SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT

METHOD 2.2

DIRECT MEASUREMENT OF GAS VOLUME THROUGH PIPES AND SMALL DUCTS

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1. Overview

1.1 Principle

A gas volume meter measures gas volume directly. Temperature and pressure measurements are made to correct the volume to standard conditions. Method 4.1 is used to correct the volume to dry conditions.

1.2 Applicability

This method applies to the measurement of gas flow rate in pipes and small ducts, either in-line or at exhaust positions, within the temperature range of 0 to 50°C (32 to 120°F).

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2. Field Procedures

2.1 Apparatus

Specifications are described below. Another apparatus that has been demonstrated to be capable of meeting the specifications will be considered acceptable, subject to the approval of the Executive Officer.

a. Gas Volume Meter

Use a positive displacement meter, turbine meter, or other direct volume measuring device capable of measuring volume to within 2 percent. The meter must be equipped with a temperature gauge accurate to ± 2 percent of the minimum absolute temperature and a pressure gauge accurate to ± 2.5 mm Hg.

The manufacturer's stated accurate flow range of the meter must fit the expected maximum and minimum flow rates encountered at sampling conditions. Consider gas temperature, pressure, corrosive characteristics, and pipe size when choosing a suitable gas meter.

b. Barometer

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

c. Temperature Gauge

Use a thermocouple, liquid-filled bulb thermometer, bimetallic thermometer, mercury-in-glass thermometer, or other device capable of measuring temperature to within 1.5 percent of the minimum absolute temperature.

d. Stopwatch

Use a stopwatch capable of measurement to within 1 second.

2.2 Installation

Since volume measurements are made in various types of pipes and small ducts, it is not possible to describe all installation schemes. In general, use flange fittings for all connections and install gaskets or other seal materials to assure leak-tight connections. Locate the volume meter to avoid severe vibrations and other factors that may affect meter calibration.

2.3 Leak Test

A volume meter installed at a location under positive pressure may be leak checked by applying a liquid leak detector solution to the connections. The formation of bubbles indicates a leak that must be corrected.

A volume meter installed at a location under negative pressure may be tested by blocking flow at the inlet of the line and watching for meter movement. If this procedure is not possible, visually check all connections and assure tight seals.

2.4 Volume Measurement

For sources with continuous, steady emission flow rates, record the initial meter volume reading, meter temperature(s), and meter pressure. Then start the stopwatch. Throughout the test period, record the meter temperature(s) and meter pressure so average values can be determined. At the end of the test, stop the timer and record the elapsed time, the final volume reading, meter temperature(s), and pressure. Record the

barometric pressure at the beginning and end of the test run. Record the data on a table similar to Figure 2.2-1.

For sources with non-continuous, non-steady emission flow rates, use the same procedure but record all the meter parameters and the start and stop times corresponding to each process cycle or non-continuous event. If reverse flow occurs, corrections to the total exhaust flow must be made.

2.5 Calibrations

Refer to Chapter III.

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3. Calculations

Perform calculations, recording values to at least one decimal place more than that of the acquired data. Round off the final results.

Nomenclature

P_{bar} = Barometric pressure, mm (in.) Hg

P_m = Average static pressure in volume meter, in. Hg

Q_s = Gas flow rate, ft^3/min, standard conditions

T_m = Average absolute meter temperature, ^oR

V_m = Meter volume reading, ft^3 (Add back reverse flow)

Y_m = Average meter calibration coefficient, dimensionless

V_{mf} = Final meter reading for test period

V_{mi} = Initial meter reading for test period

V_{ms} = Standard conditions, 60^oF and 29.92 in. Hg

θ = Elapsed test period time, min

Volume

$$V_{ms} = (0.3853)(Y_m)(V_{mf} - V_{mi})\left(\frac{P_{bar} + P_m}{T_m}\right) \text{ Metric units}$$

$$(17.38)(Ym)(Vmf - Vmi)\left(\frac{P_{bar} + P_m}{T_m}\right) \text{ English units}$$

$$Q_s = \frac{V_{ms}}{\theta}$$

To find dry standard volume multiply Q_s by

$$\frac{100 - \text{Moisture Percent}}{100}$$

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Test No._____ Date_____

Sampling Location_____

Pretest Leak Check _____ Post Test Leak Check _____

Barometric Pressure _____

Time On	Time Off	Meter Reading (ft^3)	Meter Temperature (^oF)	Meter Pressure (in. Hg)	Comments
Total Time					

Figure 2.2-1

Meter Data Sheet