

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

METHOD 5.3

**DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM
STATIONARY SOURCES USING AN IN-STACK FILTER**

**OFFICE OF OPERATIONS
TECHNICAL SERVICES DIVISION
OCTOBER 2005**

METHOD 5.3

DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES USING AN IN-STACK FILTER

TABLE OF CONTENTS

Section

1. Overview

- 1.1 Principle
- 1.2 Applicability

2. Field Procedures

- 2.1 Sampling Apparatus
- 2.2 Sampling Reagents
- 2.3 Pretest Determinations
- 2.4 Gas Volume Meter Checks
- 2.5 Pretest Preparation
- 2.6 Leak Check Procedures
- 2.7 Sampling Train Operation
- 2.8 Calculation of Percent Isokinetic
- 2.9 Sample Handling
- 2.10 Calibrations

3. Laboratory Procedures

3.1 Apparatus

3.2 Reagents

3.3 Pretest Preparation

3.4 Preparation of Sample Collection Train

3.5 Leak Check

3.6 Sample Recovery

3.7 Sample Analysis

3.8 Calculations and Reporting

3.9 Calibrations

4. Engineering Calculations and Reporting

4.1 Calculations

METHOD 5.3

DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES USING AN IN-STACK FILTER

Section 1 of 4

1. Overview

1.1 Principle

A sample is withdrawn isokinetically from the source through a sample train by a metering system. Filterable particulate matter is collected on a glass fiber filter kept inside the stack. Condensibles and particulates passing through the filter are collected in impingers containing deionized water. The impingers are contained in an ice bath to maintain a sampled gas temperature of approximately 15°C (60°F). A separate train for sulfuric acid mist may be required (see below).

The total particulate mass is defined as the sum of the mass collected in the probe, filter, and impingers after removal of uncombined water, the

organic extraction, and the sulfuric acid collected from the separate sulfuric acid train (if required). The solid particulate matter mass is defined as the total particulate matter mass minus extractable organic matter and sulfuric acid.

An adjustment to the total particulate matter mass is allowed for sulfuric acid formed from reactions between SO_2 and SO_3 with the sample train components. When ammonia is injected to enhance the efficiency of a control device, a second adjustment is allowed for total sulfate. This adjustment is allowed for fluid catalytic cracking units only.

Because of the complexity of this method testers must be trained and experienced in the test procedures.

1.2 Applicability

This method measures particulate emissions from stationary sources, except when determining compliance with New Source Performance Standards. It does not apply to stacks that contain liquid

droplets, or saturated with water vapor, or where the temperature is greater than 204°C (400°F). In addition, this method should not be used if the projected cross sectional area of the probe extension-filter holder assembly covers more than 5 percent of the stack cross sectional area (see Figure 5.3-1). This method is recommended for testing cement plants and other sources emitting highly hygroscopic particulate matter.

METHOD 5.3

DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES USING AN IN-STACK FILTER

Section 2 of 4

2. Field Procedures

2.1 Sampling Apparatus

2.1.1 Sampling Train

A schematic of the sampling train used in this method is shown in Figure 5.3-2. The procedure for the preparation of the sample collection train is given in Method 5.1, Section 3.2.1. The sampling train consists of the following components:

a. Probe Nozzle

The nozzle material should be 316 stainless steel or glass, with a sharp, tapered leading edge. The taper angle should be $\leq 30^\circ$ and on the

outside, to preserve a constant internal diameter. The stainless steel nozzle should be constructed from seamless tubing. Other materials which will not be corroded by the sampled gases or interfere with sample recovery may be used.

A range of nozzle sizes suitable for isokinetic sampling should be available in increments of 0.16 cm (1/16 in.), e.g. 0.32 to 1.27 cm (1/8 to 1/2 in.) or larger if higher volume sampling trains are used. Each nozzle must be calibrated according to procedure outlined in Method 5.1, Section 2.1.

b. Filter Holder

Use a borosilicate glass filter holder, with a Teflon, Teflon-coated stainless steel, or stainless steel support and a silicone rubber gasket. Gasket made of other materials such as stainless steel, Teflon, or Viton may

be used if they do not react with the particulate matter or sampled gases. Fritted glass supports are unsatisfactory for post-filter analysis. The holder design provides a positive seal against leakage from the outside or around the filter.

c. Probe Liner

Whenever practical, use borosilicate or quartz glass probe liners. Metal liners such as 316 stainless, Inconel, Incoloy 825, or other corrosion resistant metals made of seamless tubing may be used when the concentration of acid particulate is less than 1 mg/m³ at probe conditions or SO₂ is less than 20 ppm.

d. Pitot Tube

Use an S-type Pitot tube, as described in Section 1.1 of Method 2.1, or other device approved by the Executive Officer. Attach the Pitot tube to the

probe, as shown in Figure 5.3-2, to allow constant monitoring of the stack gas velocity. If this is not practical see Chapter X, section on Flue Factor.

The impact (high pressure) opening plane of the Pitot tube must be even with or above the nozzle entry plane (see Method 2.1) during sampling. The S-type Pitot tube assembly must have a known coefficient, as determined in Method 2.1.

e. Differential Pressure Gauge

Use an inclined manometer or equivalent device, as described in Method 2.1, for stack velocity head readings, and a separate manometer for orifice differential pressure readings.

f. Impinger Train

The train consists of four Greenburg-Smith design impingers connected in series with leak-free ground glass fittings, or any similar leak-free non-contaminating fittings. The first and second impingers must be of the Greenburg-Smith design with the standard tip. The third and fourth impingers must be of the Greenburg-Smith design, modified by replacing the tip with 1.3 cm (1/2 in.) ID glass tube extending to about 1.3 cm (1/2 in.) from the bottom of the flask.

Acceptable modifications include the following: using flexible connections between the impingers, using materials other than glass, or using flexible vacuum lines to connect the probe to the impinger train.

The first and second impingers contain 100 ml of deionized water, the third is empty and the fourth contains a known weight of silica gel, or equivalent desiccant. Place a

thermometer capable of measuring temperature to within 1°C (2°F) at the outlet of the fourth impinger to monitor outlet gas temperature.

Instead of using silica gel the moisture leaving the third impinger may be measured by monitoring the temperature and pressure at the exit of the impinger train and using Dalton's law of partial pressures.

Even if one uses means other than silica gel to determine the amount of moisture leaving the impinger train, silica gel, or equivalent should be used between the impinger system and pump to prevent moisture condensation in the pump and metering devices.

g. Metering System

The metering system includes vacuum gauge, leak-free pump, thermometers capable of measuring temperature to within 3°C (5.4°F), dry gas meter

capable of measuring volume to within 2 percent, and related equipment, as shown in Figure 5.3-2. An alternative to the thermometers and dry gas meters is an equivalent temperature-compensated dry gas meter. When the metering system is used in conjunction with a Pitot tube, the system shall allow for checks of isokinetic sampling rates.

2.1.2 Barometer

A mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm (0.1 in.) Hg may be used. Alternatively, the barometric reading may be obtained from a nearby National Weather Service station. Request the station value (which is the absolute barometric pressure) and adjust for elevation difference between the NWS station and the sampling point at the rate of minus 2.5 mm (0.1 in.) Hg per 30 m (100 ft) elevation increase or plus the same adjustment for elevation decrease.

2.1.3 Temperature Determination Equipment

Use the temperature sensor described in Method 2.1. Preferably the temperature sensor should be permanently attached to the Pitot tube or sampling probe so that the tip of the sensor extends beyond the leading edge of the probe sheath and touches no metal. Alternatively, the sensor may be attached just prior to use in the field. If the temperature sensor is attached in the field, place it in an interference-free arrangement with respect to the S-type Pitot tube openings (see Method 2.1). As another alternative, if a difference of not more than 1 percent in the average velocity measurement and resulting stack flow rate calculation would be introduced, the temperature gauge need not be attached to the probe or Pitot tube.

2.1.4 Sulfuric Acid Determination Equipment

Same as Method 6.1. If the process is steady state and sulfuric acid is less

than 10 percent of the standard for the applicable rule, concurrent sampling is not required.

2.1.5 Gas Molecular Weight Determination Equipment

Same as Method 3.1. Concurrent determination is not required when the process is steady state and the molecular weight varies less than 2 percent.

2.2 Sampling Reagents

a. Filters

Glass fiber filters, without organic binder. The filters should be at least 99.95 percent efficient (≤ 0.05 percent penetration) on 0.3-micron dioctyl phthalate smoke particles. The filter efficiency test must be conducted in accordance with ASTM Standard Method D-2986-71 or use data from the supplier's quality control program. Low sodium filters are recommended when SO_2 is present.

b. Silica Gel

Indicating-type, 6 to 16 mesh. Use new silica gel as received. If previously used, dry at 175°C (350°F) for 2 hours.

c. Water

Deionized, distilled water to conform to ASTM specification D1193-77 or D1193-91, Type 3. At the option of the chemist, the KMnO_4 test for oxidizable matter may be eliminated when high concentrations of organic matter are not expected to be present. Reference to water throughout this method implies deionized, distilled water.

Run blanks prior to field use to eliminate a high blank on test samples.

d. Crushed Ice or Dry Ice Pellets

e. Stopcock Grease

Stopcock grease is not recommended and not necessary if screw-on connectors with Teflon

sleeves or similar are used. Acetone-insoluble, heat-stable silicone grease may be used. Other types of grease may be used, subject to the approval of the Executive Officer.

2.3 Pretest Determinations

Select the sampling site and the minimum number of sampling points according to Method 1.1. If it is not possible to follow Method 1.1, or more than one sample site must be tested, see Chapter X. Determine the stack pressure, temperature and the range of velocity heads using Method 2.1.

Determine the moisture content, using Method 4.1 or its alternative, to make sampling rate settings.

Determine the stack gas dry molecular weight, as described in Method 3.1. If integrated sampling (Method 3.1) is used for molecular weight determination, take the integrated bag sample throughout the total time of the particulate sample run, unless the effect on the velocity measurement and resulting stack flow rate

calculation is less than 1 percent. In that case take the integrated sample immediately before, after, or for a shorter time during the particulate sample run.

Select a nozzle size based on the range of velocity heads, so that it is not necessary to change the nozzle size to maintain isokinetic sampling rates. Do not change the nozzle size during the run. Choose the differential pressure gauge appropriate for the range of velocity heads encountered (see Method 2.1).

Select a probe length suitable for sampling all traverse points. Consider sampling large stacks from opposite sides (four sampling port holes) to reduce probe lengths.

Select a total sampling time equal to or greater than the minimum total sampling time specified in the test procedures for the specific industry. The sampling time per point must not be less than 2 minutes and the total sample volume taken (corrected to standard conditions) must not be less than 30 ft³.

To avoid timekeeping errors, the number of minutes sampled at each point should be an integer or an integer plus one-half minute. The sampling time should be the same at each point. In some circumstances, e.g. batch cycles, it may be necessary to sample for shorter times at the traverse points, resulting in smaller gas sample volumes. In these cases, test two or more cycles.

Make a projected-area model of the probe extension-filter holder assembly, with the Pitot tube face openings positioned along the centerline of the stack, as shown in Figure 5.3-1. Calculate the estimated cross-section blockage as shown. If the blockage exceeds 5 percent of the duct cross sectional area, either (1) use a suitable out-of-stack filtration method instead of in-stack filtration; or (2) use a special in-stack arrangement with separate sampling and velocity measurement sites.

2.4 Gas Volume Meter Checks

Check the meter against the -H@ orifice calibration obtained in Chapter III without the

probe, filter, and train connected. A pretest check is recommended. A post test check is mandatory.

Check calibration of the metering system by performing calibration runs at three different flow rates. Set flow rates at 0.4 CFM \pm 10 percent, 0.75 CFM \pm 10 percent, and 1.0 CFM \pm 10 percent. The calibration will be used to calculate $\Delta H@$ at these three flow rates, where $\Delta H@$ is calculated as follows:

$$\Delta H@ = 0.0319 \Delta H \frac{T_m \Theta^2}{P_{\text{bar}} (Y^2 V_m^2 A^2)}$$

where:

$\Delta H@$ = Average pressure differential across the orifice meter, in. H₂O at 0.75 scfm (528^oF, 29.92 in. Hg)

T_m = Absolute average dry gas meter temperature, ^oR

P_{bar} = Barometric pressure, in. Hg

Θ = Total sampling time, min

Y = Dry gas meter calibration factor,
dimensionless, obtained from
Chapter III

ΔH = Pressure differential across the
orifice, in. H₂O

V_m = Volume of gas sample as measured by
dry gas meter, dcf

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

A = 1, if meter is not temperature
compensated

$$= \frac{T_m}{\text{Compensated Temp. (°R)}}$$

if temperature compensated

If the measured -H@ differs by more than ± 3
percent of the actual -H@ obtained in Chapter
III, the results of the tests are voided.

Alternative procedure e.g. using an orifice meter with a known K-factor may be used, subject to the approval of the Executive Office.

2.5 Pretest Preparation

Set up the train as in Figure 5.3-2.

Mark the probe with heat-resistant tape or by some other method to denote the proper distance to insert the probe into the stack or duct for each sampling point.

Place crushed ice or dry ice pellets around the impingers.

2.6 Leak Checks

2.6.1 Pretest Leak Check

After the sampling train has been assembled, plug the inlet to the probe nozzle with a material able to withstand the stack temperature. Insert the filter holder into the stack and wait approximately 5 minutes, or longer if necessary, to allow the system to come to

equilibrium with the stack gas temperature. Turn on the pump and draw a vacuum of at least 380 mm (15 in.) Hg; a lower vacuum may be used if it is not exceeded during the test. Determine the leakage rate. A leakage rate in excess of either 4 percent of the average sampling rate or 0.00057 m³ minute (0.02 cfm), is unacceptable.

Start the pump with the bypass valve fully open and the coarse adjust valve completely closed. Partially open the coarse adjust valve and slowly close the bypass valve until the desired vacuum is reached. Do not reverse direction of bypass valve. If the desired vacuum is exceeded, either leak check at this higher vacuum or end the leak check as shown below and start over.

When the leak check is completed, slowly remove the plug from the inlet to the probe nozzle and immediately turn off the vacuum pump. This prevents water from being forced backward and keeps silica gel

from being entrained backward. Perform leak check of Pitot lines (see Method 2.1).

2.6.2 Leak Check During Sample Run

If a component change (e.g. filter assembly or impinger) becomes necessary during the sampling run, conduct a leak check immediately before the change is made. Use the pretest leak check procedure, but use a vacuum equal to or greater than the maximum value recorded up to that point in the test.

If the leakage rate is is not greater than either $0.00057 \text{ m}^3/\text{min}$ (0.02 cfm) or 4 percent of the average sampling rate, the results are acceptable, and no correction has to be applied to the total volume of dry gas metered. However, if leakage rate exceeds either of these limits, the tester must either record the leakage rate and correct the sample volume as shown in Chapter X, or void the sampling run.

Immediately after component changes, perform pretest leak check.

2.6.3 Post Test Leak Check

A leak check is mandatory at the conclusion of each sampling run. Follow the procedures outlined in Section 2.6.1, at a vacuum equal to or greater than the maximum value reached during the sampling run. Compare the leakage rate to limits indicated in Section 2.6.2 and follow the procedure described there.

2.7 Sampling Train Operation

During the sampling run, maintain an isokinetic sampling rate within 10 percent of true isokinetic. Maintain ice in the ice bath.

For each run, record the data required on the data sheet shown in Figure 5.3-3. Be sure to record the initial dry gas meter reading. Record the dry gas meter readings at the beginning and end of each sampling time increment, when changes

in flow rates are made, before and after each leak check, and when sampling is halted.

Record other data required by the sheet in Figure 5.3-3 at least once for each sample point during each time increment. Take additional readings when significant changes (20 per cent variation in velocity head readings) require adjustments in flow rate.

Level and zero the manometer and make periodic checks during the traverse, because the manometer level and zero may drift due to vibrations and temperature changes.

During the period before sampling, the nozzle can be pointed downstream. Clean the portholes prior to the test run to minimize the chance of contamination. To begin sampling, remove the nozzle cap and verify that the Pitot tube and probe extension are properly positioned.

Position the nozzle at the first traverse point and rotate the nozzle until the tip is pointing directly into the gas stream before turning on the sampling pump. Immediately start the pump and adjust the flow to isokinetic conditions.

Use calculators or nomographs to expedite adjustment of the isokinetic sampling rate.

When the stack is under significant negative pressure (height of water in impinger stem), take care to close the coarse adjust valve before inserting the probe into the stack to prevent water from backing into the filter holder. If necessary the pump may be turned on with the coarse adjust valve closed.

When the probe is in position, block off the openings around the probe and porthole to prevent unrepresentative dilution of the gas stream.

If needed, start the $\text{H}_2\text{SO}_4 \cdot 2\text{H}_2\text{O}$ sample train following procedures outlined in Method 6.1. Traverse the stack cross section, as required by Method 1.1. Be careful to avoid bumping the probe nozzle into the stack walls when sampling near the walls or when moving the probe through the portholes. This minimizes the chance of extracting stack deposits.

During the test run, add more ice to maintain a temperature less than 15°C (60°F) at the condenser/silica gel outlet. Also periodically check the level and zero of the manometer. Note and investigate any changes in stack temperature or velocity pressure over those measured during previous tests or traverses. Changes can mean failure of sampling equipment or a change in the source.

If the pressure drop of the filter becomes too high, making isokinetic sampling difficult to maintain, the filter may be replaced during a sample run. Use another complete filter assembly rather than attempt to change the filter itself. Before a new filter assembly is installed, conduct a leak check (see Section 2.6.2).

The total particulate weight includes the summation of all filter assembly catches. Use a single train for the entire sample run, except cases when sampling is required in two or more ducts or at two or more locations within the same duct, or when equipment failure necessitates a change of trains. When two or more trains are used, perform separate analyses of the front-half

and impinger catches from each train must be performed.

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 dry gas meter reading, and conduct a post test leak check as outlined in Section 2.6.3.

Also, leak check Pitot lines as described in Method 2.1. The lines must pass this leak check to validate the velocity head data. Calibrate the meter as described in Section 2.4.

2.8 Calculation of Percent Isokinetic

Calculate percent isokinetic using the equation shown in Figure 5.3-5 to determine whether the run was valid or another test run should be made.

2.9 Sample Handling

Proper clean-up procedure begins as soon as the probe is removed from the stack at the end of the sampling period.

Allow the probe to cool. When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe nozzle and place a cap over it to prevent losing or gaining particulate matter. Do not cap off the probe tip tightly while the sampling train is cooling down. This would create a vacuum in the filter holder, drawing water from the impingers into the filter.

Before moving the sample train to the clean-up site, remove the probe from the sample train, wipe off any stopcock grease, and cap the open outlets of the probe. Be careful not to lose any condensate that might be present. Remove the umbilical cord from the last impinger and cap the impinger. If a flexible line is used between the first impinger and the probe, disconnect the line at the probe and let any condensed water or liquid drain into the impingers or condenser. After wiping off any stopcock grease, cap off the probe outlet and impinger inlet. Either ground-glass stoppers, plastic caps, or serum caps may be used to close these openings.

Transfer the probe, filter, and impinger assembly to the clean-up area. This area should be clean

and protected from the wind to reduce chances of contaminating or losing the sample. It is recommended that sample recovery be performed in a controlled laboratory environment.

2.10 Calibrations

See Chapter III.

METHOD 5.3

DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES USING AN IN-STACK FILTER

Section 3 of 4

3. Laboratory Procedures

3.1 Apparatus

3.1.1 Sampling Train

See Section 2.1.

3.1.2 Sample Recovery

See Method 5.1, Section 3.1.2.

3.1.3 Analysis of Particulate Matter

See Method 5.1, Section 3.1.3.

3.1.4 Acid and Sulfate Analysis

See Method 5.1, Section 3.1.4.

3.2 Reagents

See Method 5.1, Section 3.2.

3.3 Pretest Preparation

See Method 5.1, Section 3.3.

3.4 Preparation of Sample Collection Train

Assemble the train as shown in Figure 5.2-1. Follow the loading and connection procedures found in Method 5.1, Section 3.3.

3.5 Leak Check

The sample collection train may be leak checked in the laboratory after assembly following the procedures found in Section 2.5.

3.6 Sample Recovery

Recover the sample in three fractions: filter, prefilter, and post-filter.

3.6.1 Prefilter Fraction

This includes the nozzle and front half of the filter holder. Recover this fraction using the procedures outlined in Section 3.6.2, Method 5.1.

3.6.2 Filter Fraction

Recover the filter using the procedures outlined in Section 3.6.1, Method 5.1.

3.6.3 Post-Filter

This consists of the back half of the filter holder, the probe, first three impingers and any connectors. Measure the moisture gain using Method 4.1, and recover this fraction using the procedures outlined in Section 3.6.2 and 3.6.3, Method 5.1.

3.7 Sample Analysis

The three fractions are analyzed separately using procedures outlined in Section, 3.7, Method 5.1.

3.7.1 Prefilter

Analyze the prefilter fraction for total residue weight, acid content and, sulfate content. Organic extraction is not performed on this fraction because organic compounds do not normally deposit on heated train components.

3.7.2 Filter

Weigh the filter to constant weight and analyze for acid and sulfate if necessary.

3.7.3 Post-Filter

Analyze the post-filter catch for organic residue (if required), aqueous or total residue, acid and sulfate.

NOTE: This fraction represents "condensable" particulates i.e. compounds which condense at ambient conditions and

particulates <0.3 microns in diameter.
Filtration for insolubles is not normally required before organic extraction, since the up-filter catches most insoluble particulates.

3.8 Calculations and Reporting

Calculations are carried out as in Method 5.1.

Results are reported as follows:

Total Impinger Volume, ml (g)

Impinger Gain, ml (g)

Silica Gel Gain, ml (g)

Pre-Filter Recovered Volume, ml (g)

Residue, mg

Acid, as $H_2SO_4 \cdot 2H_2O$, mg

Sulfate, as $H_2SO_4 \cdot 2H_2O$, mg

Filter Catch, mg

Acid, as $H_2SO_4 \cdot 2H_2O$, mg

Sulfate, as $H_2SO_4 \cdot 2H_2O$, mg

Post-Filter Recovered Volume, ml (g)

Organic Residue, mg

Aqueous (or Total) Residue, mg

Acid, as $H_2SO_4 \cdot 2H_2O$, mg

Sulfate, as $H_2SO_4 \cdot 2H_2O$, mg

3.9 Calibrations

See Method 5.1, Section 3.9

METHOD 5.3

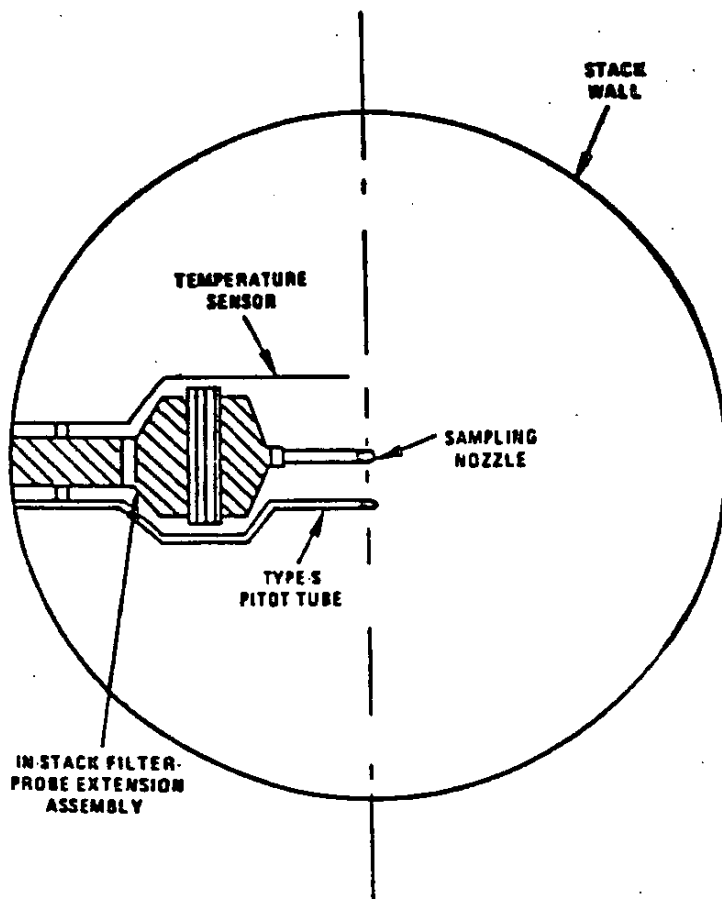
DETERMINATION OF PARTICULATE MATTER EMISSIONS FROM STATIONARY SOURCES USING AN IN-STACK FILTER

Section 4 of 4

4. Engineering Calculations and Reporting

4.1 Calculations

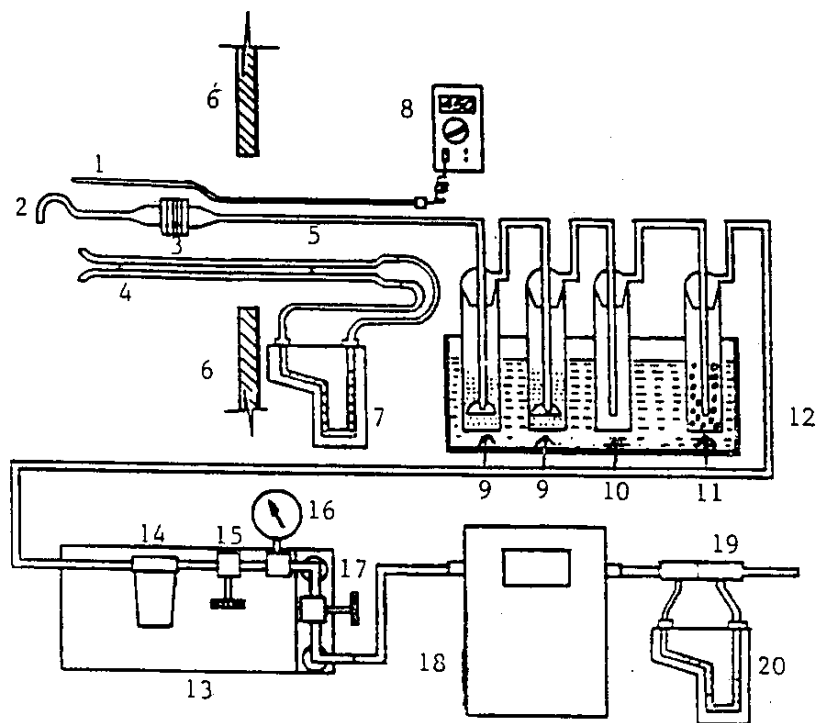
Carry out calculations, retaining at least one decimal figure more than that of the acquired data. Round off figures after the final calculation. Other forms of the equations may be used as long as they give equivalent results. See Figures 5.3-4 and 5.3-5



$$\text{ESTIMATED BLOCKAGE (\%)} = \left[\frac{\text{SHADED AREA}}{\text{DUCT AREA}} \right] \times 100$$

Figure 5.3-1

Projected Area Model of Cross-Section Blockage (Approximate Average for a Sample Traverse) Caused by an In-Stack Filter Holder-Probe Extension Assembly.



- | | |
|--|--|
| 1. Temperature Sensor | 11. Bubbler with Silica Gel |
| 2. Nozzle | 12. Ice Bath |
| 3. In Stack Filter | 13. Sealed Pump (Leak Free) |
| 4. S-type Pitot Tube | 14. Filter for Pump |
| 5. Probe Extension | 15. Metering Valve |
| 6. Stack Wall | 16. Vacuum Gauge |
| 7. Pitot Tube Inclined Manometer | 17. By-pass Valve |
| 8. Temperature Sensor Meter | 18. Temperature Compensated
Dry Gas Meter |
| 9. Impinger with 100 ml H ₂ O | 19. Orifice |
| 10. Empty Bubbler | 20. Orifice Inclined Manometer |

Figure 5.3-2

Particulate Sampling Train Setup with Instack Filter

CALCULATION SHEET

PAGES	PAGE
TEST NO.	DATE
PROCESSED BY	CHECKED BY

LAB ANALYSIS

A. Filter Catch	_____	mg
B. (1) Filter Acid	_____	mg
(2) Filter Total Sulfate	_____	mg
C. Probe Catch	_____	mg
D. (1) Probe Acid	_____	mg
(2) Probe Total Sulfate	_____	mg
E. Impinger Catch	_____	mg
F. (1) Impinger Acid	_____	mg
(2) Impinger Total Sulfate	_____	mg
G. Organic Extract	_____	mg
H. H ₂ SO ₄ .2H ₂ O from SO _x Train Thimble	_____	mg
I. Particulate Train Corrected Gas Volume Metered	_____	dscf
J. SO _x Train Corrected Gas Volume Metered	_____	dscf
K. Prorated H ₂ SO ₄ .2H ₂ O Mass ($\frac{H \times I}{J}$)	_____	mg

FILTER (PARTICULATE) TEMPERATURE GREATER THAN 200°F

L. Total Particulate (A-B*+C-D*+E-F*+G+K)	_____	mg
M. Solid Particulate (L-G-K)	_____	mg
N. Total Particulate (Corrected for Ammonium Sulfate)		
(A-B*+C-D*+E-F(1)+G+K-[F(2)-(1)] $\cdot \frac{132}{134}$)	_____	mg
O. Solid Particulate (Corrected for Ammonium Sulfate)		
(N-G-J)	_____	mg

FILTER TEMPERATURE LESS THAN 200°F

P. Total Particulate (A+C+E-F*+G)	_____	mg
Q. Solid Particulate (P-B*-D*-G)	_____	mg
R. Total Particulate (Corrected for Ammonium Sulfate)		
(A+C+E-F(1)+G-[F(2)-F(1)] $\cdot \frac{132}{134}$)	_____	mg
S. Solid Particulate (Corrected for Ammonium Sulfate)		
(R-B*-D*-G)	_____	mg

* USE LOWER OF (1) AND (2)

Figure 5.3-4
Calculation Sheet

