location _____
 Analyst _____ Date Analyzed _____ Time Analyzed _____

Run No.	Volume (mL)							AS (mg) m _s
	Extract, V _f	Filtrate, V _i	Eluate, V _e	Aliquot, V _a	Titrat'n, T ₁	Titrat'n T ₂	Avg, V _t	
Blank								

Titrant Standardization Against Sulfuric Acid 0.0100N

Mass of Ammonium Sulfate:

	Volumes (mL)		Normality (N _t)
	H ₂ SO ₄ V _s	Ba ⁺ V _t	
1			
2			
3			
Average, N			

$$m_s = \frac{66.07 (V_t - V_c) N V_e V_f}{V_a V_i}$$

V_c = Volume of titrant used for titration blank, mL

$$N_t = \frac{N_s V_s}{V_t}$$

- | | |
|--|---|
| <input type="checkbox"/> Titrations repeated and volumes averaged? | <input type="checkbox"/> Ion exchange and titrations performed on duplicate portions of filtrate? |
| <input type="checkbox"/> Blank run with every sample series? | <input type="checkbox"/> Results agree within ± 5% ? |
| <input type="checkbox"/> Replicate blank titration values agree within ± 1% or ± 0.2 mL? | <input type="checkbox"/> Ion exchange column regenerated or replaced after 20 samples? |

QA/QC Check

Completeness _____ Legibility _____ Accuracy _____ Specifications _____ Reasonableness _____

Checked by: _____
 Personnel (Signature/Date) _____ Team Leader (Signature/Date) _____

