&EPA

OFFICE OF AIR QUALITY PLANNING AND STANDARDS (OAQPS)

FABRIC FILTER

BAG LEAK DETECTION GUIDANCE

FABRIC FILTER BAG LEAK DETECTION GUIDANCE

September 1997

FABRIC FILTER BAG LEAK DETECTION GUIDANCE

Prepared for:

U. S. Environmental Protection Agency
Office of Air Quality Planning and Standards
Emissions, Monitoring and Analysis Division
Emission Measurement Center (MD-19)
Research Triangle Park, NC 27711

Attn. Mr. Daniel Bivins

Prepared by:

Midwest Research Institute
Suite 100
5520 Dillard Road
Cary, NC 27511

September 1997

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLE

vi

FABRIC FILTER BAG LEAK DETECTION GUIDANCE

This document provides guidance on the use of triboelectric monitors as fabric filter bag leak detectors. It does not impose regulatory requirements. The guidance addresses only one suggested approach to the use of bag leak detectors. However, proper setup and operation of a bag leak detector can vary with site-specific conditions and those conditions may dictate variances from the approach suggested in this guidance.

This document includes fabric filter and monitoring system descriptions; guidance on monitor selection, installation, set up, adjustment, and operation; and quality assurance procedures. The monitoring system description and information on monitor selection and installation was taken primarily from information received from one instrument vendor.[1] The monitor set up procedure in this guidance was developed based on testing conducted on shaker and pulse-jet baghouses; however, the guidance is expected to apply to reverse-air baghouses as well.[2,3]

1.0 APPLICABILITY

Several types of instruments are available to monitor changes in particulate emission rates for the purpose of detecting fabric filter bag leaks or similar failures. The principles of operation of these instruments include electrical charge transfer and light scattering. This guidance applies to charge transfer monitors that use triboelectricity to detect changes in particle mass loading. Charge transfer monitors based on electrostatic induction are also potentially applicable, but sufficient information was not available to include them in this guidance.

The set up procedures described in this guidance are intended to allow the operator to identify upset conditions within the baghouse (e.g., torn bags) using real time data. This guidance is not intended to evaluate changes in the long term performance of the baghouse system, nor does it apply to applications in which the monitoring system attempts to quantify emission rates. The guidance assumes an emission source with relatively constant exhaust gas flow rate and particulate matter (PM) characteristics. This guidance is not appropriate for applications in which these factors vary significantly. In addition, only fabric filters (both positive and negative pressure) with exhaust gas stacks are covered by this guidance.

2.0 EMISSION SOURCE AND CONTROL DEVICE DESCRIPTIONS

This section contains information on the different types of fabric filters and the types of emission sources they are used to control. Information on fabric filter types and fabric filter operation was taken from References 4 and 5.

2.1 FABRIC FILTERS

Fabric filters are one of the most widely used devices for controlling emissions of PM. A fabric filter system typically consists of multiple filter elements, or bags, enclosed in a compartment, or housing. The process stream

1

typically enters the housing and passes through the filter elements, and PM accumulates as a dust cake on the surface of the bag. This dust layer becomes the effective filter medium. The filter elements are cleaned periodically to remove the collected dust. A short-duration spike in particulate emissions occurs immediately following cleaning due to the loss of the dust cake.

Fabric filters generally are classified by cleaning method. The four types of cleaning methods are reverse-air, shaker, pulse-jet, and sonic cleaning. Reverse-air fabric filters are cleaned by back-flushing the filters with low pressure air flow, which is provided by a separate fan. Figure 1 depicts the reverse-air cleaning method. In shaker-type systems (Figure 2), a reciprocating motion is mechanically applied to knock the filter cake off the bags. Pulse-jet fabric filters use high-pressure compressed air, which creates a shock wave that travels along the bag, thereby loosening accumulated dust from the filter material (see Figure 3). Sonic cleaning employs a sonic horn to induce acoustic vibrations in the fabric. This method generally is used to enhance shaker and reverse-air cleaning systems.

Fabric filters also can be can be classified as either positive- or negative-pressure designs, depending upon the location of the fan(s) that provides the motive force for the exhaust stream through the unit. The fan is located upstream of the filter housing in a positive-pressure (forced-draft) unit, and downstream of the filter housing in a negative-pressure (induced-draft) unit. Positive-pressure baghouses require no ductwork or exhaust stack downstream of the unit, making bag leak detection more difficult. As such, this guidance does not apply to positive pressure baghouses without exhaust ductwork or an exhaust gas stack.

Fabric filters are capable of extremely high control efficiencies of both coarse and fine particles; outlet concentrations as low as 20 mg/dscm (0.01 gr/dscf) can be achieved with most
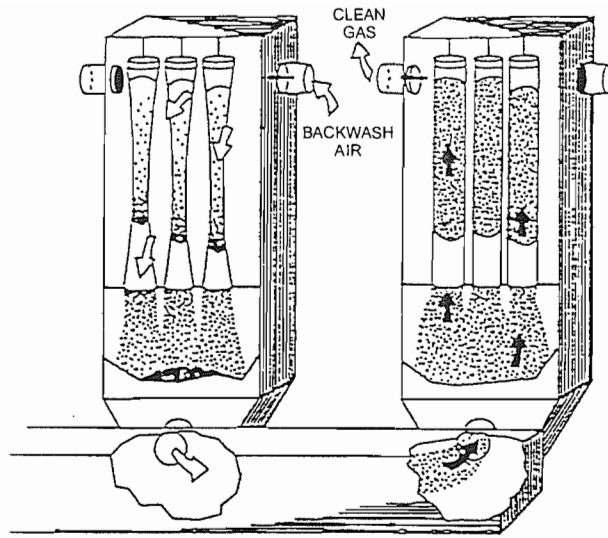
Figure 1. Reverse-air cleaning method.[4]
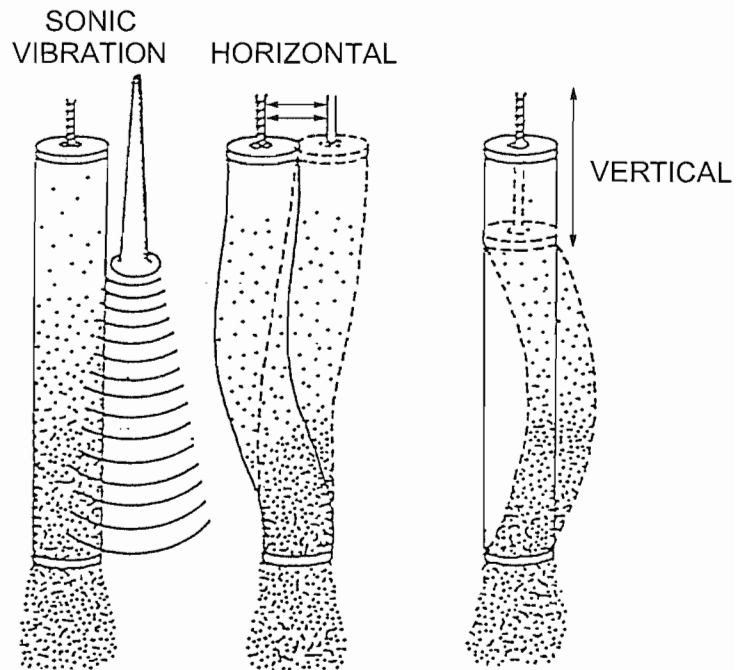
Figure 2. Shaker-type cleaning method.[4]
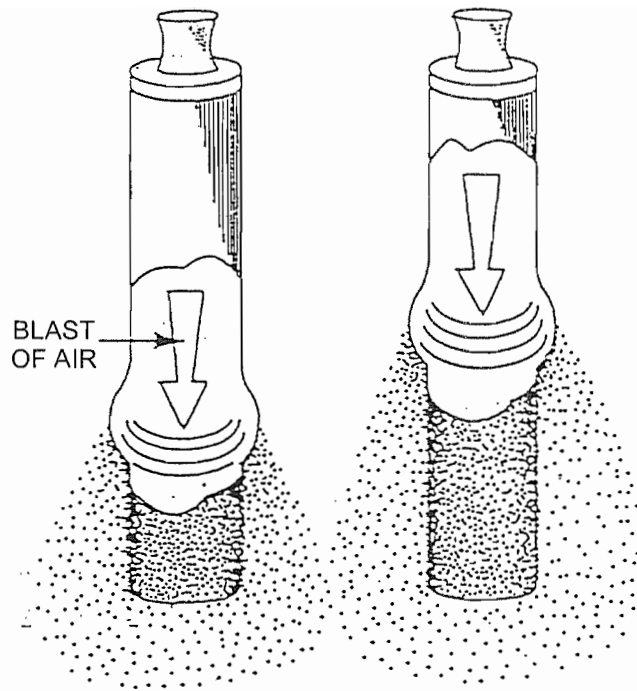
Figure 3. Pulse-jet cleaning method.[4]

fabric filter systems. Fabric filters are not suitable for use if the emission stream contains hygroscopic materials, a high moisture content, or sticky substances; clogging (blinding) of the filter media can occur in these conditions. Gas stream temperatures in excess of approximately 288°C (550°F) must first be cooled, unless special ceramic or refractory fiber bags are used. Either of these modifications can add significantly to the cost of the control system. In addition, fabric filters generally are not preferred for use on highly corrosive exhaust streams or to remove high levels of soluble gases from exhaust streams. Charge transfer monitors are particularly suited to the same type of applications that use fabric filters for control of particulate emissions.

2.2 EMISSION SOURCES

Fabric filters are used in a wide variety of industrial applications for which efficient removal of PM from relatively dry exhaust streams is desired. In the mineral product industries, fabric filters are commonly used for emission control and product recovery for milling operations such as crushing, grinding, and screening. Fabric filters also are the preferred control device for mineral product pyroprocesses such as cement and lime kilns. In the metallurgical industries, fabric filters are often used to control emissions from furnaces and boilers. Table 1 lists some of

4

TABLE 1. COMMON INDUSTRIAL APPLICATIONS FOR FABRIC FILTERS

Industry	Sources
Steel	Electric arc furnaces[a] Sintering plants[a] Boilers[a]
Foundries	Cupolas[a]
Nonferrous metals	Lead furnaces[a] Copper smelting furnaces[a] Zinc furnaces[a]
Grain handling	Cleaning operations Grinding mills Mixers and blenders Material transfer
Mineral processing	Crushers Grinding mills Screening operations Air classifiers Dryers Kilns[a] Calciners[a]
Cement	Raw mills Kilns[a] Finish mills
Asphalt concrete	Drum mixers
Glass	Melting furnaces[a]
Chemical	Dryers Grinding mills
Power plants	Coal-fired boilers[a]
Waste disposal	Incinerators[a]

[a]Cooling of the gas stream or use of refractory fiber bags may be required.

the more common industrial applications for fabric filters. Fabric filters generally are not used with sources characterized by moist and/or sticky exhaust streams, such as those from wood product dryers.

3.0 MONITORING SYSTEM DESCRIPTION

Triboelectric monitoring systems typically consist of one or more in-stack probes, a cable from the sensor assembly to the main instrument box, and signal-processing electronics housed in the main box. An example monitoring system is shown in Figure 4.

5
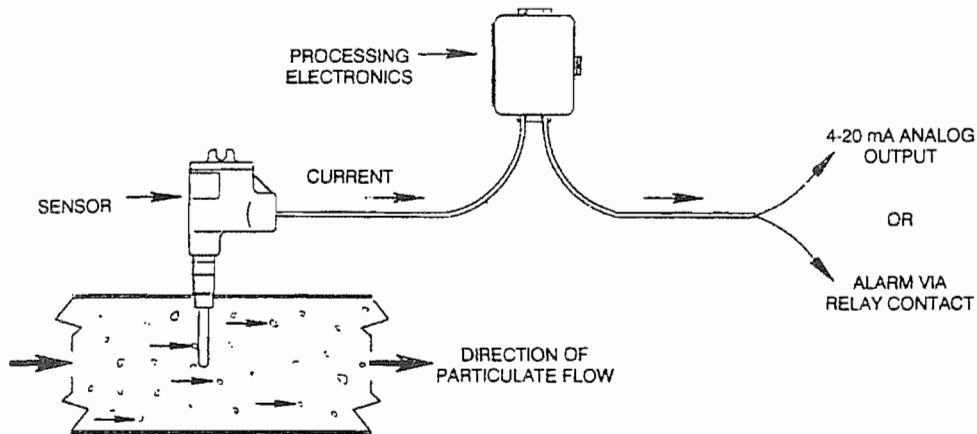
Figure 4. Monitoring system schematic.[1]

The following sections describe the principles of operation of triboelectric monitoring systems, factors that affect the performance of these systems, and signal monitoring and alarms.

3.1 PRINCIPLE OF OPERATION

When two solids come into contact, an electrical charge is transferred between the two bodies. This charge transfer is known as the triboelectric principle, or contact electrification. As particles in a gas stream collide with a sensor placed in the stream, the charge transfer generates a current that can be measured using triboelectric monitoring equipment. The current signal produced by the triboelectric effect is generally proportional to the particulate mass flow, though it can be affected by a number of factors as described below. The current, which can be as low as 10^{-13} amperes, is amplified and transmitted to the processing electronics. The processing electronics are tuned to the specific installation and configured to produce a continuous analog output (i.e., 4-20 mA signal) and/or an alarm at a specific signal level.

All fabric filter bags allow some amount of PM to pass through; this constant bleedthrough is used to establish a baseline signal. The monitoring system detects gradual or instantaneous increases in the signal from the baseline level. According to vendor literature (see Reference 1), triboelectric monitoring systems have been shown to detect baseline emissions as low as 0.1 mg/dscm (0.00005 gr/dscf).

6

3.2 FACTORS THAT AFFECT TRIBOELECTRIC MONITOR PERFORMANCE

The effects of various PM and gas stream parameters on the triboelectric signal are discussed below. The discussion is based on information obtained primarily from one vendor of triboelectric monitors.

3.2.1 Composition of PM and Probe

The materials that compose the triboelectric probe and the PM in the gas stream have direct bearing on the triboelectric signal generated. The farther apart the probe and PM materials are on the triboelectric table, the greater the charge generated by their contact. Generally, contact between a good electrical conductor and a good insulator produces the greatest signal. With the standard stainless steel triboelectric probe (a good conductor), a stronger signal is generated by PM composed of insulating materials than by metallic PM.

3.2.2 Velocity

The greater the velocity of a given particle, the greater the signal generated. Depending on the materials involved, the relationship of signal to velocity ranges from linear to exponential. Observed exponents have ranged up to a power of 2 (i.e., triboelectric signal increases with the square of velocity). Thus, the signal output can be very sensitive to changes in gas stream flow rate.

3.2.3 Particle Size

All other factors being equal, the triboelectric signal per unit mass is greater for smaller particles. Small particles have a greater surface area per unit mass of material, allowing for more efficient charge transfer. Thus, up to a point, the triboelectric monitor is more sensitive to small particles. However, at some point in the submicron range, particles no longer strike the probe because they lack sufficient momentum to break out of the gas stream as it flows around the probe. The aerodynamic diameter at which this phenomenon occurs varies with the material; denser materials are detected at smaller sizes than less dense materials.

3.2.4 Charge

Charged particles generate a signal independent of the triboelectric effect when they strike the triboelectric probe. As a result, the instrument is more sensitive to charged particles than to particles without charge. Conditions that cause variations in the charge on the PM will result in variable sensitivity.

3.2.5 Accumulation of PM on the Probe

When material accumulates on the surface of the probe, the sensitivity of the triboelectric monitor may be reduced. Harder materials tend to accumulate slowly, if at all, while softer, stickier materials accumulate more rapidly. Accumulation of conductive PM on the probe can also cause an electrical bridge between the probe and ground, generating a large signal.

7

3.2.6 Particle Shape

Particle shape is likely to have some effect on triboelectric signal because, as discussed above for particle size, shapes with greater surface area per unit mass are expected to generate a greater signal than those with a lower surface-to-mass ratio. No data, however, are available to quantify what effect, if any, particle shape has on the signal.

3.2.7 Temperature

Gas stream temperature has no direct effect on the signal as long as the temperature remains above the dew point and below about 1100°F. The triboelectric current generated in the probe is so small that the resistance of the probe is insignificant, making temperature-induced variation in the conductivity of the probe insignificant. If the temperature drops below the dew point, water droplets generate a signal in addition to the PM signal. In addition, liquid water on the probe causes PM to accumulate. Above about 1100°F, the standard stainless steel probe begins to generate electrons, interfering with the triboelectric signal; this effect increases as temperature increases.

If gas stream temperature affects the nature of the PM, indirect effects on triboelectric signal may occur. For example, temperature effects on the chemical composition or particle size of the PM would be expected to result in variations in triboelectric signal. Changes in the gas stream temperature could also indicate a change in process conditions that could have an effect on PM characteristics.

Any affect of ambient temperature on the electronic components of the instrument can be compensated for automatically.

3.2.8 Relative Humidity

No direct gas stream humidity effects have been observed as long as the temperatures of the exhaust gas is above the dew point. If the temperature of the gas stream prior to the monitor drops below the dew point, condensation may occur and cause false alarms. Indirect effects are possible when the PM is hygroscopic or the PM characteristics are otherwise sensitive to humidity.

3.3 SIGNAL MONITORING AND ALARMS

Triboelectric monitors include on/off (switch type) and analog designs. These designs differ in the output signal generated by the electronics. On/off systems operate only with an alarm relay output that is activated at a pre-set level to indicate a high emission level. Analog systems operate with a continuous 4 to 20 mA signal that corresponds directly to the relative particulate emission level. Analog systems usually also include one or more alarm relays. The simplest analog monitor has an analog gauge with a needle indicating the current signal (percent of scale) and an on/off relay that is tripped when the input signal reaches the level set by the user. Other monitors may include analog output signals and gauges, low and high alarms, digital readouts, internal diagnostics, and quality assurance functions. Analog systems are

recommended over on/off systems, so baghouse activity (baseline signal and cleaning peaks) may be tracked visually and recorded.

4.0 SYSTEM MATERIAL SELECTION AND PROBE LOCATION

The following sections provide guidance on sensor material selection, probe location, and signal processing electronics.

4.1 SENSOR ASSEMBLY MATERIAL SELECTION

The materials for the probe and insulator should be selected based on the service environment, and selections should be approved by the manufacturer. Material selection for the insulator is especially important. The insulator is positioned between the probe and the housing to electrically isolate the probe, and this isolation must be maintained to assure valid signal transmission. If PM accumulates on the probe sufficiently to bridge over the insulator to the housing, the current will flow from the housing to the probe, generating false alarms.

Several materials of construction are available for sensors. Probes are often made from stainless steel for standard applications. Other mateirals that may be used are tungsten carbide for abrasive applications or Inconel for corrosive applications. Insulators may be made from Teflon (e.g., for abrasive, noncorrosive applications), high-performance polymers (e.g., for moist gas streams), or ceramics (e.g., for high temperature and/or pressure applications). Air purge can be used to minimize the buildup of particulate matter on the insulator.

4.2 SENSOR LOCATION

The sensor, or probe, is designed to be mounted directly on the ductwork downstream of the fabric filter housing. Where practicable, the probe should be installed so that it extends at least halfway across the duct cross-sectional area. The maximum probe length may be limited (for example, 36 inches). For large ducts (greater than 72 inches), multiple sensors can be installed and electrically connected in parallel. The insulator sleeve should be flush with, or protrude slightly from, the inner duct wall; it should not be recessed within the duct wall.

The probe should be located, where practicable, in a length of straight duct, a minimum of 2 duct diameters downstream and one-half duct diameter upstream from any flow disturbance, such as a bend, expansion, or contraction in the stack or duct. A velocity traverse is recommended, in order to insure the probe is sited in a location that has similar flow characteristics to the overall exhaust gas stream. In nonmetallic ducts, an electrostatic (Faraday) shield should surround the duct and be electrically connected to the probe along with an earth ground to isolate the signal from stray electrical fields. It is important that the probe is well grounded. In addition, the probe should not be installed in a location that experiences excessive vibration or is in close proximity to a high voltage or current source.

To avoid potential build-up of particles around the probe, it should not be installed at the bottom of horizontal ducts or pipes. The location should allow ready access for maintenance and allow for removal of the sensor from the duct for inspection and cleaning. An example installation location for a negative-pressure fabric filter application is shown in Figure 5.

4.3 SIGNAL PROCESSING ELECTRONICS

The signal processing electronics can be connected directly to the sensor assembly or located at a distance using coaxial cable. The electronics should not be exposed to temperatures outside the range specified by manufacturers. The electronics should be protected from excessive vibration and physical damage and accessible for maintenance. The display should be visible to the operator.

5.0 MONITORING SYSTEM OPERATION

The following sections provide guidance on monitor set up (sensitivity, response time, and alarm levels) and operation. Methods for checking system response and drift are also included.
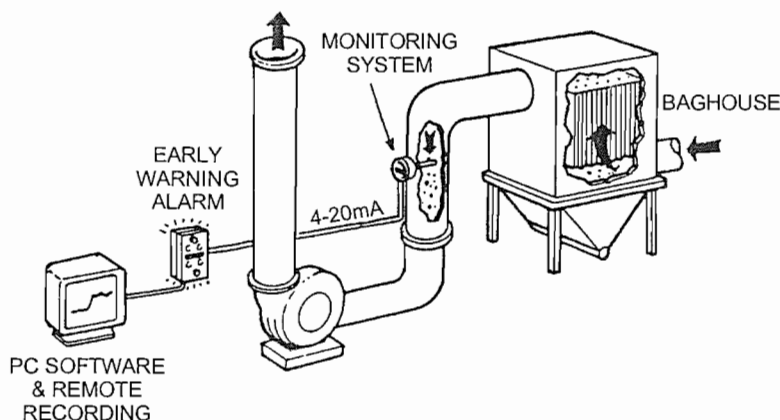
Figure 5. Installation location for a negative-pressure fabric filter application.

5.1 APPROACH TO MONITOR SET UP

After installation, the sensitivity and response time of the signal processing system are adjusted to establish signal levels for baseline operation and alarms. Sensitivity is the amplification, or gain, of the system, and this adjustment is used to establish the baseline signal level as a percent of the system full-scale (for analog systems). The scale is simply a relativescale from 0 to 100 percent, and the relationship of the signal to the particulate mass emission rate is linear. The selected baseline level determines the full scale level.

10

Increasing the sensitivity decreases the range to be measured; decreasing the sensitivity increases the range to be measured. For example, if the sensitivity is set so that baseline emissions are at 2 percent of scale, 100 percent of scale corresponds to an emission rate of 50 times baseline. However, if the sensitivity is set so that baseline is at 10 percent, full scale is only 10 times the baseline emission rate. Figure 6 illustrates these effects of sensitivity adjustments.

Decreasing the sensitivity to lower the baseline level results in smaller scale reading changes for a given change in the input signal level, which reduces the system's ability to detect small changes in PM levels (e.g., changes due to small bag leaks). A better approach is to use a short response time, discussed below, to smooth the cleaning peaks. Conversely, increasing the sensitivity to raise the baseline setting results in larger scale reading changes for a given change
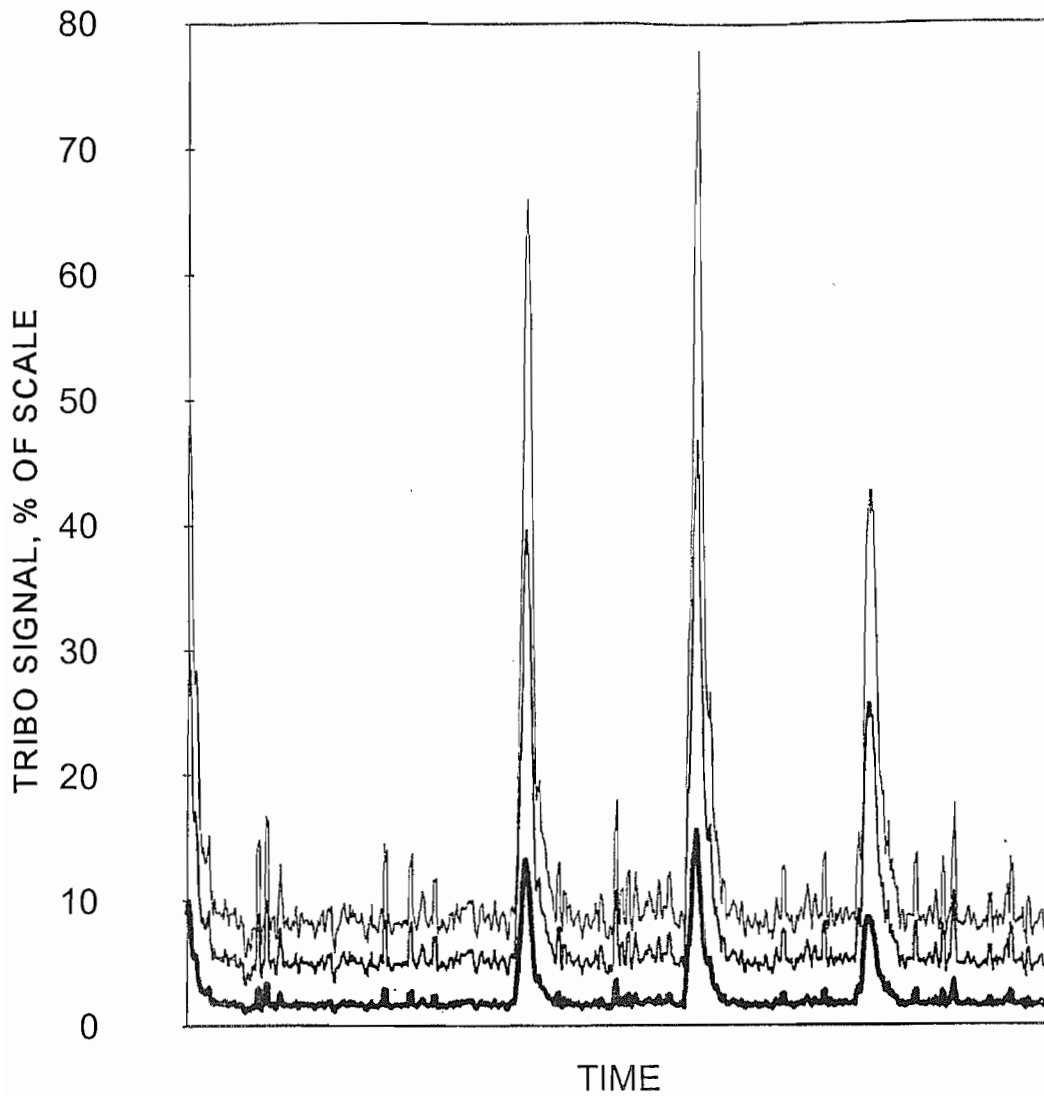
Figure 6. Effects of sensitivity adjustment.

12

in input signal level, which can result in nuisance alarms from small changes in PM levels (e.g., from emission spikes associated with normal cleaning cycles) or cause the cleaning cycle spikes to exceed the scale of the instrument. The sensitivity is typically set so that normal baseline PM loading is at some level near the bottom of the scale, usually less than 10 percent.

With a baseline greater than 10 percent, moderate to high cleaning peaks may leave no room for an adequately high broken bag alarm on scale. Sensitivity is best set so a typical cleaning peak reaches around 30 percent of scale, leaving plenty of room for an broken bag alarm as a multiple of the typical cleaning peak height, while still allowing medium and high cleaning peaks to stay within the scale of the graph.

Response time has a smoothing effect on the output signal by allowing the system to average the signal over a small period of time, thus lessening the effects of a momentary high signal. On a chart recording of the output, a longer response time results in lower, broader peaks, while a shorter response time results in taller, narrower peaks. In either case, the area under the curve is identical, and adjusting the response time does not alter the indicated emissions levels.

The shortest response time setting shows the sharp peaks associated with the filter bag cleaning cycle, and the signal can be used to identify the row or compartment of bags that may require maintenance. However, false alarms may result from momentary high signals that do not correspond to cleaning cycle peaks. Increasing the response time from the minimum setting results in a dampening of momentary high signal spikes and smooths cleaning cycle peaks. Long-term trending of bag wear and overall emissions increases is best monitored by using a long response time; however, a response time of 5 to 10 seconds is typically recommended by the manufacturer for most filter types because it smooths momentary high signal spikes while still providing a good representation of baghouse cleaning cycle activity.

Based on data analyzed by the EPA, a response time of 5 seconds typically serves to smooth the baseline and dampen momentary high signals not associated with a cleaning cycle peak, but still provides an accurate depiction of the baghouse activity. Figure 7 depicts a typical cleaning peak at 1, 5, 10, and 15 seconds of response time. At a 1 second response time, the signal is very jagged. At 5 seconds, it is smoothed out well, without overly dampening the cleaning

peak. The response time of 15 seconds provides the most smoothing, but decreases the height of this particular cleaning peak from around 20 percent of scale to approximately
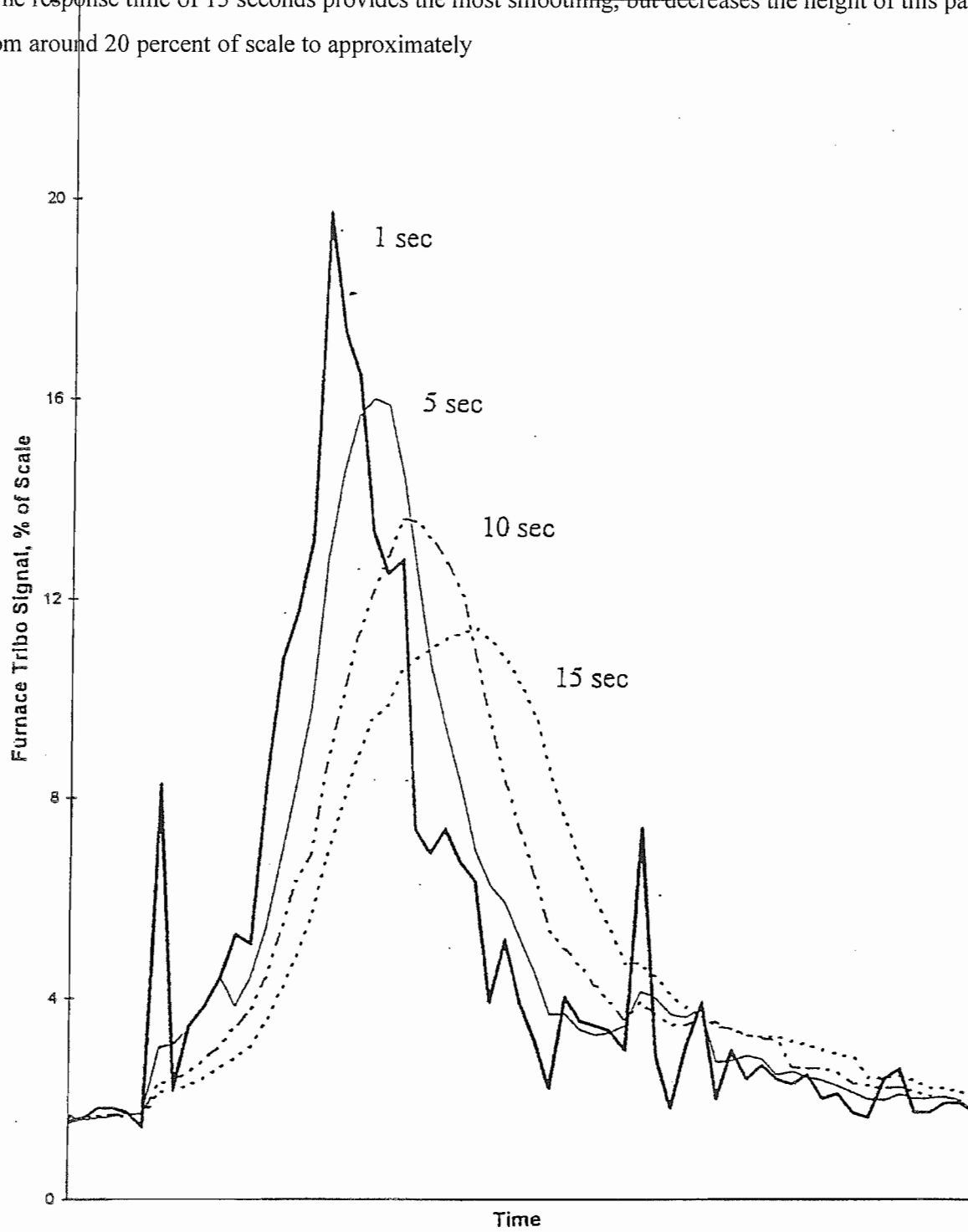
Figure 7. Effect of response time on a typical baghouse cleaning peak.

11 percent of scale. A long response time, such as 15 seconds, may permit a ruptured bag to go unnoticed for a longer time, while the 5 and 10 second response times prevent false alarms by dampening momentary high spikes very well and only slightly decreasing the height of the cleaning peak.

Some instruments can be set to incorporate a delay time. When a delay time is used, the monitor does not indicate an alarm until some set time after an emission increase is detected. The alarm is only activated when the signal remains above the alarm level for the full delay period.

5.2 MONITOR SET UP PROCEDURES

The following procedures provide a recommended set up when applicable to a given site. Changes to these procedures or alternate procedures may be necessary to address site-specific conditions.

The baseline level is established as a percentage of output scale by adjusting the sensitivity and response time of the output signal from the sensor assembly. The alarm level is then set based on the baseline emission level and/or cleaning cycle peaks. Operating characteristics vary for each baghouse, and these settings are unique to each installation. The general procedures for setting the baseline and alarm levels for analog systems are given below. The procedures for on/off systems are similar.

The general procedures for setting the baseline and alarm levels for analog type systems are as follows:

1. Ensure that the process is operating normally with air and particulate flow past the probe and that the fabric filter system is in good repair (filter bags in good condition, pressure drop normal, etc.).

2. Set the response time to minimum, and delay time to zero.

3. Adjust the sensitivity setting until the baseline emissions are 5-10 percent of scale and typical spikes during filter bag cleaning are below 50 percent of scale.

4. Increase the response time so that the baseline signal is smoothed and momentary high signals are damped, but the cleaning peaks can still be seen; a response time of 5-10 seconds is recommended.

5. Set the alarm level at 2 times the maximum height of a typical cleaning spike for bag leak detection. (For example, if the maximum height of a typical cleaning cycle peak is 30 percent of scale, the alarm level should be set to 60 percent of scale.) If there are no discernable cleaning peaks, the alarm level may be set as a multiple of the baseline, such as three times the baseline.

Some triboelectric monitors have the capability for dual alarm levels. One level may be set as a multiple of the cleaning peak height with no delay time to detect broken bags, and a second level may be set as a multiple of baseline emissions with a delay time set at least as long as the cleaning cycle in order to detect increases in the baseline emission level.

16

For on/off systems, the alarm level may be fixed at some percent of full range. Therefore, the alarm level is effectively adjusted by adjusting the sensitivity to a level which results in normal cleaning peaks occurring below the alarm level and high cleaning peaks triggering the alarm. A response time of 5-10 seconds is also recommended for on/off type systems so momentary high spikes do not cause an alarm.

Since a short response time is recommended for use in dampening momentary high signals and the alarm level is recommended to be set as a multiple of the typical cleaning peak height (once sensitivity is adjusted), the use of delay time is not recommended. This guidance addresses the use of triboelectric monitors as bag leak detectors, not as means of measuring a mass emission rate. Therefore, the alarm must prompt maintenance of the baghouse and must be able to detect an abnormally high cleaning cycle peak. The use of delay time may prevent a high cleaning cycle peak from activating the alarm.

Alternate procedures to set alarm levels may be needed to address site specific conditions. For example, during one EPA study [3], the monitor response to a bag leak was predominantly seen in the baseline signal. In cases such as this one, it may be appropriate to consider an alarm level that is a multiple of the baseline level and incorporates a delay time and a longer response time. For this particular study, setting the baseline at 10 percent of scale, the response time at 2 minutes, the alarm level at 30 percent (three times the baseline), and incorporating a delay time of 1 minute was appropriate. This setting produced alarms during simulated bag leaks. Again, however, monitor setup details will be site specific.

Another example of an alternate procedure may be when high humidity conditions cause false alarms. In this case, a procedure to detune the monitor or otherwise prevent the false alarms may be appropriate. Such procedures should clearly define when the period that alarms are prevented starts and ends.

5.3 MONITORING SYSTEM ADJUSTMENTS

An initial 30-day trial period is recommended to verify that the set up of the instrument is appropriate, in order to prevent frequent false alarms and ensure that the instrument has sufficient detection capability. Another reason such a trial period is recommended is to verify the system selected will perform reliably in the application and environment to which it is exposed. Some monitors may have higher sensitivity upon initial installation, but over a period of several days will stabilize and remain repeatable. The monitor lacks the ability to compensate for a buildup of particulate on the probe, so conditioning the system to the process environment is critical to reliable and repeatable operation.

After the sensitivity, response time, alarm levels, and alarm delay (if applicable) have been set and undergone the 30-day trial period, they should not be readjusted unless normal process conditions change in a manner that affects the characteristics of the particles or exhaust gas stream, such as:

17

1. Change out of filter bags, repair of leaks, or other process improvement that would reduce particulate emissions;

2. Slow drift of signal due to environmental factors such as humidity. If the sensitivity drifts more than -50 to 100 percent from the initial set up, the monitoring system and control device should be inspected and any necessary repairs performed.

3. Equipment is taken out of service for repair, replacement, or upgrading.

5.4 RESPONSE TEST

The response test is meant to be a check on the operational status of the monitor; it is not an accurate measure of electronic drift. The system should be tested monthly to ensure a repeatable and reliable response. A test port should be installed upstream of the probe where a known quantity of dust can be injected into the exhaust gas stream to simulate a broken filter bag. A specified dusty material and injection procedure should be prescribed that will always be used for this test. Various quantities of the selected material should be injected until the amount necessary to trigger the alarm is determined. This quantity of dust should be doubled and used to test the system monthly, in order to verify operation of the monitor. If the monitor is equipped with a continuous output, the signal response during the dust injection test should be recorded and compared to testing conducted during previous months. If signal levels differ significantly from the initial response test, action should be taken to investigate the cause of the discrepancy.

5.5 ELECTRONICS DRIFT CHECKS

The electronics drift checks are meant to be an accurate measure of the monitoring system's electronic drift. A zero drift check can be conducted by disconnecting the sensor or shielding it from particulate. A sensitivity check can be conducted with an instrument which generates a low level current similar to the signal generated by the sensor. The sensor is disconnected from the electronics (or the process is shut down) and the signal generator is connected in its place. The instrument is then used to send a controlled input signal to the electronics to test the accuracy of the system. Some models perform automatic internal drift checks at specified time intervals. The electronics should be adjusted if the drift is greater than 20 percent, or as specified by the manufacturer. Manufacturer's instructions should be consulted for procedures specific to each model.

6.0 QUALITY ASSURANCE PROCEDURES

Quality assurance (QA) is a critical element of any environmental data collection. It is a system of management activities designed to ensure that the data collected are of the type and quality needed by the data user. QA procedures should include the necessary checks of the monitor's functioning, measurement performance criteria, maintenance

procedures, and documentation to assess and document the continuing functioning and accuracy of the bag leak detection monitor. The following QA procedures are suggested to ensure proper monitoring system operation.

6.1 SENSOR INSPECTION AND CLEANING

Each sensor should be inspected at regular intervals to remove any build-up of material that may collect on the probe or insulator. A build-up of material on the probe may dampen or decrease the signal strength, and material on the insulator can form a conductive electrical bridge across the insulator, increasing the signal strength and resulting in a high alarm.

The rate of material buildup on the sensor assembly is dependent upon many factors and will vary for each installation. Thus, the interval between inspections or probe cleaning may vary considerably among installations. Inspection and cleaning of the probe and insulator should be in accordance with the manufacturer's recommendations.

6.2 MONTHLY CHECKS

Monthly QA checks should be performed to ensure the monitor is operating properly. If the results of the response test or electronics drift check are not favorable, the cause should be investigated and any malfunctions corrected.

6.2.1 Response Test

According to the procedures specified in section 5.4, inject the previously determined type and quantity of dust into the port installed in the duct to test the operation of the triboelectric monitor and alarm. A specific injection procedure and dust type should be defined on a case-by-case basis during the set up of the monitoring system. The output signal response should be recorded and compared to the reading obtained during the initial monitor set up. If the readings differ significantly, corrective action should be initiated.

6.2.2 Electronics Drift Check

According to the procedures specified in section 5.5, a signal generator should be used, with signal strengths that match those determined when the monitor was initially set up, to check the baseline and alarm level readouts. A zero drift check should be conducted; the readouts should be within 20 percent of the set levels. If the readouts do not meet this criteria, corrective action should be initiated.

6.3 ANNUAL INSTRUMENT SET UP

If the monitor's settings have not been adjusted within a year's time, an annual instrument set up should be performed. The set up procedures given in section 5.2 should be repeated and documented.

6.4 RECORDKEEPING

A record that includes the date, time, condition of each sensor as-found, and a description of any actions taken should be maintained of all inspections (e.g., probe/insulator cleaning). Records should also be maintained for all drift checks and response tests performed. Each entry in the log should be signed by the person conducting the inspection, testing, or maintenance.

The initial instrument set up procedures should also be documented so the annual instrument set up will be performed consistently. Documentation should include values for the baseline (sensitivity) setting, response time setting, and alarm level(s) and a description of how each was established. If process changes require the system parameters to be adjusted (see Section 5.3 of this guidance), the date, adjustments, and reasons for the adjustments should be documented and signed by the personnel responsible for the modifications. The instrument set up procedures should then be revised accordingly.

7.0 REFERENCES

1. Auburn International, <u>Triboflow and Triboguard Dust Emission Monitors and Broken Bag Detectors, General Guidelines for Operation</u>, April 1995.

2. Midwest Research Institute, <u>Evaluation of Triboelectric Monitors, Final Test Report</u>, prepared for U.S. Environmental Protection Agency, Emission Measurement Center, March 1997.

3. Midwest Research Institute, <u>Evaluation of Triboelectric Monitors on Pulse Jet Fabric Filters</u>, prepared for U.S. Environmental Protection Agency, Emission Measurement Center, September 1997.

4. U.S. Environmental Protection Agency, <u>APTI Course 413: Control of Particulate Emissions, Student Manual</u>, EPA 450/2-80-066, Research Triangle Park, NC, October 1981.

5. U.S. Environmental Protection Agency, <u>Operation and Maintenance Manual for Fabric Filters</u>, EPA/625/1-86/020, Research Triangle Park, NC, June 1986.

Attachment B

Environmental Protection Agency   **§ 60.32e**

§ 60.33c(a)(3) is met (i.e., the date of the first annual nonmethane organic compounds emission rate which equals or exceeds 50 megagrams per year).

[61 FR 9919, Mar. 12, 1996, as amended at 63 FR 32750, June 16, 1998]

Subpart Cd—Emissions Guidelines and Compliance Times for Sulfuric Acid Production Units

SOURCE: 60 FR 65414, Dec. 19, 1995, unless otherwise noted.

§ 60.30d Designated facilities.

Sulfuric acid production units. The designated facility to which §§ 60.31d and 60.32d apply is each existing "sulfuric acid production unit" as defined in § 60.81(a) of subpart H of this part.

§ 60.31d Emissions guidelines.

Sulfuric acid production units. The emission guideline for designated facilities is 0.25 grams sulfuric acid mist (as measured by EPA Reference Method 8 of appendix A of this part) per kilogram (0.5 pounds per ton) of sulfuric acid produced, the production being expressed as 100 percent sulfuric acid.

§ 60.32d Compliance times.

Sulfuric acid production units. Planning, awarding of contracts, and installation of equipment capable of attaining the level of the emission guideline established under § 60.31d can be accomplished within 17 months after the effective date of a State emission standard for sulfuric acid mist.

Subpart Ce—Emission Guidelines and Compliance Times for Hospital/Medical/Infectious Waste Incinerators

SOURCE: 62 FR 48379, Sept. 15, 1997, unless otherwise noted.

§ 60.30e Scope.

This subpart contains emission guidelines and compliance times for the control of certain designated pollutants from hospital/medical/infectious waste incinerator(s) (HMIWI) in accordance with sections 111 and 129 of the Clean Air Act and subpart B of this part. The provisions in these emission guidelines supersede the provisions of § 60.24(f) of subpart B of this part.

§ 60.31e Definitions.

Terms used but not defined in this subpart have the meaning given them in the Clean Air Act and in subparts A, B, and Ec of this part.

Standard Metropolitan Statistical Area or *SMSA* means any areas listed in OMB Bulletin No. 93–17 entitled "Revised Statistical Definitions for Metropolitan Areas" dated June 30, 1993 (incorporated by reference, see § 60.17).

§ 60.32e Designated facilities.

(a) Except as provided in paragraphs (b) through (h) of this section, the designated facility to which the guidelines apply is each individual HMIWI:

(1) For which construction was commenced on or before June 20, 1996, or for which modification was commenced on or before March 16, 1998.

(2) For which construction was commenced after June 20, 1996 but no later than December 1, 2008, or for which modification is commenced after March 16, 1998 but no later than April 6, 2010.

(b) A combustor is not subject to this subpart during periods when only pathological waste, low-level radioactive waste, and/or chemotherapeutic waste (all defined in § 60.51c) is burned, provided the owner or operator of the combustor:

(1) Notifies the Administrator of an exemption claim; and

(2) Keeps records on a calendar quarter basis of the periods of time when only pathological waste, low-level radioactive waste, and/or chemotherapeutic waste is burned.

(c) Any co-fired combustor (defined in § 60.51c) is not subject to this subpart if the owner or operator of the co-fired combustor:

(1) Notifies the Administrator of an exemption claim;

(2) Provides an estimate of the relative weight of hospital waste, medical/infectious waste, and other fuels and/or wastes to be combusted; and

(3) Keeps records on a calendar quarter basis of the weight of hospital waste and medical/infectious waste

121

combusted, and the weight of all other fuels and wastes combusted at the co-fired combustor.

(d) Any combustor required to have a permit under Section 3005 of the Solid Waste Disposal Act is not subject to this subpart.

(e) Any combustor which meets the applicability requirements under sub-part Cb, Ea, or Eb of this part (stand-ards or guidelines for certain munic-ipal waste combustors) is not subject to this subpart.

(f) Any pyrolysis unit (defined in § 60.51c) is not subject to this subpart.

(g) Cement kilns firing hospital waste and/or medical/infectious waste are not subject to this subpart.

(h) Physical or operational changes made to an existing HMIWI unit solely for the purpose of complying with emission guidelines under this subpart are not considered a modification and do not result in an existing HMIWI unit becoming subject to the provisions of subpart Ec (see § 60.50c).

(i) Beginning September 15, 2000, or on the effective date of an EPA ap-proved operating permit program under Clean Air Act title V and the imple-menting regulations under 40 CFR part 70 in the State in which the unit is lo-cated, whichever date is later, des-ignated facilities subject to this sub-part shall operate pursuant to a permit issued under the EPA-approved oper-ating permit program.

(j) The requirements of this subpart as promulgated on September 15, 1997, shall apply to the designated facilities defined in paragraph (a)(1) of this sec-tion until the applicable compliance date of the requirements of this sub-part, as amended on October 6, 2009. Upon the compliance date of the re-quirements of this subpart, designated facilities as defined in paragraph (a)(1) of this section are no longer subject to the requirements of this subpart, as promulgated on September 15, 1997, but are subject to the requirements of this subpart, as amended on October 6, 2009.

[60 FR 65414, Dec. 19, 1995, as amended at 74 FR 51402, Oct. 6, 2009]

§ 60.33e Emissions guidelines.

(a) For approval, a State plan shall include the requirements for emissions

limits at least as protective as the fol-lowing requirements, as applicable:

(1) For a designated facility as de-fined in § 60.32e(a)(1) subject to the emissions guidelines as promulgated on September 15, 1997, the requirements listed in Table 1A of this subpart, ex-cept as provided in paragraph (b) of this section.

(2) For a designated facility as de-fined in § 60.32e(a)(1) subject to the emissions guidelines as amended on Oc-tober 6, 2009, the requirements listed in Table 1B of this subpart, except as pro-vided in paragraph (b) of this section.

(3) For a designated facility as de-fined in § 60.32e(a)(2), the more strin-gent of the requirements listed in Table 1B of this subpart and Table 1A of subpart Ec of this part.

(b) For approval, a State plan shall include the requirements for emissions limits for any small HMIWI con-structed on or before June 20, 1996, which is located more than 50 miles from the boundary of the nearest Standard Metropolitan Statistical Area (defined in § 60.31e) and which burns less than 2,000 pounds per week of hospital waste and medical/infec-tious waste that are at least as protec-tive as the requirements in paragraphs (b)(1) and (b)(2) of this section, as appli-cable. The 2,000 lb/week limitation does not apply during performance tests.

(1) For a designated facility as de-fined in § 60.32e(a)(1) subject to the emissions guidelines as promulgated on September 15, 1997, the requirements listed in Table 2A of this subpart.

(2) For a designated facility as de-fined in § 60.32e(a)(1) subject to the emissions guidelines as amended on Oc-tober 6, 2009, the requirements listed in Table 2B of this subpart.

(c) For approval, a State plan shall include the requirements for stack opacity at least as protective as the following, as applicable:

(1) For a designated facility as de-fined in § 60.32e(a)(1) subject to the emissions guidelines as promulgated on September 15, 1997, the requirements in § 60.52c(b)(1) of subpart Ec of this part.

(2) For a designated facility as de-fined in § 60.32e(a)(1) subject to the emissions guidelines as amended on Oc-tober 6, 2009 and a designated facility

as defined in §60.32e(a)(2), the requirements in §60.52c(b)(2) of subpart Ec of this part.

[74 FR 51403, Oct. 6, 2009]

§60.34e Operator training and qualification guidelines.

For approval, a State plan shall include the requirements for operator training and qualification at least as protective as those requirements listed in §60.53c of subpart Ec of this part. The State plan shall require compliance with these requirements according to the schedule specified in §60.39e(e).

§60.35e Waste management guidelines.

For approval, a State plan shall include the requirements for a waste management plan at least as protective as those requirements listed in §60.55c of subpart Ec of this part.

§60.36e Inspection guidelines.

(a) For approval, a State plan shall require each small HMIWI subject to the emissions limits under §60.33e(b) and each HMIWI subject to the emissions limits under §60.33e(a)(2) and (a)(3) to undergo an initial equipment inspection that is at least as protective as the following within 1 year following approval of the State plan:

(1) At a minimum, an inspection shall include the following:

(i) Inspect all burners, pilot assemblies, and pilot sensing devices for proper operation; clean pilot flame sensor, as necessary;

(ii) Ensure proper adjustment of primary and secondary chamber combustion air, and adjust as necessary;

(iii) Inspect hinges and door latches, and lubricate as necessary;

(iv) Inspect dampers, fans, and blowers for proper operation;

(v) Inspect HMIWI door and door gaskets for proper sealing;

(vi) Inspect motors for proper operation;

(vii) Inspect primary chamber refractory lining; clean and repair/replace lining as necessary;

(viii) Inspect incinerator shell for corrosion and/or hot spots;

(ix) Inspect secondary/tertiary chamber and stack, clean as necessary;

(x) Inspect mechanical loader, including limit switches, for proper operation, if applicable;

(xi) Visually inspect waste bed (grates), and repair/seal, as appropriate;

(xii) For the burn cycle that follows the inspection, document that the incinerator is operating properly and make any necessary adjustments;

(xiii) Inspect air pollution control device(s) for proper operation, if applicable;

(xiv) Inspect waste heat boiler systems to ensure proper operation, if applicable;

(xv) Inspect bypass stack components;

(xvi) Ensure proper calibration of thermocouples, sorbent feed systems and any other monitoring equipment; and

(xvii) Generally observe that the equipment is maintained in good operating condition.

(2) Within 10 operating days following an equipment inspection all necessary repairs shall be completed unless the owner or operator obtains written approval from the State agency establishing a date whereby all necessary repairs of the designated facility shall be completed.

(b) For approval, a State plan shall require each small HMIWI subject to the emissions limits under §60.33e(b) and each HMIWI subject to the emissions limits under §60.33e(a)(2) and (a)(3) to undergo an equipment inspection annually (no more than 12 months following the previous annual equipment inspection), as outlined in paragraph (a) of this section.

(c) For approval, a State plan shall require each small HMIWI subject to the emissions limits under §60.33e(b)(2) and each HMIWI subject to the emissions limits under §60.33e(a)(2) and (a)(3) to undergo an initial air pollution control device inspection, as applicable, that is at least as protective as the following within 1 year following approval of the State plan:

(1) At a minimum, an inspection shall include the following:

(i) Inspect air pollution control device(s) for proper operation, if applicable;

(ii) Ensure proper calibration of thermocouples, sorbent feed systems, and any other monitoring equipment; and

(iii) Generally observe that the equipment is maintained in good operating condition.

(2) Within 10 operating days following an air pollution control device inspection, all necessary repairs shall be completed unless the owner or operator obtains written approval from the State agency establishing a date whereby all necessary repairs of the designated facility shall be completed.

(d) For approval, a State plan shall require each small HMIWI subject to the emissions limits under § 60.33e(b)(2) and each HMIWI subject to the emissions limits under § 60.33e(a)(2) and (a)(3) to undergo an air pollution control device inspection, as applicable, annually (no more than 12 months following the previous annual air pollution control device inspection), as outlined in paragraph (c) of this section.

[60 FR 65414, Dec. 19, 1995, as amended at 74 FR 51403, Oct. 6, 2009]

§ 60.37e Compliance, performance testing, and monitoring guidelines.

(a) Except as provided in paragraph (b) of this section, for approval, a State plan shall include the requirements for compliance and performance testing listed in § 60.56c of subpart Ec of this part, with the following exclusions:

(1) For a designated facility as defined in § 60.32e(a)(1) subject to the emissions limits in § 60.33e(a)(1), the test methods listed in § 60.56c(b)(7) and (8), the fugitive emissions testing requirements under § 60.56c(b)(14) and (c)(3), the CO CEMS requirements under § 60.56c(c)(4), and the compliance requirements for monitoring listed in § 60.56c(c)(5)(ii) through (v), (c)(6), (c)(7), (e)(6) through (10), (f)(7) through (10), (g)(6) through (10), and (h).

(2) For a designated facility as defined in § 60.32e(a)(1) and (a)(2) subject to the emissions limits in § 60.33e(a)(2) and (a)(3), the annual fugitive emissions testing requirements under § 60.56c(c)(3), the CO CEMS requirements under § 60.56c(c)(4), and the compliance requirements for monitoring listed in § 60.56c(c)(5)(ii) through (v), (c)(6), (c)(7), (e)(6) through (10), (f)(7)

through (10), and (g)(6) through (10). Sources subject to the emissions limits under § 60.33e(a)(2) and (a)(3) may, however, elect to use CO CEMS as specified under § 60.56c(c)(4) or bag leak detection systems as specified under § 60.57c(h).

(b) Except as provided in paragraphs (b)(1) and (b)(2) of this section, for approval, a State plan shall require each small HMIWI subject to the emissions limits under § 60.33e(b) to meet the performance testing requirements listed in § 60.56c of subpart Ec of this part. The 2,000 lb/week limitation under § 60.33e(b) does not apply during performance tests.

(1) For a designated facility as defined in § 60.32e(a)(1) subject to the emissions limits under § 60.33e(b)(1), the test methods listed in § 60.56c(b)(7), (8), (12), (13) (Pb and Cd), and (14), the annual PM, CO, and HCl emissions testing requirements under § 60.56c(c)(2), the annual fugitive emissions testing requirements under § 60.56c(c)(3), the CO CEMS requirements under § 60.56c(c)(4), and the compliance requirements for monitoring listed in § 60.56c(c)(5) through (7), and (d) through (k) do not apply.

(2) For a designated facility as defined in § 60.32e(a)(2) subject to the emissions limits under § 60.33e(b)(2), the annual fugitive emissions testing requirements under § 60.56c(c)(3), the CO CEMS requirements under § 60.56c(c)(4), and the compliance requirements for monitoring listed in § 60.56c(c)(5)(ii) through (v), (c)(6), (c)(7), (e)(6) through (10), (f)(7) through (10), and (g)(6) through (10) do not apply. Sources subject to the emissions limits under § 60.33e(b)(2) may, however, elect to use CO CEMS as specified under § 60.56c(c)(4) or bag leak detection systems as specified under § 60.57c(h).

(c) For approval, a State plan shall require each small HMIWI subject to the emissions limits under § 60.33e(b) that is not equipped with an air pollution control device to meet the following compliance and performance testing requirements:

(1) Establish maximum charge rate and minimum secondary chamber temperature as site-specific operating parameters during the initial performance test to determine compliance with applicable emission limits.

(2) Following the date on which the initial performance test is completed or is required to be completed under §60.8, whichever date comes first, ensure that the designated facility does not operate above the maximum charge rate or below the minimum secondary chamber temperature measured as 3-hour rolling averages (calculated each hour as the average of the previous 3 operating hours) at all times. Operating parameter limits do not apply during performance tests. Operation above the maximum charge rate or below the minimum secondary chamber temperature shall constitute a violation of the established operating parameter(s).

(3) Except as provided in paragraph (c)(4) of this section, operation of the designated facility above the maximum charge rate and below the minimum secondary chamber temperature (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the PM, CO, and dioxin/furan emissions limits.

(4) The owner or operator of a designated facility may conduct a repeat performance test within 30 days of violation of applicable operating parameter(s) to demonstrate that the designated facility is not in violation of the applicable emissions limit(s). Repeat performance tests conducted pursuant to this paragraph must be conducted under process and control device operating conditions duplicating as nearly as possible those that indicated a violation under paragraph (c)(3) of this section.

(d) For approval, a State plan shall include the requirements for monitoring listed in §60.57c of subpart Ec of this part for HMIWI subject to the emissions limits under §60.33e(a) and (b). except as provided for under paragraph (e) of this section.

(e) For approval, a State plan shall require small HMIWI subject to the emissions limits under §60.33e(b) that are not equipped with an air pollution control device to meet the following monitoring requirements:

(1) Install, calibrate (to manufacturers' specifications), maintain, and operate a device for measuring and recording the temperature of the secondary chamber on a continuous basis, the output of which shall be recorded, at a minimum, once every minute throughout operation.

(2) Install, calibrate (to manufacturers' specifications), maintain, and operate a device which automatically measures and records the date, time, and weight of each charge fed into the HMIWI.

(3) The owner or operator of a designated facility shall obtain monitoring data at all times during HMIWI operation except during periods of monitoring equipment malfunction, calibration, or repair. At a minimum, valid monitoring data shall be obtained for 75 percent of the operating hours per day for 90 percent of the operating hours per calendar quarter that the designated facility is combusting hospital waste and/or medical/infectious waste.

(f) The owner or operator of a designated facility as defined in §60.32e(a)(1) or (a)(2) subject to emissions limits under §60.33e(a)(2), (a)(3), or (b)(2) may use the results of previous emissions tests to demonstrate compliance with the emissions limits, provided that the conditions in paragraphs (f)(1) through (f)(3) of this section are met:

(1) The designated facility's previous emissions tests must have been conducted using the applicable procedures and test methods listed in §60.56c(b) of subpart Ec of this part. Previous emissions test results obtained using EPA-accepted voluntary consensus standards are also acceptable.

(2) The HMIWI at the designated facility shall currently be operated in a manner (e.g., with charge rate, secondary chamber temperature, etc.) that would be expected to result in the same or lower emissions than observed during the previous emissions test(s), and the HMIWI may not have been modified such that emissions would be expected to exceed (notwithstanding normal test-to-test variability) the results from previous emissions test(s).

(3) The previous emissions test(s) must have been conducted in 1996 or later.

[60 FR 65414, Dec. 19, 1995, as amended at 74 FR 51403, Oct. 6, 2009]

§ 60.38e Reporting and recordkeeping guidelines.

(a) Except as provided in paragraphs (a)(1) and (a)(2) of this section, for approval, a State plan shall include the reporting and recordkeeping requirements listed in § 60.58c(b) through (g) of subpart Ec of this part.

(1) For a designated facility as defined in § 60.32e(a)(1) subject to emissions limits under § 60.33e(a)(1) or (b)(1), excluding § 60.58c(b)(2)(ii) (fugitive emissions), (b)(2)(viii) (NO$_X$ reagent), (b)(2)(xvii) (air pollution control device inspections), (b)(2)(xviii) (bag leak detection system alarms), (b)(2)(xix) (CO CEMS data), and (b)(7) (siting documentation).

(2) For a designated facility as defined in § 60.32e(a)(1) or (a)(2) subject to emissions limits under § 60.33e(a)(2), (a)(3), or (b)(2), excluding § 60.58c(b)(2)(xviii) (bag leak detection system alarms), (b)(2)(xix) (CO CEMS data), and (b)(7) (siting documentation).

(b) For approval, a State plan shall require the owner or operator of each HMIWI subject to the emissions limits under § 60.33e to:

(1) As specified in § 60.36e, maintain records of the annual equipment inspections that are required for each HMIWI subject to the emissions limits under § 60.33e(a)(2), (a)(3), and (b), and the annual air pollution control device inspections that are required for each HMIWI subject to the emissions limits under § 60.33e(a)(2), (a)(3), and (b)(2), any required maintenance, and any repairs not completed within 10 days of an inspection or the timeframe established by the State regulatory agency; and

(2) Submit an annual report containing information recorded under paragraph (b)(1) of this section no later than 60 days following the year in which data were collected. Subsequent reports shall be sent no later than 12 calendar months following the previous report (once the unit is subject to permitting requirements under Title V of the Act, the owner or operator must submit these reports semiannually). The report shall be signed by the facilities manager.

[60 FR 65414, Dec. 19, 1995, as amended at 74 FR 51404, Oct. 6, 2009]

§ 60.39e Compliance times.

(a) Each State in which a designated facility is operating shall submit to the Administrator a plan to implement and enforce the emissions guidelines as specified in paragraphs (a)(1) and (a)(2) of this section:

(1) Not later than September 15, 1998, for the emissions guidelines as promulgated on September 15, 1997.

(2) Not later than October 6, 2010, for the emissions guidelines as amended on October 6, 2009.

(b) Except as provided in paragraphs (c) and (d) of this section, State plans shall provide that designated facilities comply with all requirements of the State plan on or before the date 1 year after EPA approval of the State plan, regardless of whether a designated facility is identified in the State plan inventory required by § 60.25(a) of subpart B of this part.

(c) State plans that specify measurable and enforceable incremental steps of progress towards compliance for designated facilities planning to install the necessary air pollution control equipment may allow compliance on or before the date 3 years after EPA approval of the State plan (but not later than September 16, 2002), for the emissions guidelines as promulgated on September 15, 1997, and on or before the date 3 years after approval of an amended State plan (but not later than October 6, 2014), for the emissions guidelines as amended on October 6, 2009). Suggested measurable and enforceable activities to be included in State plans are:

(1) Date for submitting a petition for site-specific operating parameters under § 60.56c(j) of subpart Ec of this part.

(2) Date for obtaining services of an architectural and engineering firm regarding the air pollution control device(s);

(3) Date for obtaining design drawings of the air pollution control device(s);

(4) Date for ordering the air pollution control device(s);

(5) Date for obtaining the major components of the air pollution control device(s);

(6) Date for initiation of site preparation for installation of the air pollution control device(s);

(7) Date for initiation of installation of the air pollution control device(s);

(8) Date for initial startup of the air pollution control device(s); and

(9) Date for initial compliance test(s) of the air pollution control device(s).

(d) State plans that include provisions allowing designated facilities to petition the State for extensions beyond the compliance times required in paragraph (b) of this section shall:

(1) Require that the designated facility requesting an extension submit the following information in time to allow the State adequate time to grant or deny the extension within 1 year after EPA approval of the State plan:

(i) Documentation of the analyses undertaken to support the need for an extension, including an explanation of why up to 3 years after EPA approval of the State plan is sufficient time to comply with the State plan while 1 year after EPA approval of the State plan is not sufficient. The documentation shall also include an evaluation of the option to transport the waste off-site to a commercial medical waste treatment and disposal facility on a temporary or permanent basis; and

(ii) Documentation of measurable and enforceable incremental steps of progress to be taken towards compliance with the emission guidelines.

(2) Include procedures for granting or denying the extension; and

(3) If an extension is granted, require compliance with the emissions guidelines on or before the date 3 years after EPA approval of the State plan (but not later than September 16, 2002), for the emissions guidelines as promulgated on September 15, 1997, and on or before the date 3 years after EPA approval of an amended State plan (but not later than October 6, 2014), for the emissions guidelines as amended on October 6, 2009.

(e) For approval, a State plan shall require compliance with §60.34e—Operator training and qualification guidelines and §60.36e—Inspection guidelines by the date 1 year after EPA approval of a State plan.

(f) The Administrator shall develop, implement, and enforce a plan for existing HMIWI located in any State that has not submitted an approvable plan within 2 years after September 15, 1997, for the emissions guidelines as promulgated on September 15, 1997, and within 2 years after October 6, 2009 for the emissions guidelines as amended on October 6, 2009. Such plans shall ensure that each designated facility is in compliance with the provisions of this subpart no later than 5 years after September 15, 1997, for the emissions guidelines as promulgated on September 15, 1997, and no later than 5 years after October 6, 2009 for the emissions guidelines as amended on October 6, 2009.

[60 FR 65414, Dec. 19, 1995, as amended at 74 FR 51404, Oct. 6, 2009]

TABLE 1A TO SUBPART Ce OF PART 60—EMISSIONS LIMITS FOR SMALL, MEDIUM, AND LARGE HMIWI AT DESIGNATED FACILITIES AS DEFINED IN §60.32e(a)(1)

Pollutant	Units (7 percent oxygen, dry basis)	Emissions limits			Averaging time[1]	Method for demonstrating compliance[2]
		HMIWI size				
		Small	Medium	Large		
Particulate matter.	Milligrams per dry standard cubic meter (mg/dscm) (grains per dry standard cubic foot (gr/dscf)).	115 (0.05)	69 (0.03)	34 (0.015)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 5 of appendix A–3 of part 60, or EPA Reference Method 26A or 29 of appendix A–8 of part 60.

127

Pollutant	Units (7 percent oxygen, dry basis)	Emissions limits			Averaging time[1]	Method for demonstrating compliance[2]
		HMIWI size				
		Small	Medium	Large		
Carbon monoxide.	Parts per million by volume (ppmv).	40	40	40	3-run average (1-hour minimum sample time per run).	EPA Reference Method 10 or 10B of appendix A–4 of part 60.
Dioxins/furans.	Nanograms per dry standard cubic meter total dioxins/furans (ng/dscm) (grains per billion dry standard cubic feet (gr/10^9 dscf)) or ng/dscm TEQ (gr/10^9 dscf).	125 (55) or 2.3 (1.0).	125 (55) or 2.3 (1.0).	125 (55) or 2.3 (1.0)	3-run average (4-hour minimum sample time per run).	EPA Reference Method 23 of appendix A–7 of part 60.
Hydrogen chloride.	ppmv	100 or 93%	100 or 93%	100 or 93%	3-run average (1-hour minimum sample time per run).	EPA Reference Method 26 or 26A of appendix A–8 of part 60.
Sulfur dioxide.	ppmv	55	55	55	3-run average (1-hour minimum sample time per run).	EPA Reference Method 6 or 6C of appendix A–4 of part 60.
Nitrogen oxides.	ppmv	250	250	250	3-run average (1-hour minimum sample time per run).	EPA Reference Method 7 or 7E of appendix A–4 of part 60.
Lead	mg/dscm (grains per thousand dry standard cubic feet (gr/10^3 dscf)).	1.2 (0.52) or 70%	1.2 (0.52) or 70%	1.2 (0.52) or 70% ...	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.
Cadmium	mg/dscm (gr/10^3 dscf).	0.16 (0.07) or 65%.	0.16 (0.07) or 65%.	0.16 (0.07) or 65%	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.

128

Pollutant	Units (7 percent oxygen, dry basis)	Emissions limits			Averaging time [1]	Method for demonstrating compliance [2]
		HMIWI size				
		Small	Medium	Large		
Mercury ..	mg/dscm (gr/10³ dscf).	0.55 (0.24) or 85%.	0.55 (0.24) or 85%.	0.55 (0.24) or 85%	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.

[1] Except as allowed under § 60.56c(c) for HMIWI equipped with CEMS.
[2] Does not include CEMS and approved alternative non-EPA test methods allowed under § 60.56c(b).

[60 FR 65414, Dec. 19, 1995, as amended at 74 FR 51405, Oct. 6, 2009]

TABLE 1B TO SUBPART Ce OF PART 60—EMISSIONS LIMITS FOR SMALL, MEDIUM, AND LARGE HMIWI AT DESIGNATED FACILITIES AS DEFINED IN § 60.32e(a)(1) AND (a)(2)

Pollutant	Units (7 percent oxygen, dry basis)	Emissions limits			Averaging time [1]	Method for demonstrating compliance [2]
		HMIWI size				
		Small	Medium	Large		
Particulate matter.	Milligrams per dry standard cubic meter (mg/dscm) (grains per dry standard cubic foot (gr/dscf)).	66 (0.029)	46 (0.020)	25 (0.011)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 5 of appendix A–3 of part 60, or EPA Reference Method 26A or 29 of appendix A–8 of part 60.
Carbon monoxide.	Parts per million by volume (ppmv).	20	5.5	11	3-run average (1-hour minimum sample time per run).	EPA Reference Method 10 or 10B of appendix A–4 of part 60.
Dioxins/furans.	Nanograms per dry standard cubic meter total dioxins/furans (ng/dscm) (grains per billion dry standard cubic feet (gr/10⁹ dscf)) or ng/dscm TEQ (gr/10⁹ dscf).	16 (7.0) or 0.013 (0.0057).	0.85 (0.37) or 0.020 (0.0087).	9.3 (4.1) or 0.054 (0.024).	3-run average (4-hour minimum sample time per run).	EPA Reference Method 23 of appendix A–7 of part 60.
Hydrogen chloride.	ppmv	44	7.7	6.6	3-run average (1-hour minimum sample time per run).	EPA Reference Method 26 or 26A of appendix A–8 of part 60.
Sulfur dioxide.	ppmv	4.2	4.2	9.0	3-run average (1-hour minimum sample time per run).	EPA Reference Method 6 or 6C of appendix A–4 of part 60.

Pollutant	Units (7 percent oxygen, dry basis)	Emissions limits			Averaging time [1]	Method for demonstrating compliance [2]
		HMIWI size				
		Small	Medium	Large		
Nitrogen oxides.	ppmv	190	190	140	3-run average (1-hour minimum sample time per run).	EPA Reference Method 7 or 7E of appendix A–4 of part 60.
Lead	mg/dscm (grains per thousand dry standard cubic feet (gr/10³ dscf)).	0.31 (0.14)	0.018 (0.0079)	0.036 (0.016)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.
Cadmium	mg/dscm (gr/10³ dscf).	0.017 (0.0074)	0.013 (0.0057)	0.0092 (0.0040) ..	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.
Mercury ..	mg/dscm (gr/10³ dscf).	0.014 (0.0061)	0.025 (0.011)	0.018 (0.0079)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.

[1] Except as allowed under § 60.56c(c) for HMIWI equipped with CEMS.
[2] Does not include CEMS and approved alternative non-EPA test methods allowed under § 60.56c(b).

[74 FR 51406, Oct. 6, 2009]

TABLE 2A TO SUBPART Ce OF PART 60—EMISSIONS LIMITS FOR SMALL HMIWI WHICH MEET THE CRITERIA UNDER § 60.33e(b)(1)

Pollutant	Units (7 percent oxygen, dry basis)	HMIWI emissions limits	Averaging time [1]	Method for demonstrating compliance [2]
Particulate matter.	mg/dscm (gr/dscf).	197 (0.086)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 5 of appendix A–3 of part 60, or EPA Reference Method 26A or 29 of appendix A–8 of part 60.
Carbon monoxide.	ppmv	40	3-run average (1-hour minimum sample time per run).	EPA Reference Method 10 or 10B of appendix A–4 of part 60.
Dioxins/furans ..	ng/dscm total dioxins/furans (gr/10⁹ dscf) or ng/dscm TEQ (gr/10⁹ dscf).	800 (350) or 15 (6.6) ...	3-run average (4-hour minimum sample time per run).	EPA Reference Method 23 of appendix A–7 of part 60.
Hydrogen chloride.	ppmv	3,100	3-run average (1-hour minimum sample time per run).	EPA Reference Method 26 or 26A of appendix A–8 of part 60.
Sulfur dioxide ...	ppmv	55	3-run average (1-hour minimum sample time per run).	EPA Reference Method 6 or 6C of appendix A–4 of part 60.
Nitrogen oxides	ppmv	250	3-run average (1-hour minimum sample time per run).	EPA Reference Method 7 or 7E of appendix A–4 of part 60.
Lead	mg/dscm (gr/10³ dscf).	10 (4.4)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.
Cadmium	mg/dscm (gr/10³ dscf).	4 (1.7)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.

Pollutant	Units (7 percent oxygen, dry basis)	HMIWI emissions limits	Averaging time [1]	Method for demonstrating compliance [2]
Mercury	mg/dscm (gr/10³ dscf).	7.5 (3.3)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.

[1] Except as allowed under §60.56c(c) for HMIWI equipped with CEMS.
[2] Does not include CEMS and approved alternative non-EPA test methods allowed under §60.56c(b).

[74 FR 51407. Oct. 6, 2009]

TABLE 2B TO SUBPART Ce OF PART 60—EMISSIONS LIMITS FOR SMALL HMIWI WHICH MEET THE CRITERIA UNDER §60.33e(b)(2)

Pollutant	Units (7 percent oxygen, dry basis)	HMIWI Emissions limits	Averaging time [1]	Method for demonstrating compliance [2]
Particulate matter.	mg/dscm (gr/dscf).	87 (0.038)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 5 of appendix A–3 of part 60, or EPA Reference Method 26A or 29 of appendix A–8 of part 60.
Carbon monoxide.	ppmv	20	3-run average (1-hour minimum sample time per run).	EPA Reference Method 10 or 10B of appendix A–4 of part 60.
Dioxins/furans	ng/dscm total dioxins/furans (gr/10⁹ dscf) or ng/dscm TEQ (gr/10⁹ dscf).	240 (100) or 5.1 (2.2)	3-run average (4-hour minimum sample time per run).	EPA Reference Method 23 of appendix A–7 of part 60.
Hydrogen chloride.	ppmv	810	3-run average (1-hour minimum sample time per run).	EPA Reference Method 26 or 26A of appendix A–8 of part 60.
Sulfur dioxide	ppmv	55	3-run average (1-hour minimum sample time per run).	EPA Reference Method 6 or 6C of appendix A–4 of part 60.
Nitrogen oxides	ppmv	130	3-run average (1-hour minimum sample time per run).	EPA Reference Method 7 or 7E of appendix A–4 of part 60.
Lead	mg/dscm (gr/10³ dscf).	0.50 (0.22)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.
Cadmium	mg/dscm (gr/10³ dscf).	0.11 (0.048)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.
Mercury	mg/dscm (gr/10³ dscf).	0.0051 (0.0022)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.

[1] Except as allowed under §60.56c(c) for HMIWI equipped with CEMS.
[2] Does not include CEMS and approved alternative non-EPA test methods allowed under §60.56c(b).

[74 FR 51407, Oct. 6, 2009]

Subpart D—Standards of Performance for Fossil-Fuel-Fired Steam Generators for Which Construction Is Commenced After August 17, 1971

SOURCE: 72 FR 32717, June 13, 2007, unless otherwise noted.

§60.40 Applicability and designation of affected facility.

(a) The affected facilities to which the provisions of this subpart apply are:

(1) Each fossil-fuel-fired steam generating unit of more than 73 megawatts (MW) heat input rate (250 million British thermal units per hour (MMBtu/hr)).

(2) Each fossil-fuel and wood-residue-fired steam generating unit capable of firing fossil fuel at a heat input rate of more than 73 MW (250 MMBtu/hr).

(b) Any change to an existing fossil-fuel-fired steam generating unit to accommodate the use of combustible materials, other than fossil fuels as defined in this subpart, shall not bring that unit under the applicability of this subpart.

(c) Except as provided in paragraph (d) of this section, any facility under

131

made available for inspection, upon request, by the Administrator, for a period of 5 years after each revision to the plan.

(12) Submit information concerning all out-of-control periods for each continuous automated sampling system, including start and end dates and hours and descriptions of corrective actions taken in the annual or semiannual reports required in paragraphs (g) or (h) of this section.

[60 FR 65419, Dec. 19, 1995, as amended at 62 FR 45121, 45127, Aug. 25, 1997; 71 FR 27345, May 10, 2006]

Subpart Ec—Standards of Performance for Hospital/Medical/Infectious Waste Incinerators for Which Construction is Commenced After June 20, 1996

SOURCE: 62 FR 48382, Sept. 15, 1997, unless otherwise noted.

§ 60.50c Applicability and delegation of authority.

(a) Except as provided in paragraphs (b) through (h) of this section, the affected facility to which this subpart applies is each individual hospital/medical/infectious waste incinerator (HMIWI):

(1) For which construction is commenced after June 20, 1996 but no later than December 1, 2008; or

(2) For which modification is commenced after March 16, 1998 but no later than April 6, 2010.

(3) For which construction is commenced after December 1, 2008; or

(4) For which modification is commenced after April 6, 2010.

(b) A combustor is not subject to this subpart during periods when only pathological waste, low-level radioactive waste, and/or chemotherapeutic waste (all defined in § 60.51c) is burned, provided the owner or operator of the combustor:

(1) Notifies the Administrator of an exemption claim; and

(2) Keeps records on a calendar quarter basis of the periods of time when only pathological waste, low-level radioactivewaste and/or chemotherapeutic waste is burned.

(c) Any co-fired combustor (defined in § 60.51c) is not subject to this subpart if the owner or operator of the co-fired combustor:

(1) Notifies the Administrator of an exemption claim;

(2) Provides an estimate of the relative amounts of hospital waste, medical/infectious waste, and other fuels and wastes to be combusted; and

(3) Keeps records on a calendar quarter basis of the weight of hospital waste and medical/infectious waste combusted, and the weight of all other fuels and wastes combusted at the co-fired combustor.

(d) Any combustor required to have a permit under section 3005 of the Solid Waste Disposal Act is not subject to this subpart.

(e) Any combustor which meets the applicability requirements under subpart Cb, Ea, or Eb of this part (standards or guidelines for certain municipal waste combustors) is not subject to this subpart.

(f) Any pyrolysis unit (defined in § 60.51c) is not subject to this subpart.

(g) Cement kilns firing hospital waste and/or medical/infectious waste are not subject to this subpart.

(h) Physical or operational changes made to an existing HMIWI solely for the purpose of complying with emission guidelines under subpart Ce are not considered a modification and do not result in an existing HMIWI becoming subject to this subpart.

(i) In delegating implementation and enforcement authority to a State under section 111(c) of the Clean Air Act, the following authorities shall be retained by the Administrator and not transferred to a State:

(1) The requirements of Sec. 60.56c(i) establishing operating parameters when using controls other than those listed in Sec. 60.56c(d).

(2) Approval of alternative methods of demonstrating compliance under § 60.8 including:

(i) Approval of CEMS for PM, HCl, multi-metals, and Hg where used for purposes of demonstrating compliance,

(ii) Approval of continuous automated sampling systems for dioxin/furan and Hg where used for purposes of demonstrating compliance, and

(iii) Approval of major alternatives to test methods;

(3) Approval of major alternatives to monitoring;

(4) Waiver of recordkeeping requirements; and

(5) Performance test and data reduction waivers under § 60.8(b).

(j) Affected facilities subject to this subpart are not subject to the requirements of 40 CFR part 64.

(i) Approval of CEMS for PM, HCl, multi-metals, and Hg where used for purposes of demonstrating compliance,

(ii) Approval of continuous automated sampling systems for dioxin/furan and Hg where used for purposes of demonstrating compliance, and

(iii) Approval of major alternatives to test methods;

(3) Approval of major alternatives to monitoring;

(4) Waiver of recordkeeping requirements; and

(5) Performance test and data reduction waivers under § 60.8(b).

(k) The requirements of this subpart shall become effective March 16, 1998

(l) Beginning September 15, 2000, or on the effective date of an EPA-approved operating permit program under Clean Air Act title V and the implementing regulations under 40 CFR part 70 in the State in which the unit is located, whichever date is later, affected facilities subject to this subpart shall operate pursuant to a permit issued under the EPA approved State operating permit program.

(m) The requirements of this subpart as promulgated on September 15, 1997, shall apply to the affected facilities defined in paragraph (a)(1) and (2) of this section until the applicable compliance date of the requirements of subpart Ce of this part, as amended on October 6, 2009. Upon the compliance date of the requirements of the amended subpart Ce of this part, affected facilities as defined in paragraph (a) of this section are no longer subject to the requirements of this subpart, but are subject to the requirements of subpart Ce of this part, as amended on October 6, 2009, except where the emissions limits of this subpart as promulgated on September 15, 1997 are more stringent than the emissions limits of the amended subpart Ce of this part. Compliance

with subpart Ce of this part, as amended on October 6, 2009 is required on or before the date 3 years after EPA approval of the State plan for States in which an affected facility as defined in paragraph (a) of this section is located (but not later than the date 5 years after promulgation of the amended subpart).

(n) The requirements of this subpart, as amended on October 6, 2009, shall become effective April 6, 2010.

[62 FR 48382, Sept. 15, 1997, as amended at 74 FR 51408, Oct. 6, 2009]

§ 60.51c Definitions.

Bag leak detection system means an instrument that is capable of monitoring PM loadings in the exhaust of a fabric filter in order to detect bag failures. A bag leak detection system includes, but is not limited to, an instrument that operates on triboelectric, light-scattering, light-transmittance, or other effects to monitor relative PM loadings.

Batch HMIWI means an HMIWI that is designed such that neither waste charging nor ash removal can occur during combustion.

Biologicals means preparations made from living organisms and their products, including vaccines, cultures, etc., intended for use in diagnosing, immunizing, or treating humans or animals or in research pertaining thereto.

Blood products means any product derived from human blood, including but not limited to blood plasma, platelets, red or white blood corpuscles, and other derived licensed products, such as interferon, etc.

Body fluids means liquid emanating or derived from humans and limited to blood; dialysate; amniotic, cerebrospinal, synovial, pleural, peritoneal and pericardial fluids; and semen and vaginal secretions.

Bypass stack means a device used for discharging combustion gases to avoid severe damage to the air pollution control device or other equipment.

Chemotherapeutic waste means waste material resulting from the production or use of antineoplastic agents used for the purpose of stopping or reversing the growth of malignant cells.

Co-fired combustor means a unit combusting hospital waste and/or medical/

infectious waste with other fuels or wastes (e.g., coal, municipal solid waste) and subject to an enforceable requirement limiting the unit to combusting a fuel feed stream, 10 percent or less of the weight of which is comprised, in aggregate, of hospital waste and medical/infectious waste as measured on a calendar quarter basis. For purposes of this definition, pathological waste, chemotherapeutic waste, and low-level radioactive waste are considered ·"other" wastes when calculating the percentage of hospital waste and medical/infectious waste combusted.

Commercial HMIWI means a HMIWI which offers incineration services for hospital/medical/infectious waste generated offsite by firms unrelated to the firm that owns the HMIWI.

Continuous emission monitoring system or *CEMS* means a monitoring system for continuously measuring and recording the emissions of a pollutant from an affected facility.

Continuous HMIWI means an HMIWI that is designed to allow waste charging and ash removal during combustion.

Dioxins/furans means the combined emissions of tetra-through octa-chlorinated dibenzo-para-dioxins and dibenzofurans, as measured by EPA Reference Method 23.

Dry scrubber means an add-on air pollution control system that injects dry alkaline sorbent (dry injection) or sprays an alkaline sorbent (spray dryer) to react with and neutralize acid gases in the HMIWI exhaust stream forming a dry powder material.

Fabric filter or *baghouse* means an add-on air pollution control system that removes particulate matter (PM) and nonvaporous metals emissions by passing flue gas through filter bags.

Facilities manager means the individual in charge of purchasing, maintaining, and operating the HMIWI or the owner's or operator's representative responsible for the management of the HMIWI. Alternative titles may include director of facilities or vice president of support services.

High-air phase means the stage of the batch operating cycle when the primary chamber reaches and maintains maximum operating temperatures.

Hospital means any facility which has an organized medical staff, maintains at least six inpatient beds, and where the primary function of the institution is to provide diagnostic and therapeutic patient services and continuous nursing care primarily to human inpatients who are not related and who stay on average in excess of 24 hours per admission. This definition does not include facilities maintained for the sole purpose of providing nursing or convalescent care to human patients who generally are not acutely ill but who require continuing medical supervision.

Hospital/medical/infectious waste incinerator or *HMIWI* or *HMIWI unit* means any device that combusts any amount of hospital waste and/or medical/infectious waste.

Hospital/medical/infectious waste incinerator operator or *HMIWI operator* means any person who operates, controls or supervises the day-to-day operation of an HMIWI.

Hospital waste means discards generated at a hospital, except unused items returned to the manufacturer. The definition of hospital waste does not include human corpses, remains, and anatomical parts that are intended for interment or cremation.

Infectious agent means any organism (such as a virus or bacteria) that is capable of being communicated by invasion and multiplication in body tissues and capable of causing disease or adverse health impacts in humans.

Intermittent HMIWI means an HMIWI that is designed to allow waste charging, but not ash removal, during combustion.

Large HMIWI means:

(1) Except as provided in (2);

(i) An HMIWI whose maximum design waste burning capacity is more than 500 pounds per hour; or

(ii) A continuous or intermittent HMIWI whose maximum charge rate is more than 500 pounds per hour; or

(iii) A batch HMIWI whose maximum charge rate is more than 4,000 pounds per day.

(2) The following are not large HMIWI:

(i) A continuous or intermittent HMIWI whose maximum charge rate is

less than or equal to 500 pounds per hour; or

(ii) A batch HMIWI whose maximum charge rate is less than or equal to 4,000 pounds per day.

Low-level radioactive waste means waste material which contains radioactive nuclides emitting primarily beta or gamma radiation, or both, in concentrations or quantities that exceed applicable federal or State standards for unrestricted release. Low-level radioactive waste is not high-level radioactive waste, spent nuclear fuel, or byproduct material as defined by the Atomic Energy Act of 1954 (42 U.S.C. 2014(e)(2)).

Malfunction means any sudden, infrequent, and not reasonably preventable failure of air pollution control equipment, process equipment, or a process to operate in a normal or usual manner. Failures that are caused, in part, by poor maintenance or careless operation are not malfunctions. During periods of malfunction the operator shall operate within established parameters as much as possible, and monitoring of all applicable operating parameters shall continue until all waste has been combusted or until the malfunction ceases, whichever comes first.

Maximum charge rate means:

(1) For continuous and intermittent HMIWI, 110 percent of the lowest 3-hour average charge rate measured during the most recent performance test demonstrating compliance with all applicable emission limits.

(2) For batch HMIWI, 110 percent of the lowest daily charge rate measured during the most recent performance test demonstrating compliance with all applicable emission limits.

Maximum design waste burning capacity means:

(1) For intermittent and continuous HMIWI,

$$C = P_v \times 15,000/8,500$$

Where:

C=HMIWI capacity, lb/hr
P_v=primary chamber volume, ft^3
15,000=primary chamber heat release rate factor, Btu/ft^3/hr
8,500=standard waste heating value, Btu/lb;

(2) For batch HMIWI,

$$C = P_v \times 4.5/8$$

Where:

C=HMIWI capacity, lb/hr
P_v=primary chamber volume, ft^3
4.5=waste density, lb/ft^3
8=typical hours of operation of a batch HMIWI, hours.

Maximum fabric filter inlet temperature means 110 percent of the lowest 3-hour average temperature at the inlet to the fabric filter (taken, at a minimum, once every minute) measured during the most recent performance test demonstrating compliance with the dioxin/furan emission limit.

Maximum flue gas temperature means 110 percent of the lowest 3-hour average temperature at the outlet from the wet scrubber (taken, at a minimum, once every minute) measured during the most recent performance test demonstrating compliance with the mercury (Hg) emission limit.

Medical/infectious waste means any waste generated in the diagnosis, treatment, or immunization of human beings or animals, in research pertaining thereto, or in the production or testing of biologicals that is listed in paragraphs (1) through (7) of this definition. The definition of medical/infectious waste does not include hazardous waste identified or listed under the regulations in part 261 of this chapter; household waste, as defined in §261.4(b)(1) of this chapter; ash from incineration of medical/infectious waste, once the incineration process has been completed; human corpses, remains, and anatomical parts that are intended for interment mation; and domestic sewage materials identified in §261.4(a)(1) of this chapter.

(1) Cultures and stocks of infectious agents and associated biologicals, including: cultures from medical and pathological laboratories; cultures and stocks of infectious agents from research and industrial laboratories; wastes from the production of biologicals; discarded live and attenuated vaccines; and culture dishes and devices used to transfer, inoculate, and mix cultures.

(2) Human pathological waste, including tissues, organs, and body parts and body fluids that are removed during surgery or autopsy, or other medical procedures, and specimens of body fluids and their containers.

(3) Human blood and blood products including:

(i) Liquid waste human blood;

(ii) Products of blood;

(iii) Items saturated and/or dripping with human blood; or

(iv) Items that were saturated and/or dripping with human blood that are now caked with dried human blood; including serum, plasma, and other blood components, and their containers, which were used or intended for use in either patient care, testing and laboratory analysis or the development of pharmaceuticals. Intravenous bags are also include in this category.

(4) Sharps that have been used in animal or human patient care or treatment or in medical, research, or industrial laboratories, including hypodermic needles, syringes (with or without the attached needle), pasteur pipettes, scalpel blades, blood vials, needles with attached tubing, and culture dishes (regardless of presence of infectious agents). Also included are other types of broken or unbroken glassware that were in contact with infectious agents, such as used slides and cover slips.

(5) Animal waste including contaminated animal carcasses, body parts, and bedding of animals that were known to have been exposed to infectious agents during research (including research in veterinary hospitals), production of biologicals or testing of pharmaceuticals.

(6) Isolation wastes including biological waste and discarded materials contaminated with blood, excretions, exudates, or secretions from humans who are isolated to protect others from certain highly communicable diseases, or isolated animals known to be infected with highly communicable diseases.

(7) Unused sharps including the following unused, discarded sharps: hypodermic needles, suture needles, syringes, and scalpel blades.

Medium HMIWI means:

(1) Except as provided in paragraph (2);

(i) An HMIWI whose maximum design waste burning capacity is more than 200 pounds per hour but less than or equal to 500 pounds per hour; or

(ii) A continuous or intermittent HMIWI whose maximum charge rate is more than 200 pounds per hour but less than or equal to 500 pounds per hour; or

(iii) A batch HMIWI whose maximum charge rate is more than 1,600 pounds per day but less than or equal to 4,000 pounds per day.

(2) The following are not medium HMIWI:

(i) A continuous or intermittent HMIWI whose maximum charge rate is less than or equal to 200 pounds per hour or more than 500 pounds per hour; or

(ii) A batch HMIWI whose maximum charge rate is more than 4,000 pounds per day or less than or equal to 1,600 pounds per day.

Minimum dioxin/furan sorbent flow rate means 90 percent of the highest 3-hour average dioxin/furan sorbent flow rate (taken, at a minimum, once every hour) measured during the most recent performance test demonstrating compliance with the dioxin/furan emission limit.

Minimum Hg sorbent flow rate means 90 percent of the highest 3-hour average Hg sorbent flow rate (taken, at a minimum, once every hour) measured during the most recent performance test demonstrating compliance with the Hg emission limit.

Minimum hydrogen chloride (HCl) sorbent flow rate means 90 percent of the highest 3-hour average HCl sorbent flow rate (taken, at a minimum, once every hour) measured during the most recent performance test demonstrating compliance with the HCl emission limit.

Minimum horsepower or amperage means 90 percent of the highest 3-hour average horsepower or amperage to the wet scrubber (taken, at a minimum, once every minute) measured during the most recent performance test demonstrating compliance with the applicable emission limits.

Minimum pressure drop across the wet scrubber means 90 percent of the highest 3-hour average pressure drop across the wet scrubber PM control device (taken, at a minimum, once every minute) measured during the most recent performance test demonstrating compliance with the PM emission limit.

Minimum reagent flow rate means 90 percent of the highest 3-hour average reagent flow rate at the inlet to the selective noncatalytic reduction technology (taken, at a minimum, once every minute) measured during the most recent performance test demonstrating compliance with the NO$_x$ emissions limit.

Minimum scrubber liquor flow rate means 90 percent of the highest 3-hour average liquor flow rate at the inlet to the wet scrubber (taken, at a minimum, once every minute) measured during the most recent performance test demonstrating compliance with all applicable emission limits.

Minimum scrubber liquor pH means 90 percent of the highest 3-hour average liquor pH at the inlet to the wet scrubber (taken, at a minimum, once every minute) measured during the most recent performance test demonstrating compliance with the HCl emission limit.

Minimum secondary chamber temperature means 90 percent of the highest 3-hour average secondary chamber temperature (taken, at a minimum, once every minute) measured during the most recent performance test demonstrating compliance with the PM, CO, dioxin/furan, and NO$_x$ emissions limits.

Modification or *Modified HMIWI* means any change to an HMIWI unit after the effective date of these standards such that:

(1) The cumulative costs of the modifications, over the life of the unit, exceed 50 per centum of the original cost of the construction and installation of the unit (not including the cost of any land purchased in connection with such construction or installation) updated to current costs, or

(2) The change involves a physical change in or change in the method of operation of the unit which increases the amount of any air pollutant emitted by the unit for which standards have been established under section 129 or section 111.

Operating day means a 24-hour period between 12:00 midnight and the following midnight during which any amount of hospital waste or medical/infectious waste is combusted at any time in the HMIWI.

Operation means the period during which waste is combusted in the incinerator excluding periods of startup or shutdown.

Particulate matter or *PM* means the total particulate matter emitted from an HMIWI as measured by EPA Reference Method 5 or EPA Reference Method 29.

Pathological waste means waste material consisting of only human or animal remains, anatomical parts, and/or tissue, the bags/containers used to collect and transport the waste material, and animal bedding (if applicable).

Primary chamber means the chamber in an HMIWI that receives waste material, in which the waste is ignited, and from which ash is removed.

Pyrolysis means the endothermic gasification of hospital waste and/or medical/infectious waste using external energy.

Secondary chamber means a component of the HMIWI that receives combustion gases from the primary chamber and in which the combustion process is completed.

Shutdown means the period of time after all waste has been combusted in the primary chamber. For continuous HMIWI, shutdown shall commence no less than 2 hours after the last charge to the incinerator. For intermittent HMIWI, shutdown shall commence no less than 4 hours after the last charge to the incinerator. For batch HMIWI, shutdown shall commence no less than 5 hours after the high-air phase of combustion has been completed.

Small HMIWI means:

(1) Except as provided in (2):

(i) An HMIWI whose maximum design waste burning capacity is less than or equal to 200 pounds per hour; or

(ii) A continuous or intermittent HMIWI whose maximum charge rate is less than or equal to 200 pounds per hour; or

(iii) A batch HMIWI whose maximum charge rate is less than or equal to 1,600 pounds per day.

(2) The following are not small HMIWI:

(i) A continuous or intermittent HMIWI whose maximum charge rate is more than 200 pounds per hour:

(ii) A batch HMIWI whose maximum charge rate is more than 1,600 pounds per day.

Standard conditions means a temperature of 20 °C and a pressure of 101.3 kilopascals.

Startup means the period of time between the activation of the system and the first charge to the unit. For batch HMIWI, startup means the period of time between activation of the system and ignition of the waste.

Wet scrubber means an add-on air pollution control device that utilizes an alkaline scrubbing liquor to collect particulate matter (including non-vaporous metals and condensed organics) and/or to absorb and neutralize acid gases.

[62 FR 48382, Sept. 15, 1997, as amended at 74 FR 51408, Oct. 6, 2009]

§ 60.52c Emission limits.

(a) On and after the date on which the initial performance test is completed or is required to be completed under § 60.8, whichever date comes first, no owner or operator of an affected facility shall cause to be discharged into the atmosphere:

(1) From an affected facility as defined in § 60.50c(a)(1) and (2), any gases that contain stack emissions in excess of the limits presented in Table 1A to this subpart.

(2) From an affected facility as defined in § 60.50c(a)(3) and (4), any gases that contain stack emissions in excess of the limits presented in Table 1B to this subpart.

(b) On and after the date on which the initial performance test is completed or is required to be completed under § 60.8, whichever date comes first, no owner or operator of an affected facility shall cause to be discharged into the atmosphere:

(1) From an affected facility as defined in § 60.50c(a)(1) and (2), any gases that exhibit greater than 10 percent opacity (6-minute block average).

(2) From an affected facility as defined in § 60.50c(a)(3) and (4), any gases that exhibit greater than 6 percent opacity (6-minute block average).

(c) On and after the date on which the initial performance test is completed or is required to be completed under § 60.8, whichever date comes first,

no owner or operator of an affected facility as defined in § 60.50c(a)(1) and (2) and utilizing a large HMIWI, and in § 60.50c(a)(3) and (4), shall cause to be discharged into the atmosphere visible emissions of combustion ash from an ash conveying system (including conveyor transfer points) in excess of 5 percent of the observation period (i.e., 9 minutes per 3-hour period), as determined by EPA Reference Method 22 of appendix A-1 of this part, except as provided in paragraphs (d) and (e) of this section.

(d) The emission limit specified in paragraph (c) of this section does not cover visible emissions discharged inside buildings or enclosures of ash conveying systems; however, the emission limit does cover visible emissions discharged to the atmosphere from buildings or enclosures of ash conveying systems.

(e) The provisions specified in paragraph (c) of this section do not apply during maintenance and repair of ash conveying systems. Maintenance and/or repair shall not exceed 10 operating days per calendar quarter unless the owner or operator obtains written approval from the State agency establishing a date whereby all necessary maintenance and repairs of ash conveying systems shall be completed.

[62 FR 48382, Sept. 15, 1997, as amended at 74 FR 51409, Oct. 6, 2009]

§ 60.53c Operator training and qualification requirements.

(a) No owner or operator of an affected facility shall allow the affected facility to operate at any time unless a fully trained and qualified HMIWI operator is accessible, either at the facility or available within 1 hour. The trained and qualified HMIWI operator may operate the HMIWI directly or be the direct supervisor of one or more HMIWI operators.

(b) Operator training and qualification shall be obtained through a State-approved program or by completing the requirements included in paragraphs (c) through (g) of this section.

(c) Training shall be obtained by completing an HMIWI operator training course that includes, at a minimum, the following provisions:

(1) 24 hours of training on the following subjects:

(i) Environmental concerns, including pathogen destruction and types of emissions;

(ii) Basic combustion principles, including products of combustion;

(iii) Operation of the type of incinerator to be used by the operator, including proper startup, waste charging, and shutdown procedures;

(iv) Combustion controls and monitoring;

(v) Operation of air pollution control equipment and factors affecting performance (if applicable);

(vi) Methods to monitor pollutants (continuous emission monitoring systems and monitoring of HMIWI and air pollution control device operating parameters) and equipment calibration procedures (where applicable);

(vii) Inspection and maintenance of the HMIWI, air pollution control devices, and continuous emission monitoring systems;

(viii) Actions to correct malfunctions or conditions that may lead to malfunction;

(ix) Bottom and fly ash characteristics and handling procedures;

(x) Applicable Federal, State, and local regulations;

(xi) Work safety procedures;

(xii) Pre-startup inspections; and

(xiii) Recordkeeping requirements.

(2) An examination designed and administered by the instructor.

(3) Reference material distributed to the attendees covering the course topics.

(d) Qualification shall be obtained by:

(1) Completion of a training course that satisfies the criteria under paragraph (c) of this section; and

(2) Either 6 months experience as an HMIWI operator, 6 months experience as a direct supervisor of an HMIWI operator, or completion of at least two burn cycles under the observation of two qualified HMIWI operators.

(e) Qualification is valid from the date on which the examination is passed or the completion of the required experience, whichever is later.

(f) To maintain qualification, the trained and qualified HMIWI operator shall complete and pass an annual re-

view or refresher course of at least 4 hours covering, at a minimum, the following:

(1) Update of regulations;

(2) Incinerator operation, including startup and shutdown procedures;

(3) Inspection and maintenance;

(4) Responses to malfunctions or conditions that may lead to malfunction; and

(5) Discussion of operating problems encountered by attendees.

(g) A lapsed qualification shall be renewed by one of the following methods:

(1) For a lapse of less than 3 years, the HMIWI operator shall complete and pass a standard annual refresher course described in paragraph (f) of this section.

(2) For a lapse of 3 years or more, the HMIWI operator shall complete and pass a training course with the minimum criteria described in paragraph (c) of this section.

(h) The owner or operator of an affected facility shall maintain documentation at the facility that address the following:

(1) Summary of the applicable standards under this subpart;

(2) Description of basic combustion theory applicable to an HMIWI;

(3) Procedures for receiving, handling, and charging waste;

(4) HMIWI startup, shutdown, and malfunction procedures;

(5) Procedures for maintaining proper combustion air supply levels;

(6) Procedures for operating the HMIWI and associated air pollution control systems within the standards established under this subpart;

(7) Procedures for responding to periodic malfunction or conditions that may lead to malfunction;

(8) Procedures for monitoring HMIWI emissions;

(9) Reporting and recordkeeping procedures; and

(10) Procedures for handling ash.

(i) The owner or operator of an affected facility shall establish a program for reviewing the information listed in paragraph (h) of this section annually with each HMIWI operator (defined in §60.51c).

(1) The initial review of the information listed in paragraph (h) of this section shall be conducted within 6

295

months after the effective date of this subpart or prior to assumption of responsibilities affecting HMIWI operation, whichever date is later.

(2) Subsequent reviews of the information listed in paragraph (h) of this section shall be conducted annually.

(j) The information listed in paragraph (h) of this section shall be kept in a readily accessible location for all HMIWI operators. This information, along with records of training shall be available for inspection by the EPA or its delegated enforcement agent upon request.

§ 60.54c   Siting requirements.

(a) The owner or operator of an affected facility for which construction is commenced after September 15, 1997 shall prepare an analysis of the impacts of the affected facility. The analysis shall consider air pollution control alternatives that minimize, on a site-specific basis, to the maximum extent practicable, potential risks to public health or the environment. In considering such alternatives, the analysis may consider costs, energy impacts, non-air environmental impacts, or any other factors related to the practicability of the alternatives.

(b) Analyses of facility impacts prepared to comply with State, local, or other Federal regulatory requirements may be used to satisfy the requirements of this section, as long as they include the consideration of air pollution control alternatives specified in paragraph (a) of this section.

(c) The owner or operator of the affected facility shall complete and submit the siting requirements of this section as required under § 60.58c(a)(1)(iii).

§ 60.55c   Waste management plan.

The owner or operator of an affected facility shall prepare a waste management plan. The waste management plan shall identify both the feasibility and the approach to separate certain components of solid waste from the health care waste stream in order to reduce the amount of toxic emissions from incinerated waste. A waste management plan may include, but is not limited to, elements such as segregation and recycling of paper, cardboard, plastics, glass, batteries, food waste,

and metals (e.g., aluminum cans, metals-containing devices): segregation of non-recyclable wastes (e.g., poly-chlorinated biphenyl-containing waste, pharmaceutical waste, and mercury-containing waste, such as dental waste): and purchasing recycled or recyclable products. A waste management plan may include different goals or approaches for different areas or departments of the facility and need not include new waste management goals for every waste stream. It should identify, where possible, reasonably available additional waste management measures, taking into account the effectiveness of waste management measures already in place, the costs of additional measures, the emissions reductions expected to be achieved, and any other environmental or energy impacts they might have. The American Hospital Association publication entitled "An Ounce of Prevention: Waste Reduction Strategies for Health Care Facilities" (incorporated by reference, see § 60.17) shall be considered in the development of the waste management plan. The owner or operator of each commercial HMIWI company shall conduct training and education programs in waste segregation for each of the company's waste generator clients and ensure that each client prepares its own waste management plan that includes, but is not limited to, the provisions listed previously in this section.

[74 FR 51409, Oct. 6, 2009]

§ 60.56c   Compliance and performance testing.

(a) The emissions limits apply at all times.

(b) The owner or operator of an affected facility as defined in § 60.50c(a)(1) and (2), shall conduct an initial performance test as required under § 60.8 to determine compliance with the emissions limits using the procedures and test methods listed in paragraphs (b)(1) through (b)(6) and (b)(9) through (b)(14) of this section. The owner or operator of an affected facility as defined in § 60.50c(a)(3) and (4), shall conduct an initial performance test as required under § 60.8 to determine compliance with the emissions limits using the procedures and test methods listed in paragraphs (b)(1) through (b)(14). The

use of the bypass stack during a performance test shall invalidate the performance test.

(1) All performance tests shall consist of a minimum of three test runs conducted under representative operating conditions.

(2) The minimum sample time shall be 1 hour per test run unless otherwise indicated.

(3) EPA Reference Method 1 of appendix A of this part shall be used to select the sampling location and number of traverse points.

(4) EPA Reference Method 3, 3A, or 3B of appendix A-2 of this part shall be used for gas composition analysis, including measurement of oxygen concentration. EPA Reference Method 3, 3A, or 3B of appendix A-2 of this part shall be used simultaneously with each of the other EPA reference methods. As an alternative to EPA Reference Method 3B, ASME PTC-19-10-1981-Part 10 may be used (incorporated by reference, *see* § 60.17).

(5) The pollutant concentrations shall be adjusted to 7 percent oxygen using the following equation:

$$C_{adj}=C_{meas} (20.9-7)/(20.9-\%O_2)$$

where:

C_{adj}=pollutant concentration adjusted to 7 percent oxygen;

C_{meas}=pollutant concentration measured on a dry basis (20.9-7)=20.9 percent oxygen—7 percent oxygen (defined oxygen correction basis);

20.9=oxygen concentration in air, percent; and

$\%O_2$=oxygen concentration measured on a dry basis, percent.

(6) EPA Reference Method 5 of appendix A-3 or Method 26A or Method 29 of appendix A-8 of this part shall be used to measure the particulate matter emissions. As an alternative, PM CEMS may be used as specified in paragraph (c)(5) of this section.

(7) EPA Reference Method 7 or 7E of appendix A-4 of this part shall be used to measure NO_x emissions.

(8) EPA Reference Method 6 or 6C of appendix A-4 of this part shall be used to measure SO_2 emissions.

(9) EPA Reference Method 9 of appendix A-4 of this part shall be used to measure stack opacity. As an alternative, demonstration of compliance with the PM standards using bag leak detection systems as specified in § 60.57c(h) or PM CEMS as specified in paragraph (c)(5) of this section is considered demonstrative of compliance with the opacity requirements.

(10) EPA Reference Method 10 or 10B of appendix A-4 of this part shall be used to measure the CO emissions. As specified in paragraph (c)(4) of this section, use of CO CEMS are required for affected facilities under § 60.50c(a)(3) and (4).

(11) EPA Reference Method 23 of appendix A-7 of this part shall be used to measure total dioxin/furan emissions. As an alternative, an owner or operator may elect to sample dioxins/furans by installing, calibrating, maintaining, and operating a continuous automated sampling system for monitoring dioxin/furan emissions as specified in paragraph (c)(6) of this section. For Method 23 of appendix A-7 sampling, the minimum sample time shall be 4 hours per test run. If the affected facility has selected the toxic equivalency standards for dioxins/furans, under § 60.52c, the following procedures shall be used to determine compliance:

(i) Measure the concentration of each dioxin/furan tetra-through octa-congener emitted using EPA Reference Method 23.

(ii) For each dioxin/furan congener measured in accordance with paragraph (b)(9)(i) of this section, multiply the congener concentration by its corresponding toxic equivalency factor specified in table 2 of this subpart.

(iii) Sum the products calculated in accordance with paragraph (b)(9)(ii) of this section to obtain the total concentration of dioxins/furans emitted in terms of toxic equivalency.

(12) EPA Reference Method 26 or 26A of appendix A-8 of this part shall be used to measure HCl emissions. As an alternative, HCl CEMS may be used as specified in paragraph (c)(5) of this section.

(13) EPA Reference Method 29 of appendix A-8 of this part shall be used to measure Pb, Cd, and Hg emissions. As an alternative, Hg emissions may be measured using ASTM D6784-02 (incorporated by reference, *see* § 60.17). As an alternative for Pb, Cd, and Hg, multimetals CEMS or Hg CEMS, may be used as specified in paragraph (c)(5) of

this section. As an alternative, an owner or operator may elect to sample Hg by installing, calibrating, maintaining, and operating a continuous automated sampling system for monitoring Hg emissions as specified in paragraph (c)(7) of this section.

(14) The EPA Reference Method 22 of appendix A–7 of this part shall be used to determine compliance with the fugitive ash emissions limit under § 60.52c(c). The minimum observation time shall be a series of three 1-hour observations.

(c) Following the date on which the initial performance test is completed or is required to be completed under § 60.8, whichever date comes first, the owner or operator of an affected facility shall:

(1) Determine compliance with the opacity limit by conducting an annual performance test (no more than 12 months following the previous performance test) using the applicable procedures and test methods listed in paragraph (b) of this section.

(2) Except as provided in paragraphs (c)(4) and (c)(5) of this section, determine compliance with the PM, CO, and HCl emissions limits by conducting an annual performance test (no more than 12 months following the previous performance test) using the applicable procedures and test methods listed in paragraph (b) of this section. If all three performance tests over a 3-year period indicate compliance with the emissions limit for a pollutant (PM, CO, or HCl), the owner or operator may forego a performance test for that pollutant for the subsequent 2 years. At a minimum, a performance test for PM, CO, and HCl shall be conducted every third year (no more than 36 months following the previous performance test). If a performance test conducted every third year indicates compliance with the emissions limit for a pollutant (PM, CO, or HCl), the owner or operator may forego a performance test for that pollutant for an additional 2 years. If any performance test indicates noncompliance with the respective emissions limit, a performance test for that pollutant shall be conducted annually until all annual performance tests over a 3-year period indicate compliance with the emissions

limit. The use of the bypass stack during a performance test shall invalidate the performance test.

(3) For an affected facility as defined in § 60.50c(a)(1) and (2) and utilizing a large HMIWI, and in § 60.50c(a)(3) and (4), determine compliance with the visible emissions limits for fugitive emissions from flyash/bottom ash storage and handling by conducting a performance test using EPA Reference Method 22 of appendix A–7 on an annual basis (no more than 12 months following the previous performance test).

(4) For an affected facility as defined in § 60.50c(a)(3) and (4), determine compliance with the CO emissions limit using a CO CEMS according to paragraphs (c)(4)(i) through (c)(4)(iii) of this section:

(i) Determine compliance with the CO emissions limit using a 24-hour block average, calculated as specified in section 12.4.1 of EPA Reference Method 19 of appendix A–7 of this part.

(ii) Operate the CO CEMS in accordance with the applicable procedures under appendices B and F of this part.

(iii) Use of a CO CEMS may be substituted for the CO annual performance test and minimum secondary chamber temperature to demonstrate compliance with the CO emissions limit.

(5) Facilities using CEMS to demonstrate compliance with any of the emissions limits under § 60.52c shall:

(i) For an affected facility as defined in § 60.50c(a)(1) and (2), determine compliance with the appropriate emissions limit(s) using a 12-hour rolling average, calculated each hour as the average of the previous 12 operating hours.

(ii) For an affected facility as defined in § 60.50c(a)(3) and (4), determine compliance with the appropriate emissions limit(s) using a 24-hour block average, calculated as specified in section 12.4.1 of EPA Reference Method 19 of appendix A–7 of this part.

(iii) Operate all CEMS in accordance with the applicable procedures under appendices B and F of this part. For those CEMS for which performance specifications have not yet been promulgated (HCl, multi-metals), this option for an affected facility as defined in § 60.50c(a)(3) and (4) takes effect on

the date a final performance specification is published in the FEDERAL REGISTER or the date of approval of a site-specific monitoring plan.

(iv) For an affected facility as defined in § 60.50c(a)(3) and (4), be allowed to substitute use of an HCl CEMS for the HCl annual performance test, minimum HCl sorbent flow rate, and minimum scrubber liquor pH to demonstrate compliance with the HCl emissions limit.

(v) For an affected facility as defined in § 60.50c(a)(3) and (4), be allowed to substitute use of a PM CEMS for the PM annual performance test and minimum pressure drop across the wet scrubber, if applicable, to demonstrate compliance with the PM emissions limit.

(6) An affected facility as defined in § 60.50c(a)(3) and (4) using a continuous automated sampling system to demonstrate compliance with the dioxin/furan emissions limits under § 60.52c shall record the output of the system and analyze the sample according to EPA Reference Method 23 of appendix A–7 of this part. This option to use a continuous automated sampling system takes effect on the date a final performance specification applicable to dioxin/furan from monitors is published in the FEDERAL REGISTER or the date of approval of a site-specific monitoring plan. The owner or operator of an affected facility as defined in § 60.50c(a)(3) and (4) who elects to continuously sample dioxin/furan emissions instead of sampling and testing using EPA Reference Method 23 of appendix A–7 shall install, calibrate, maintain, and operate a continuous automated sampling system and shall comply with the requirements specified in § 60.58b(p) and (q) of subpart Eb of this part.

(7) An affected facility as defined in § 60.50c(a)(3) and (4) using a continuous automated sampling system to demonstrate compliance with the Hg emissions limits under § 60.52c shall record the output of the system and analyze the sample at set intervals using any suitable determinative technique that can meet appropriate performance criteria. This option to use a continuous automated sampling system takes effect on the date a final performance specification applicable to Hg from

monitors is published in the FEDERAL REGISTER or the date of approval of a site-specific monitoring plan. The owner or operator of an affected facility as defined in § 60.50c(a)(3) and (4) who elects to continuously sample Hg emissions instead of sampling and testing using EPA Reference Method 29 of appendix A–8 of this part, or an approved alternative method for measuring Hg emissions, shall install, calibrate, maintain, and operate a continuous automated sampling system and shall comply with the requirements specified in § 60.58b(p) and (q) of subpart Eb of this part.

(d) Except as provided in paragraphs (c)(4) through (c)(7) of this section, the owner or operator of an affected facility equipped with a dry scrubber followed by a fabric filter, a wet scrubber, or a dry scrubber followed by a fabric filter and wet scrubber shall:

(1) Establish the appropriate maximum and minimum operating parameters, indicated in table 3 of this subpart for each control system, as site specific operating parameters during the initial performance test to determine compliance with the emission limits; and

(2) Following the date on which the initial performance test is completed or is required to be completed under § 60.8, whichever date comes first, ensure that the affected facility does not operate above any of the applicable maximum operating parameters or below any of the applicable minimum operating parameters listed in table 3 of this subpart and measured as 3-hour rolling averages (calculated each hour as the average of the previous 3 operating hours) at all times except during periods of startup, shutdown and malfunction. Operating parameter limits do not apply during performance tests. Operation above the established maximum or below the established minimum operating parameter(s) shall constitute a violation of established operating parameter(s).

(e) Except as provided in paragraph (i) of this section, for affected facilities equipped with a dry scrubber followed by a fabric filter:

(1) Operation of the affected facility above the maximum charge rate and

299

below the minimum secondary chamber temperature (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the CO emission limit.

(2) Operation of the affected facility above the maximum fabric filter inlet temperature, above the maximum charge rate, and below the minimum dioxin/furan sorbent flow rate (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the dioxin/furan emission limit.

(3) Operation of the affected facility above the maximum charge rate and below the minimum HCl sorbent flow rate (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the HCl emission limit.

(4) Operation of the affected facility above the maximum charge rate and below the minimum Hg sorbent flow rate (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the Hg emission limit.

(5) Use of the bypass stack shall constitute a violation of the PM, dioxin/furan, HCl, Pb, Cd and Hg emissions limits.

(6) Operation of the affected facility as defined in § 60.50c(a)(3) and (4) above the CO emissions limit as measured by the CO CEMS specified in paragraph (c)(4) of this section shall constitute a violation of the CO emissions limit.

(7) For an affected facility as defined in § 60.50c(a)(3) and (4), failure to initiate corrective action within 1 hour of a bag leak detection system alarm; or failure to operate and maintain the fabric filter such that the alarm is not engaged for more than 5 percent of the total operating time in a 6-month block reporting period shall constitute a violation of the PM emissions limit. If inspection of the fabric filter demonstrates that no corrective action is required, no alarm time is counted. If corrective action is required, each alarm is counted as a minimum of 1 hour. If it takes longer than 1 hour to initiate corrective action, the alarm time is counted as the actual amount of time taken to initiate corrective action. If the bag leak detection system is used to demonstrate compliance

with the opacity limit, this would also constitute a violation of the opacity emissions limit.

(8) Operation of the affected facility as defined in § 60.50c(a)(3) and (4) above the PM, HCl, Pb, Cd, and/or Hg emissions limit as measured by the CEMS specified in paragraph (c)(5) of this section shall constitute a violation of the applicable emissions limit.

(9) Operation of the affected facility as defined in § 60.50c(a)(3) and (4) above the dioxin/furan emissions limit as measured by the continuous automated sampling system specified in paragraph (c)(6) of this section shall constitute a violation of the dioxin/furan emissions limit.

(10) Operation of the affected facility as defined in § 60.50c(a)(3) and (4) above the Hg emissions limit as measured by the continuous automated sampling system specified in paragraph (c)(7) of this section shall constitute a violation of the Hg emissions limit.

(f) Except as provided in paragraph (i) of this section, for affected facilities equipped with a wet scrubber:

(1) Operation of the affected facility above the maximum charge rate and below the minimum pressure drop across the wet scrubber or below the minimum horsepower or amperage to the system (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the PM emission limit.

(2) Operation of the affected facility above the maximum charge rate and below the minimum secondary chamber temperature (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the CO emission limit.

(3) Operation of the affected facility above the maximum charge rate, below the minimum secondary chamber temperature, and below the minimum scrubber liquor flow rate (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the dioxin/furan emission limit.

(4) Operation of the affected facility above the maximum charge rate and below the minimum scrubber liquor pH (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the HCl emission limit.

(5) Operation of the affected facility above the maximum flue gas temperature and above the maximum charge rate (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the Hg emission limit.

(6) Use of the bypass stack shall constitute a violation of the PM, dioxin/furan, HCl, Pb, Cd and Hg emissions limits.

(7) Operation of the affected facility as defined in §60.50c(a)(3) and (4) above the CO emissions limit as measured by the CO CEMS specified in paragraph (c)(4) of this section shall constitute a violation of the CO emissions limit.

(8) Operation of the affected facility as defined in §60.50c(a)(3) and (4) above the PM, HCl, Pb, Cd, and/or Hg emissions limit as measured by the CEMS specified in paragraph (c)(5) of this section shall constitute a violation of the applicable emissions limit.

(9) Operation of the affected facility as defined in §60.50c(a)(3) and (4) above the dioxin/furan emissions limit as measured by the continuous automated sampling system specified in paragraph (c)(6) of this section shall constitute a violation of the dioxin/furan emissions limit.

(10) Operation of the affected facility as defined in §60.50c(a)(3) and (4) above the Hg emissions limit as measured by the continuous automated sampling system specified in paragraph (c)(7) of this section shall constitute a violation of the Hg emissions limit.

(g) Except as provided in paragraph (i) of this section, for affected facilities equipped with a dry scrubber followed by a fabric filter and a wet scrubber:

(1) Operation of the affected facility above the maximum charge rate and below the minimum secondary chamber temperature (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the CO emission limit.

(2) Operation of the affected facility above the maximum fabric filter inlet temperature, above the maximum charge rate, and below the minimum dioxin/furan sorbent flow rate (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the dioxin/furan emission limit.

(3) Operation of the affected facility above the maximum charge rate and below the minimum scrubber liquor pH (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the HCl emission limit.

(4) Operation of the affected facility above the maximum charge rate and below the minimum Hg sorbent flow rate (each measured on a 3-hour rolling average) simultaneously shall constitute a violation of the Hg emission limit.

(5) Use of the bypass stack shall constitute a violation of the PM, dioxin/furan, HCl, Pb, Cd and Hg emissions limits.

(6) Operation of the affected facility as defined in §60.50c(a)(3) and (4) above the CO emissions limit as measured by the CO CEMS specified in paragraph (c)(4) of this section shall constitute a violation of the CO emissions limit.

(7) For an affected facility as defined in §60.50c(a)(3) and (4), failure to initiate corrective action within 1 hour of a bag leak detection system alarm; or failure to operate and maintain the fabric filter such that the alarm is not engaged for more than 5 percent of the total operating time in a 6-month block reporting period shall constitute a violation of the PM emissions limit. If inspection of the fabric filter demonstrates that no corrective action is required, no alarm time is counted. If corrective action is required, each alarm is counted as a minimum of 1 hour. If it takes longer than 1 hour to initiate corrective action, the alarm time is counted as the actual amount of time taken to initiate corrective action. If the bag leak detection system is used to demonstrate compliance with the opacity limit, this would also constitute a violation of the opacity emissions limit.

(8) Operation of the affected facility as defined in §60.50c(a)(3) and (4) above the PM, HCl, Pb, Cd, and/or Hg emissions limit as measured by the CEMS specified in paragraph (c)(5) of this section shall constitute a violation of the applicable emissions limit.

(9) Operation of the affected facility as defined in §60.50c(a)(3) and (4) above the dioxin/furan emissions limit as measured by the continuous automated sampling system specified in paragraph

(c)(6) of this section shall constitute a violation of the dioxin/furan emissions limit.

(10) Operation of the affected facility as defined in §60.50c(a)(3) and (4) above the Hg emissions limit as measured by the continuous automated sampling system specified in paragraph (c)(7) of this section shall constitute a violation of the Hg emissions limit.

(h) The owner or operator of an affected facility as defined in §60.50c(a)(3) and (4) equipped with selective non-catalytic reduction technology shall:

(1) Establish the maximum charge rate, the minimum secondary chamber temperature, and the minimum reagent flow rate as site specific operating parameters during the initial performance test to determine compliance with the emissions limits;

(2) Following the date on which the initial performance test is completed or is required to be completed under §60.8, whichever date comes first, ensure that the affected facility does not operate above the maximum charge rate, or below the minimum secondary chamber temperature or the minimum reagent flow rate measured as 3-hour rolling averages (calculated each hour as the average of the previous 3 operating hours) at all times. Operating parameter limits do not apply during performance tests.

(3) Except as provided in paragraph (i) of this section, operation of the affected facility above the maximum charge rate, below the minimum secondary chamber temperature, and below the minimum reagent flow rate simultaneously shall constitute a violation of the NO_x emissions limit.

(i) The owner or operator of an affected facility may conduct a repeat performance test within 30 days of violation of applicable operating parameter(s) to demonstrate that the affected facility is not in violation of the applicable emissions limit(s). Repeat performance tests conducted pursuant to this paragraph shall be conducted using the identical operating parameters that indicated a violation under paragraph (e), (f), (g), or (h) of this section.

(j) The owner or operator of an affected facility using an air pollution control device other than a dry scrub-ber followed by a fabric filter, a wet scrubber, a dry scrubber followed by a fabric filter and a wet scrubber, or selective noncatalytic reduction technology to comply with the emissions limits under §60.52c shall petition the Administrator for other site-specific operating parameters to be established during the initial performance test and continuously monitored thereafter. The owner or operator shall not conduct the initial performance test until after the petition has been approved by the Administrator.

(k) The owner or operator of an affected facility may conduct a repeat performance test at any time to establish new values for the operating parameters. The Administrator may request a repeat performance test at any time.

[62 FR 48382, Sept. 15, 1997, as amended at 65 FR 61753, Oct. 17, 2000; 74 FR 51409, Oct. 6, 2009]

§ 60.57c   Monitoring requirements.

(a) Except as provided in §60.56c(c)(4) through (c)(7), the owner or operator of an affected facility shall install, calibrate (to manufacturers' specifications), maintain, and operate devices (or establish methods) for monitoring the applicable maximum and minimum operating parameters listed in Table 3 to this subpart (unless CEMS are used as a substitute for certain parameters as specified) such that these devices (or methods) measure and record values for these operating parameters at the frequencies indicated in Table 3 of this subpart at all times.

(b) The owner or operator of an affected facility as defined in §60.50c(a)(3) and (4) that uses selective noncatalytic reduction technology shall install, calibrate (to manufacturers' specifications), maintain, and operate devices (or establish methods) for monitoring the operating parameters listed in §60.56c(h) such that the devices (or methods) measure and record values for the operating parameters at all times. Operating parameter values shall be measured and recorded at the following minimum frequencies:

(1) Maximum charge rate shall be measured continuously and recorded once each hour;

(2) Minimum secondary chamber temperature shall be measured continuously and recorded once each minute; and

(3) Minimum reagent flow rate shall be measured hourly and recorded once each hour.

(c) The owner or operator of an affected facility shall install, calibrate (to manufacturers' specifications), maintain, and operate a device or method for measuring the use of the bypass stack including date, time, and duration.

(d) The owner or operator of an affected facility using an air pollution control device other than a dry scrubber followed by a fabric filter, a wet scrubber, a dry scrubber followed by a fabric filter and a wet scrubber, or selective noncatalytic reduction technology to comply with the emissions limits under §60.52c shall install, calibrate (to manufacturers' specifications), maintain, and operate the equipment necessary to monitor the site-specific operating parameters developed pursuant to §60.56c(j).

(e) The owner or operator of an affected facility shall obtain monitoring data at all times during HMIWI operation except during periods of monitoring equipment malfunction, calibration, or repair. At a minimum, valid monitoring data shall be obtained for 75 percent of the operating hours per day for 90 percent of the operating days per calendar quarter that the affected facility is combusting hospital waste and/or medical/infectious waste.

(f) The owner or operator of an affected facility as defined in §60.50c(a)(3) and (4) shall ensure that each HMIWI subject to the emissions limits in §60.52c undergoes an initial air pollution control device inspection that is at least as protective as the following:

(1) At a minimum, an inspection shall include the following:

(i) Inspect air pollution control device(s) for proper operation, if applicable;

(ii) Ensure proper calibration of thermocouples, sorbent feed systems, and any other monitoring equipment; and

(iii) Generally observe that the equipment is maintained in good operating condition.

(2) Within 10 operating days following an air pollution control device inspection, all necessary repairs shall be completed unless the owner or operator obtains written approval from the Administrator establishing a date whereby all necessary repairs of the designated facility shall be completed.

(g) The owner or operator of an affected facility as defined in §60.50c(a)(3) and (4) shall ensure that each HMIWI subject to the emissions limits under §60.52c undergoes an air pollution control device inspection annually (no more than 12 months following the previous annual air pollution control device inspection), as outlined in paragraphs (f)(1) and (f)(2) of this section.

(h) For affected facilities as defined in §60.50c(a)(3) and (4) that use an air pollution control device that includes a fabric filter and are not demonstrating compliance using PM CEMS, determine compliance with the PM emissions limit using a bag leak detection system and meet the requirements in paragraphs (h)(1) through (h)(12) of this section for each bag leak detection system.

(1) Each triboelectric bag leak detection system may be installed, calibrated, operated, and maintained according to the "Fabric Filter Bag Leak Detection Guidance," (EPA–454/R–98–015, September 1997). This document is available from the U.S. Environmental Protection Agency (U.S. EPA); Office of Air Quality Planning and Standards; Sector Policies and Programs Division; Measurement Policy Group (D–243–02), Research Triangle Park, NC 27711. This document is also available on the Technology Transfer Network (TTN) under Emissions Measurement Center Continuous Emissions Monitoring. Other types of bag leak detection systems shall be installed, operated, calibrated, and maintained in a manner consistent with the manufacturer's written specifications and recommendations.

(2) The bag leak detection system shall be certified by the manufacturer to be capable of detecting PM emissions at concentrations of 10 milligrams per actual cubic meter (0.0044 grains per actual cubic foot) or less.

(3) The bag leak detection system sensor shall provide an output of relative PM loadings.

(4) The bag leak detection system shall be equipped with a device to continuously record the output signal from the sensor.

(5) The bag leak detection system shall be equipped with an audible alarm system that will sound automatically when an increase in relative PM emissions over a preset level is detected. The alarm shall be located where it is easily heard by plant operating personnel.

(6) For positive pressure fabric filter systems, a bag leak detector shall be installed in each baghouse compartment or cell.

(7) For negative pressure or induced air fabric filters, the bag leak detector shall be installed downstream of the fabric filter.

(8) Where multiple detectors are required, the system's instrumentation and alarm may be shared among detectors.

(9) The baseline output shall be established by adjusting the range and the averaging period of the device and establishing the alarm set points and the alarm delay time according to section 5.0 of the "Fabric Filter Bag Leak Detection Guidance."

(10) Following initial adjustment of the system, the sensitivity or range, averaging period, alarm set points, or alarm delay time may not be adjusted. In no case may the sensitivity be increased by more than 100 percent or decreased more than 50 percent over a 365-day period unless such adjustment follows a complete fabric filter inspection that demonstrates that the fabric filter is in good operating condition. Each adjustment shall be recorded.

(11) Record the results of each inspection, calibration, and validation check.

(12) Initiate corrective action within 1 hour of a bag leak detection system alarm; operate and maintain the fabric filter such that the alarm is not engaged for more than 5 percent of the total operating time in a 6-month block reporting period. If inspection of the fabric filter demonstrates that no corrective action is required, no alarm time is counted. If corrective action is required, each alarm is counted as a minimum of 1 hour. If it takes longer than 1 hour to initiate corrective action, the alarm time is counted as the actual amount of time taken to initiate corrective action.

[62 FR 48382, Sept. 15, 1997, as amended at 74 FR 51412, Oct. 6, 2009]

§ 60.58c Reporting and recordkeeping requirements.

(a) The owner or operator of an affected facility shall submit notifications, as provided by § 60.7. In addition, the owner or operator shall submit the following information:

(1) Prior to commencement of construction;

(i) A statement of intent to construct;

(ii) The anticipated date of commencement of construction; and

(iii) All documentation produced as a result of the siting requirements of § 60.54c.

(2) Prior to initial startup;

(i) The type(s) of waste to be combusted;

(ii) The maximum design waste burning capacity;

(iii) The anticipated maximum charge rate; and

(iv) If applicable, the petition for site-specific operating parameters under § 60.56c(j).

(b) The owner or operator of an affected facility shall maintain the following information (as applicable) for a period of at least 5 years:

(1) Calendar date of each record;

(2) Records of the following data:

(i) Concentrations of any pollutant listed in § 60.52c or measurements of opacity as determined by the continuous emission monitoring system (if applicable);

(ii) Results of fugitive emissions (by EPA Reference Method 22) tests, if applicable;

(iii) HMIWI charge dates, times, and weights and hourly charge rates;

(iv) Fabric filter inlet temperatures during each minute of operation, as applicable;

(v) Amount and type of dioxin/furan sorbent used during each hour of operation, as applicable;

(vi) Amount and type of Hg sorbent used during each hour of operation, as applicable;

(vii) Amount and type of HCl sorbent used during each hour of operation, as applicable;

(viii) For affected facilities as defined in §60.50c(a)(3) and (4), amount and type of NO_x reagent used during each hour of operation, as applicable;

(ix) Secondary chamber temperatures recorded during each minute of operation;

(x) Liquor flow rate to the wet scrubber inlet during each minute of operation, as applicable;

(xi) Horsepower or amperage to the wet scrubber during each minute of operation, as applicable;

(xii) Pressure drop across the wet scrubber system during each minute of operation, as applicable,

(xiii) Temperature at the outlet from the wet scrubber during each minute of operation, as applicable;

(xiv) pH at the inlet to the wet scrubber during each minute of operation, as applicable,

(xv) Records indicating use of the bypass stack, including dates, times, and durations, and

(xvi) For affected facilities complying with §60.56c(j) and §60.57c(d), the owner or operator shall maintain all operating parameter data collected;

(xvii) For affected facilities as defined in §60.50c(a)(3) and (4), records of the annual air pollution control device inspections, any required maintenance, and any repairs not completed within 10 days of an inspection or the timeframe established by the Administrator.

(xviii) For affected facilities as defined in §60.50c(a)(3) and (4), records of each bag leak detection system alarm, the time of the alarm, the time corrective action was initiated and completed, and a brief description of the cause of the alarm and the corrective action taken, as applicable.

(xix) For affected facilities as defined in §60.50c(a)(3) and (4), concentrations of CO as determined by the continuous emissions monitoring system.

(3) Identification of calendar days for which data on emission rates or operating parameters specified under paragraph (b)(2) of this section have not been obtained, with an identification of the emission rates or operating parameters not measured, reasons for not obtaining the data, and a description of corrective actions taken.

(4) Identification of calendar days, times and durations of malfunctions, a description of the malfunction and the corrective action taken.

(5) Identification of calendar days for which data on emission rates or operating parameters specified under paragraph (b)(2) of this section exceeded the applicable limits, with a description of the exceedances, reasons for such exceedances, and a description of corrective actions taken.

(6) The results of the initial, annual, and any subsequent performance tests conducted to determine compliance with the emissions limits and/or to establish or re-establish operating parameters, as applicable, and a description, including sample calculations, of how the operating parameters were established or re-established, if applicable.

(7) All documentation produced as a result of the siting requirements of §60.54c;

(8) Records showing the names of HMIWI operators who have completed review of the information in §60.53c(h) as required by §60.53c(i), including the date of the initial review and all subsequent annual reviews;

(9) Records showing the names of the HMIWI operators who have completed the operator training requirements, including documentation of training and the dates of the training;

(10) Records showing the names of the HMIWI operators who have met the criteria for qualification under §60.53c and the dates of their qualification; and

(11) Records of calibration of any monitoring devices as required under §60.57c(a) through (d).

(c) The owner or operator of an affected facility shall submit the information specified in paragraphs (c)(1) through (c)(4) of this section no later than 60 days following the initial performance test. All reports shall be signed by the facilities manager.

(1) The initial performance test data as recorded under §60.56c(b)(1) through (b)(14), as applicable.

(2) The values for the site-specific operating parameters established pursuant to § 60.56c(d), (h), or (j), as applicable, and a description, including sample calculations, of how the operating parameters were established during the initial performance test.

(3) The waste management plan as specified in § 60.55c.

(4) For each affected facility as defined in § 60.50c(a)(3) and (4) that uses a bag leak detection system, analysis and supporting documentation demonstrating conformance with EPA guidance and specifications for bag leak detection systems in § 60.57c(h).

(d) An annual report shall be submitted 1 year following the submissions of the information in paragraph (c) of this section and subsequent reports shall be submitted no more than 12 months following the previous report (once the unit is subject to permitting requirements under title V of the Clean Air Act, the owner or operator of an affected facility must submit these reports semiannually). The annual report shall include the information specified in paragraphs (d)(1) through (11) of this section. All reports shall be signed by the facilities manager.

(1) The values for the site-specific operating parameters established pursuant to § 60.56(d), (h), or (j), as applicable.

(2) The highest maximum operating parameter and the lowest minimum operating parameter, as applicable, for each operating parameter recorded for the calendar year being reported, pursuant to § 60.56(d), (h), or (j), as applicable.

(3) The highest maximum operating parameter and the lowest minimum operating parameter, as applicable, for each operating parameter recorded pursuant to § 60.56(d), (h), or (j) for the calendar year preceding the year being reported, in order to provide the Administrator with a summary of the performance of the affected facility over a 2-year period.

(4) Any information recorded under paragraphs (b)(3) through (b)(5) of this section for the calendar year being reported.

(5) Any information recorded under paragraphs (b)(3) through (b)(5) of this

section for the calendar year preceding the year being reported, in order to provide the Administrator with a summary of the performance of the affected facility over a 2-year period.

(6) If a performance test was conducted during the reporting period, the results of that test.

(7) If no exceedances or malfunctions were reported under paragraphs (b)(3) through (b)(5) of this section for the calendar year being reported, a statement that no exceedances occurred during the reporting period.

(8) Any use of the bypass stack, the duration, reason for malfunction, and corrective action taken.

(9) For affected facilities as defined in § 60.50c(a)(3) and (4), records of the annual air pollution control device inspection, any required maintenance, and any repairs not completed within 10 days of an inspection or the timeframe established by the Administrator.

(10) For affected facilities as defined in § 60.50c(a)(3) and (4), records of each bag leak detection system alarm, the time of the alarm, the time corrective action was initiated and completed, and a brief description of the cause of the alarm and the corrective action taken, as applicable.

(11) For affected facilities as defined in § 60.50c(a)(3) and (4), concentrations of CO as determined by the continuous emissions monitoring system.

(e) The owner or operator of an affected facility shall submit semiannual reports containing any information recorded under paragraphs (b)(3) through (b)(5) of this section no later than 60 days following the reporting period. The first semiannual reporting period ends 6 months following the submission of information in paragraph (c) of this section. Subsequent reports shall be submitted no later than 6 calendar months following the previous report. All reports shall be signed by the facilities manager.

(f) All records specified under paragraph (b) of this section shall be maintained onsite in either paper copy or computer-readable format, unless an alternative format is approved by the Administrator.

(g) For affected facilities, as defined in § 60.50c(a)(3) and (4), that choose to

submit an electronic copy of stack test reports to EPA's WebFIRE data base, as of December 31, 2011, the owner or operator of an affected facility shall enter the test data into EPA's data base using the Electronic Reporting Tool located at *http://www.epa.gov/ttn/ chief/ert/ert__tool.html.*

[62 FR 48382, Sept. 15, 1997, as amended at 74 FR 51413. Oct. 6, 2009]

TABLE 1A TO SUBPART Ec OF PART 60—EMISSIONS LIMITS FOR SMALL, MEDIUM, AND LARGE HMIWI AT AFFECTED FACILITIES AS DEFINED IN §60.50c(a)(1) AND (2)

Pollutant	Units (7 percent oxygen, dry basis)	Emissions limits HMIWI size			Averaging time[1]	Method for demonstrating compliance[2]
		Small	Medium	Large		
Particulate matter	Milligrams per dry standard cubic meter (grains per dry standard cubic foot).	69 (0.03)	34 (0.015)	34 (0.015)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 5 of appendix A–3 of part 60, or EPA Reference Method M 26A or 29 of appendix A–8 of part 60.
Carbon monoxide	Parts per million by volume	40	40	40	3-run average (1-hour minimum sample time per run).	EPA Reference Method 10 or 10B of appendix A–4 of part 60.
Dioxins/furans	Nanograms per dry standard cubic meter total dioxins/furans (grains per billion dry standard cubic feet) or nanograms per dry standard cubic meter TEQ (grains per billion dry standard cubic feet).	125 (55) or 2.3 (1.0).	25 (11) or 0.6 (0.26).	25 (11) or 0.6 (0.26).	3-run average (4-hour minimum sample time per run).	EPA Reference Method 23 of appendix A–7 of part 60.
Hydrogen chloride.	Parts per million by volume	15 or 99%	15 or 99%	15 or 99%5.1	3-run average (1-hour minimum sample time per run).	EPA Reference Method 26 or 26A of appendix A–8 of part 60.
Sulfur dioxide	Parts per million by volume	55	55	55	3-run average (1-hour minimum sample time per run).	EPA Reference Method 6 or 6C of appendix A–4 of part 60.
Nitrogen oxides	Parts per million by volume	250	250	250	3-run average (1-hour minimum sample time per run).	EPA Reference Method 7 or 7E of appendix A–4 of part 60.
Lead	Milligrams per dry standard cubic meter (grains per thousand dry standard cubic feet.	1.2 (0.52) or 70%	0.07 (0.03) or 98%.	0.07 (0.03) or 98%.	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.
Cadmium	Milligrams per dry standard cubic meter (grains per thousand dry standard cubic feet) or percent reduction.	0.16 (0.07) or 65%.	0.04 (0.02) or 90%.	0.04 (0.02) or 90%.	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.
Mercury	Milligrams per dry standard cubic meter (grains per thousand dry standard cubic feet) or percent reduction.	0.55 (0.24) or 85%.	0.55 (0.24) or 85%.	0.55 (0.24) or 85%.	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.

[1] Except as allowed under §60.56c(c) for HMIWI equipped with CEMS.
[2] Does not include CEMS and approved alternative non-EPA test methods allowed under §60.56c(b).

[74 FR 51414, Oct. 6, 2009]

TABLE 1B TO SUBPART Ec OF PART 60—EMISSIONS LIMITS FOR SMALL, MEDIUM, AND LARGE HMIWI AT AFFECTED FACILITIES AS DEFINED IN §60.50c(a)(3) AND (4)

Pollutant	Units (7 percent oxygen, dry basis)	Emissions limits			Averaging time[1]	Method for demonstrating compliance[2]
		HMIWI size				
		Small	Medium	Large		
Particulate matter	Milligrams per dry standard cubic meter (grains per dry standard cubic foot).	66 (0.029)	22 (0.0095)	18 (0.0080)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 5 of appendix A–3 of part 60, or EPA Reference Method M 26A or 29 of appendix A–8 of part 60.
Carbon monoxide	Parts per million by volume	20	1.8	11	3-run average (1-hour minimum sample time per run).	EPA Reference Method 10 or 10B of appendix A–4 of part 60.
Dioxins/furans	Nanograms per dry standard cubic meter total dioxins/furans (grains per billion dry standard cubic feet) or nanograms per dry standard cubic meter TEQ (grains per billion dry standard cubic feet).	16 (7.0) or 0.013 (0.0057).	0.47 (0.21) or 0.014 (0.0061).	9.3 (4.1) or 0.035 (0.015).	3-run average (4-hour minimum sample time per run).	EPA Reference Method 23 of appendix A–7 of part 60.
Hydrogen chloride	Parts per million by volume	15	7.7	5.1	3-run average (1-hour minimum sample time per run).	EPA Reference Method 26 or 26A of appendix A–8 of part 60.
Sulfur dioxide	Parts per million by volume	1.4	1.4	1.6	3-run average (1-hour minimum sample time per run).	EPA Reference Method 6 or 6C of appendix A–4 of part 60.
Nitrogen oxides	Parts per million by volume	67	67	130	3-run average (1-hour minimum sample time per run).	EPA Reference Method 7 or 7E of appendix A–4 of part 60.
Lead	Milligrams per dry standard cubic meter (grains per thousand dry standard cubic feet).	0.31 (0.14)	0.018 (0.0079)	0.00069 (0.00030).	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.
Cadmium	Milligrams per dry standard cubic meter (grains per thousand dry standard cubic feet) or percent reduction.	0.017 (0.0074)	0.0098 (0.0043)	0.00013 (0.000057).	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.
Mercury	Milligrams per dry standard cubic meter (grains per thousand dry standard cubic feet) or percent reduction.	0.014 (0.0061)	0.0035 (0.0015)	0.0013 (0.00057)	3-run average (1-hour minimum sample time per run).	EPA Reference Method 29 of appendix A–8 of part 60.

[1] Except as allowed under §60.56c(c) for HMIWI equipped with CEMS.
[2] Does not include CEMS and approved alternative non-EPA test methods allowed under §60.56c(b).

[74 FR 51414, Oct. 6, 2009]

309

TABLE 2 OF SUBPART Ec TO PART 60—TOXIC EQUIVALENCY FACTORS

Dioxin/furan congener	Toxic equiva- lency factor
2,3,7,8-tetrachlorinated dibenzo-p-dioxin	1
1,2,3,7,8-pentachlorinated dibenzo-p-dioxin	0.5
1,2,3,4,7,8-hexachlorinated dibenzo-p-dioxin	0.1
1,2,3,7,8,9-hexachlorinated dibenzo-p-dioxin	0.1
1,2,3,6,7,8-hexachlorinated dibenzo-p-dioxin	0.1
1,2,3,4,6,7,8-heptachlorinated dibenzo-p-dioxin	0.01
octachlorinated dibenzo-p-dioxin	0.001
2,3,7,8-tetrachlorinated dibenzofuran	0.1
2,3,4,7,8-pentachlorinated dibenzofuran	0.5
1,2,3,7,8-pentachlorinated dibenzofuran	0.05
1,2,3,4,7,8-hexachlorinated dibenzofuran	0.1
1,2,3,6,7,8-hexachlorinated dibenzofuran	0.1
1,2,3,7,8,9-hexachlorinated dibenzofuran	0.1
2,3,4,6,7,8-hexachlorinated dibenzofuran	0.1
1,2,3,4,6,7,8-heptachlorinated dibenzofuran	0.01
1,2,3,4,7,8,9-heptachlorinated dibenzofuran	0.01
Octachlorinated dibenzofuran	0.001

TABLE 3 TO SUBPART Ec OF PART 60—OPERATING PARAMETERS TO BE MONITORED AND MINIMUM MEASUREMENT AND RECORDING FREQUENCIES

Operating parameters to be monitored	Minimum frequency		Control system		
	Data measurement	Data recording	Dry scrubber followed by fabric filter	Wet scrubber	Dry scrubber followed by fabric filter and wet scrubber
Maximum operating parameters:					
Maximum charge rate	Continuous	1×hour	✔	✔	✔
Maximum fabric filter inlet temperature.	Continuous	1×minute	✔		✔
Maximum flue gas temperature.	Continuous	1×minute	✔	✔	
Minimum operating parameters:					
Minimum secondary chamber temperature.	Continuous	1×minute	✔	✔	✔
Minimum dioxin/furan sorbent flow rate.	Hourly	1×hour	✔		✔
Minimum HCl sorbent flow rate.	Hourly	1×hour	✔		✔
Minimum mercury (Hg) sorbent flow rate.	Hourly	1×hour	✔		✔
Minimum pressure drop across the wet scrubber or minimum horsepower or amperage to wet scrubber.	Continuous	1×minute		✔	✔
Minimum scrubber liquor flow rate.	Continuous	1×minute		✔	✔
Minimum scrubber liquor pH.	Continuous	1×minute		✔	✔

Subpart F—Standards of Performance for Portland Cement Plants

§ 60.60 Applicability and designation of affected facility.

(a) The provisions of this subpart are applicable to the following affected facilities in portland cement plants: Kiln, clinker cooler, raw mill system, finish mill system, raw mill dryer, raw material storage, clinker storage, finished product storage, conveyor transfer points, bagging and bulk loading and unloading systems.

(b) Any facility under paragraph (a) of this section that commences construction or modification after August

Attachment D

the alternative acceptance criterion for 3-point sampling will be ± 0.5 percent CO_2 or O_2, and the alternative acceptance criterion for single-point sampling will be ± 0.3 percent CO_2 or O_2. In that case, you may use single-point integrated sampling as described in Section 8.2.1 of Method 3.

8.2 Initial Measurement System Performance Tests. You must follow the procedures in Section 8.2 of Method 7E. If a dilution-type measurement system is used, the special considerations in Section 8.3 of Method 7E apply.

8.3 Interference Check. The O_2 or CO_2 analyzer must be documented to show that interference effects to not exceed 2.5 percent of the calibration span. The interference test in Section 8.2.7 of Method 7E is a procedure that may be used to show this. The effects of all potential interferences at the concentrations encountered during testing must be addressed and documented. This testing and documentation may be done by the instrument manufacturer.

8.4 Sample Collection. You must follow the procedures in Section 8.4 of Method 7E.

8.5 Post-Run System Bias Check and Drift Assessment. You must follow the procedures in Section 8.5 of Method 7E.

9.0 Quality Control

Follow quality control procedures in Section 9.0 of Method 7E.

10.0 Calibration and Standardization

Follow the procedures for calibration and standardization in Section 10.0 of Method 7E.

11.0 Analytical Procedures

Because sample collection and analysis are performed together (see Section 8), additional discussion of the analytical procedure is not necessary.

12.0 Calculations and Data Analysis

You must follow the applicable procedures for calculations and data analysis in Section

12.0 of Method 7E, substituting percent O_2 and percent CO_2 for ppmv of NO_X as appropriate.

13.0 Method Performance

The specifications for the applicable performance checks are the same as in Section 13.0 of Method 7E except for the alternative specifications for system bias, drift, and calibration error. In these alternative specifications, replace the term "0.5 ppmv" with the term "0.5 percent O_2" or "0.5 percent CO_2" (as applicable).

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 Alternative Procedures [Reserved]

17.0 References

1. "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards" September 1997 as amended, EPA-600/R-97/121.

18.0 Tables, Diagrams, Flowcharts, and Validation Data

Refer to Section 18.0 of Method 7E.

METHOD 3B—GAS ANALYSIS FOR THE DETERMINATION OF EMISSION RATE CORRECTION FACTOR OR EXCESS AIR

NOTE: This method does not include all of the specifications (*e.g.*, equipment and supplies) and procedures (*e.g.*, sampling) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should have a thorough knowledge of at least the following additional test methods: Method 1 and 3.

1.0 Scope and Application

1.1 Analytes.

Analyte	CAS No.	Sensitivity
Oxygen (O_2)	7782-44-7	2,000 ppmv.
Carbon Dioxide (CO_2)	124-38-9	2,000 ppmv.
Carbon Monoxide (CO)	630-08-0	N/A.

1.2 Applicability. This method is applicable for the determination of O_2, CO_2, and CO concentrations in the effluent from fossil-fuel combustion processes for use in excess air or emission rate correction factor calculations. Where compounds other than CO_2, O_2, CO, and nitrogen (N_2) are present in concentrations sufficient to affect the results, the calculation procedures presented in this method must be modified, subject to the approval of the Administrator.

1.3 Other methods, as well as modifications to the procedure described herein, are also applicable for all of the above determinations. Examples of specific methods and modifications include: (1) A multi-point sampling method using an Orsat analyzer to analyze individual grab samples obtained at each point, and (2) a method using CO_2 or O_2 and stoichiometric calculations to determine excess air. These methods and modifications

may be used, but are subject to the approval of the Administrator.

1.4 Data Quality Objectives. Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods.

2.0 Summary of Method

2.1 A gas sample is extracted from a stack by one of the following methods: (1) Single-point, grab sampling; (2) single-point, integrated sampling; or (3) multi-point, integrated sampling. The gas sample is analyzed for percent CO_2, percent O_2, and, if necessary, percent CO using an Orsat combustion gas analyzer.

3.0 Definitions [Reserved]

4.0 Interferences

4.1 Several compounds can interfere, to varying degrees, with the results of Orsat analyses. Compounds that interfere with $CO2$ concentration measurement include acid gases (e.g., sulfur dioxide, hydrogen chloride); compounds that interfere with O_2 concentration measurement include unsaturated hydrocarbons (e.g., acetone, acetylene), nitrous oxide, and ammonia. Ammonia reacts chemically with the O_2 absorbing solution, and when present in the effluent gas stream must be removed before analysis.

5.0 Safety

5.1 Disclaimer. This method may involve hazardous materials, operations, and equipment. This test method may not address all of the safety problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this test method.

5.2 Corrosive Reagents. A typical Orsat analyzer requires four reagents: a gas-confining solution, CO_2 absorbent, O_2 absorbent, and CO absorbent. These reagents may contain potassium hydroxide, sodium hydroxide, cuprous chloride, cuprous sulfate, alkaline pyrogallic acid, and/or chromous chloride. Follow manufacturer's operating instructions and observe all warning labels for reagent use.

6.0 Equipment and Supplies

NOTE: As an alternative to the sampling apparatus and systems described herein, other sampling systems (e.g., liquid displacement) may be used, provided such systems are capable of obtaining a representative sample and maintaining a constant sampling rate, and are, otherwise, capable of yielding acceptable results. Use of such systems is subject to the approval of the Administrator.

6.1 Grab Sampling and Integrated Sampling. Same as in Sections 6.1 and 6.2, respectively for Method 3.

6.2 Analysis. An Orsat analyzer only. For low CO_2 (less than 4.0 percent) or high O_2 (greater than 15.0 percent) concentrations, the measuring burette of the Orsat must have at least 0.1 percent subdivisions. For Orsat maintenance and operation procedures, follow the instructions recommended by the manufacturer, unless otherwise specified herein.

7.0 Reagents and Standards

7.1 Reagents. Same as in Method 3, Section 7.1.

7.2 Standards. Same as in Method 3, Section 7.2.

8.0 Sample Collection, Preservation, Storage, and Transport

NOTE: Each of the three procedures below shall be used only when specified in an applicable subpart of the standards. The use of these procedures for other purposes must have specific prior approval of the Administrator. A Fyrite-type combustion gas analyzer is not acceptable for excess air or emission rate correction factor determinations, unless approved by the Administrator. If both percent CO_2 and percent O_2 are measured, the analytical results of any of the three procedures given below may also be used for calculating the dry molecular weight (see Method 3).

8.1 Single-Point, Grab Sampling and Analytical Procedure.

8.1.1 The sampling point in the duct shall either be at the centroid of the cross section or at a point no closer to the walls than 1.0 m (3.3 ft), unless otherwise specified by the Administrator.

8.1.2 Set up the equipment as shown in Figure 3–1 of Method 3, making sure all connections ahead of the analyzer are tight. Leak-check the Orsat analyzer according to the procedure described in Section 11.5 of Method 3. This leak-check is mandatory.

8.1.3 Place the probe in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line long enough to allow at least five exchanges. Draw a sample into the analyzer. For emission rate correction factor determinations, immediately analyze the sample for percent CO_2 or percent O_2, as outlined in Section 11.2. For excess air determination, immediately analyze the sample for percent CO_2, O_2, and CO, as outlined in Section 11.2, and calculate excess air as outlined in Section 12.2.

8.1.4 After the analysis is completed, leak-check (mandatory) the Orsat analyzer once again, as described in Section 11.5 of Method 3. For the results of the analysis to be valid, the Orsat analyzer must pass this leak-test before and after the analysis.

8.2 Single-Point. Integrated Sampling and Analytical Procedure.

8.2.1 The sampling point in the duct shall be located as specified in Section 8.1.1.

8.2.2 Leak-check (mandatory) the flexible bag as in Section 6.2.6 of Method 3. Set up the equipment as shown in Figure 3-2 of Method 3. Just before sampling, leak-check (mandatory) the train by placing a vacuum gauge at the condenser inlet, pulling a vacuum of at least 250 mm Hg (10 in. Hg), plugging the outlet at the quick disconnect, and then turning off the pump. The vacuum should remain stable for at least 0.5 minute. Evacuate the flexible bag. Connect the probe, and place it in the stack, with the tip of the probe positioned at the sampling point; purge the sampling line. Next, connect the bag, and make sure that all connections are tight.

8.2.3 Sample at a constant rate, or as specified by the Administrator. The sampling run must be simultaneous with, and for the same total length of time as, the pollutant emission rate determination. Collect at least 28 liters (1.0 ft³) of sample gas. Smaller volumes may be collected, subject to approval of the Administrator.

8.2.4 Obtain one integrated flue gas sample during each pollutant emission rate determination. For emission rate correction factor determination, analyze the sample within 4 hours after it is taken for percent CO_2 or percent O_2 (as outlined in Section 11.2).

8.3 Multi-Point, Integrated Sampling and Analytical Procedure.

8.3.1 Unless otherwise specified in an applicable regulation, or by the Administrator, a minimum of eight traverse points shall be used for circular stacks having diameters less than 0.61 m (24 in.), a minimum of nine shall be used for rectangular stacks having equivalent diameters less than 0.61 m (24 in.), and a minimum of 12 traverse points shall be used for all other cases. The traverse points shall be located according to Method 1.

8.3.2 Follow the procedures outlined in Sections 8.2.2 through 8.2.4, except for the following: Traverse all sampling points, and sample at each point for an equal length of time. Record sampling data as shown in Figure 3-3 of Method 3.

9.0 Quality Control

9.1 Data Validation Using Fuel Factor. Although in most instances, only CO_2 or O_2 measurement is required, it is recommended that both CO_2 and O_2 be measured to provide a check on the quality of the data. The data validation procedure of Section 12.3 is suggested.

NOTE: Since this method for validating the CO_2 and O_2 analyses is based on combustion of organic and fossil fuels and dilution of the gas stream with air, this method does not apply to sources that (1) remove CO_2 or O_2 through processes other than combustion, (2) add O_2 (e.g., oxygen enrichment) and N_2 in proportions different from that of air, (3) add CO_2 (e.g., cement or lime kilns), or (4) have no fuel factor, F_o, values obtainable (e.g., extremely variable waste mixtures). This method validates the measured proportions of CO_2 and O_2 for fuel type, but the method does not detect sample dilution resulting from leaks during or after sample collection. The method is applicable for samples collected downstream of most lime or limestone flue-gas desulfurization units as the CO_2 added or removed from the gas stream is not significant in relation to the total CO_2 concentration. The CO_2 concentrations from other types of scrubbers using only water or basic slurry can be significantly affected and would render the fuel factor check minimally useful.

10.0 Calibration and Standardization

10.1 Analyzer. The analyzer and analyzer operator technique should be audited periodically as follows: take a sample from a manifold containing a known mixture of CO_2 and O_2, and analyze according to the procedure in Section 11.3. Repeat this procedure until the measured concentration of three consecutive samples agrees with the stated value ±0.5 percent. If necessary, take corrective action, as specified in the analyzer users manual.

10.2 Rotameter. The rotameter need not be calibrated, but should be cleaned and maintained according to the manufacturer's instruction.

11.0 Analytical Procedure

11.1 Maintenance. The Orsat analyzer should be maintained according to the manufacturers specifications.

11.2 Grab Sample Analysis. To ensure complete absorption of the CO_2, O_2, or if applicable. CO, make repeated passes through each absorbing solution until two consecutive readings are the same. Several passes (three or four) should be made between readings. (If constant readings cannot be obtained after three consecutive readings, replace the absorbing solution.) Although in most cases, only CO_2 or O_2 concentration is required, it is recommended that both CO_2 and O_2 be measured, and that the procedure in Section 12.3 be used to validate the analytical data.

NOTE: Since this single-point, grab sampling and analytical procedure is normally conducted in conjunction with a single-point, grab sampling and analytical procedure for a pollutant. only one analysis is ordinarily conducted. Therefore, great care must be taken to obtain a valid sample and analysis.

11.3 Integrated Sample Analysis. The Orsat analyzer must be leak-checked (see Section 11.5 of Method 3) before the analysis. If excess air is desired, proceed as follows: (1) within 4 hours after the sample is taken, analyze it (as in Sections 11.3.1 through 11.3.3) for percent CO_2, O_2, and CO; (2) determine the percentage of the gas that is N_2 by subtracting the sum of the percent CO_2, percent O_2, and percent CO from 100 percent; and (3) calculate percent excess air, as outlined in Section 12.2.

11.3.1 To ensure complete absorption of the CO_2, O_2, or if applicable, CO, follow the procedure described in Section 11.2.

NOTE: Although in most instances only CO_2 or O_2 is required, it is recommended that both CO_2 and O_2 be measured, and that the procedures in Section 12.3 be used to validate the analytical data.

11.3.2 Repeat the analysis until the following criteria are met:

11.3.2.1 For percent CO_2, repeat the analytical procedure until the results of any three analyses differ by no more than (a) 0.3 percent by volume when CO_2 is greater than 4.0 percent or (b) 0.2 percent by volume when CO_2 is less than or equal to 4.0 percent. Average three acceptable values of percent CO_2, and report the results to the nearest 0.2 percent.

11.3.2.2 For percent O_2, repeat the analytical procedure until the results of any three analyses differ by no more than (a) 0.3 percent by volume when O_2 is less than 15.0 percent or (b) 0.2 percent by volume when O_2 is greater than or equal to 15.0 percent. Average the three acceptable values of percent O_2, and report the results to the nearest 0.1 percent.

11.3.2.3 For percent CO, repeat the analytical procedure until the results of any three analyses differ by no more than 0.3 percent. Average the three acceptable values of percent CO, and report the results to the nearest 0.1 percent.

11.3.3 After the analysis is completed, leak-check (mandatory) the Orsat analyzer once again, as described in Section 11.5 of Method 3. For the results of the analysis to be valid, the Orsat analyzer must pass this leak-test before and after the analysis.

11.4 Standardization. A periodic check of the reagents and of operator technique should be conducted at least once every three series of test runs as indicated in Section 10.1.

12.0 Calculations and Data Analysis

12.1 Nomenclature. Same as Section 12.1 of Method 3 with the addition of the following:

%EA=Percent excess air.

0.264=Ratio of O_2 to N_2 in air, v/v.

12.2 Percent Excess Air. Determine the percentage of the gas that is N_2 by subtracting the sum of the percent CO_2, percent CO, and percent O_2 from 100 percent. Calculate the percent excess air (if applicable) by substituting the appropriate values of percent O_2, CO, and N_2 into Equation 3B-1.

$$\%EA = \frac{\%O_2 - 0.5\ \%CO}{0.264\ \%N_2 - \left(\%O_2 - 0.5\ \%CO\right)} \times 100 \qquad \text{Eq. 3B-1}$$

NOTE: The equation above assumes that ambient air is used as the source of O_2 and that the fuel does not contain appreciable amounts of N_2 (as do coke oven or blast furnace gases). For those cases when appreciable amounts of N_2 are present (coal, oil, and natural gas do not contain appreciable amounts of N_2) or when oxygen enrichment is used, alternative methods, subject to approval of the Administrator, are required.

12.3 Data Validation When Both CO_2 and O_2 Are Measured.

12.3.1 Fuel Factor. F_o. Calculate the fuel factor (if applicable) using Equation 3B-2:

$$F_o = \frac{20.9 - \%O_2}{\%CO_2} \qquad \text{Eq. 3B-2}$$

Where:

%O_2=Percent O_2 by volume, dry basis.
%CO_2=Percent CO_2 by volume, dry basis.

20.9=Percent O_2 by volume in ambient air.

If CO is present in quantities measurable by this method, adjust the O_2 and CO_2 values using Equations 3B-3 and 3B-4 before performing the calculation for F_o:

$$\%CO_2(adj) = \%CO_2 + \%CO \qquad \text{Eq. 3B-3}$$

$$\%O_2(adj) = \%O_2 - 0.5\ \%CO \qquad \text{Eq. 3B-4}$$

Where:

%CO=Percent CO by volume, dry basis.

12.3.2 Compare the calculated F_o factor with the expected F_o values. Table 3B-1 in Section 17.0 may be used in establishing acceptable ranges for the expected F_o if the fuel being burned is known. When fuels are burned in combinations, calculate the combined fuel F_d and F_c factors (as defined in Method 19, Section 12.2) according to the procedure in Method 19. Sections 12.2 and 12.3.

156

Then calculate the F_o factor according to Equation 3B–5.

$$F_o = \frac{0.209\ F_d}{F_c} \qquad Eq.\ 3B\text{-}5$$

12.3.3 Calculated F_o values, beyond the acceptable ranges shown in this table, should be investigated before accepting the test results. For example, the strength of the solutions in the gas analyzer and the analyzing technique should be checked by sampling and analyzing a known concentration. such as air; the fuel factor should be reviewed and verified. An acceptability range of ±12 percent is appropriate for the F_o factor of mixed fuels with variable fuel ratios. The level of the emission rate relative to the compliance level should be considered in determining if a retest is appropriate; i.e., if the measured emissions are much lower or much greater than the compliance limit. repetition of the test would not significantly change the compliance status of the source and would be unnecessarily time consuming and costly.

13.0 Method Performance [Reserved]

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 References

Same as Method 3. Section 16.0.

17.0 Tables, Diagrams, Flowcharts, and Validation Data

TABLE 3B–1—F_o FACTORS FOR SELECTED FUELS

Fuel type	F_o range
Coal:	
Anthracite and lignite	1.016–1.130
Bituminous	1.083–1.230
Oil:	
Distillate	1.260–1.413
Residual	1.210–1.370
Gas:	
Natural	1.600–1.836
Propane	1.434–1.586
Butane	1.405–1.553
Wood	1.000–1.120
Wood bark	1.003–1.130

METHOD 3C—DETERMINATION OF CARBON DIOXIDE, METHANE, NITROGEN. AND OXYGEN FROM STATIONARY SOURCES

1. Applicability and Principle

1.1 Applicability. This method applies to the analysis of carbon dioxide (CO_2), methane (CH_4). nitrogen (N_2). and oxygen (O_2) in samples from municipal solid waste landfills and other sources when specified in an applicable subpart.

1.2 Principle. A portion of the sample is injected into a gas chromatograph (GC) and the CO_2. CH_4, N_2. and O_2 concentrations are determined by using a thermal conductivity detector (TCD) and integrator.

2. Range and Sensitivity

2.1 Range. The range of this method depends upon the concentration of samples. The analytical range of TCD's is generally between approximately 10 ppmv and the upper percent range.

2.2 Sensitivity. The sensitivity limit for a compound is defined as the minimum detectable concentration of that compound, or the concentration that produces a signal-to-noise ratio of three to one. For CO_2. CH_4, N_2, and O_2. the sensitivity limit is in the low ppmv range.

3. Interferences

Since the TCD exhibits universal response and detects all gas components except the carrier, interferences may occur. Choosing the appropriate GC or shifting the retention times by changing the column flow rate may help to eliminate resolution interferences.

To assure consistent detector response, helium is used to prepare calibration gases. Frequent exposure to samples or carrier gas containing oxygen may gradually destroy filaments.

4. Apparatus

4.1 Gas Chromatograph. GC having at least the following components:

4.1.1 Separation Column. Appropriate column(s) to resolve CO_2, CH_4, N_2, O_2, and other gas components that may be present in the sample.

4.1.2 Sample Loop. Teflon or stainless steel tubing of the appropriate diameter. NOTE: Mention of trade names or specific products does not constitute endorsement or recommendation by the U. S. Environmental Protection Agency.

4.1.3 Conditioning System. To maintain the column and sample loop at constant temperature.

4.1.4 Thermal Conductivity Detector.

4.2 Recorder. Recorder with linear strip chart. Electronic integrator (optional) is recommended.

4.3 Teflon Tubing. Diameter and length determined by connection requirements of cylinder regulators and the GC.

4.4 Regulators. To control gas cylinder pressures and flow rates.

4.5 Adsorption Tubes. Applicable traps to remove any O_2 from the carrier gas.

5. Reagents

5.1 Calibration and Linearity Gases. Standard cylinder gas mixtures for each

Environmental Protection Agency

the techniques or alternatives are in fact applicable and are properly executed; (2) including a written description of the alternative method in the test report (the written method must be clear and must be capable of being performed without additional instruction, and the degree of detail should be similar to the detail contained in the test methods); and (3) providing any rationale or supporting data necessary to show the validity of the alternative in the particular application. Failure to meet these requirements can result in the Administrator's disapproval of the alternative.

METHOD 6—DETERMINATION OF SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

NOTE: This method does not include all of the specifications (e.g., equipment and supplies) and procedures (e.g., sampling and analytical) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should have a thorough knowledge of at least the following additional test methods: Method 1, Method 2, Method 3, Method 5, and Method 8.

1.0 Scope and Application

1.1 Analytes.

Analyte	CAS No.	Sensitivity
SO₂	7449–09–5	3.4 mg SO₂/m³ $(2.12 \times 10)_{-7}$ lb/ft³

1.2 Applicability. This method applies to the measurement of sulfur dioxide (SO_2) emissions from stationary sources.

1.3 Data Quality Objectives. Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sampling methods.

2.0 Summary of Method

2.1 A gas sample is extracted from the sampling point in the stack. The SO_2 and the sulfur trioxide, including those fractions in any sulfur acid mist, are separated. The SO_2 fraction is measured by the barium-thorin titration method.

3.0 Definitions [Reserved]

4.0 Interferences

4.1 Free Ammonia. Free ammonia interferes with this method by reacting with SO_2 to form particulate sulfite and by reacting with the indicator. If free ammonia is present (this can be determined by knowledge of the process and/or noticing white particulate matter in the probe and isopropanol bubbler), alternative methods, subject to the approval of the Administrator are required. One approved alternative is listed in Reference 13 of Section 17.0.

4.2 Water-Soluble Cations and Fluorides. The cations and fluorides are removed by a glass wool filter and an isopropanol bubbler; therefore, they do not affect the SO_2 analysis. When samples are collected from a gas stream with high concentrations of metallic fumes (i.e., very fine cation aerosols) a high-efficiency glass fiber filter must be used in place of the glass wool plug (i.e., the one in the probe) to remove the cation interferent.

5.0 Safety

5.1 Disclaimer. This method may involve hazardous materials, operations, and equipment. This test method may not address all of the safety problems associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and determine the applicability of regulatory limitations before performing this test method.

5.2 Corrosive reagents. The following reagents are hazardous. Personal protective equipment and safe procedures are useful in preventing chemical splashes. If contact occurs, immediately flush with copious amounts of water for at least 15 minutes. Remove clothing under shower and decontaminate. Treat residual chemical burns as thermal burns.

5.2.1 Hydrogen Peroxide (H_2O_2). Irritating to eyes, skin, nose, and lungs. 30% H_2O_2 is a strong oxidizing agent. Avoid contact with skin, eyes, and combustible material. Wear gloves when handling.

5.2.2 Sodium Hydroxide (NaOH). Causes severe damage to eyes and skin. Inhalation causes irritation to nose, throat, and lungs. Reacts exothermically with limited amounts of water.

5.2.3 Sulfuric Acid (H_2SO_4). Rapidly destructive to body tissue. Will cause third degree burns. Eye damage may result in blindness. Inhalation may be fatal from spasm of the larynx, usually within 30 minutes. May cause lung tissue damage with edema. 1 mg/m³ for 8 hours will cause lung damage or, in higher concentrations, death. Provide ventilation to limit inhalation. Reacts violently with metals and organics.

6.0 Equipment and Supplies

6.1 Sample Collection. The following items are required for sample collection:

6.1.1 Sampling Train. A schematic of the sampling train is shown in Figure 6–1. The sampling equipment described in Method 8 may be substituted in place of the midget impinger equipment of Method 6. However, the Method 8 train must be modified to include a heated filter between the probe and isopropanol impinger, and the operation of the sampling train and sample analysis must be at the flow rates and solution volumes defined in Method 8. Alternatively, SO_2 may be determined simultaneously with particulate

matter and moisture determinations by either (1) replacing the water in a Method 5 impinger system with a 3 percent H_2O_2 solution, or (2) replacing the Method 5 water impinger system with a Method 8 isopropanol-filter-H_2O_2 system. The analysis for SO_2 must be consistent with the procedure of Method 8. The Method 6 sampling train consists of the following components:

6.1.1.1 Probe. Borosilicate glass or stainless steel (other materials of construction may be used, subject to the approval of the Administrator), approximately 6 mm (0.25 in.) inside diameter, with a heating system to prevent water condensation and a filter (either in-stack or heated out-of-stack) to remove particulate matter, including sulfuric acid mist. A plug of glass wool is a satisfactory filter.

6.1.1.2 Bubbler and Impingers. One midget bubbler with medium-coarse glass frit and borosilicate or quartz glass wool packed in top (see Figure 6–1) to prevent sulfuric acid mist carryover, and three 30-ml midget impingers. The midget bubbler and midget impingers must be connected in series with leak-free glass connectors. Silicone grease may be used, if necessary, to prevent leakage. A midget impinger may be used in place of the midget bubbler.

NOTE: Other collection absorbers and flow rates may be used, subject to the approval of the Administrator, but the collection efficiency must be shown to be at least 99 percent for each test run and must be documented in the report. If the efficiency is found to be acceptable after a series of three tests, further documentation is not required. To conduct the efficiency test, an extra absorber must be added and analyzed separately. This extra absorber must not contain more than 1 percent of the total SO_2.

6.1.1.3 Glass Wool. Borosilicate or quartz.

6.1.1.4 Stopcock Grease. Acetone-insoluble, heat-stable silicone grease may be used, if necessary.

6.1.1.5 Temperature Sensor. Dial thermometer, or equivalent, to measure temperature of gas leaving impinger train to within 1 °C (2 °F).

6.1.1.6 Drying Tube. Tube packed with 6-to 16- mesh indicating-type silica gel, or equivalent, to dry the gas sample and to protect the meter and pump. If silica gel is previously used, dry at 177 °C (350 °F) for 2 hours. New silica gel may be used as received. Alternatively, other types of desiccants (equivalent or better) may be used, subject to the approval of the Administrator.

6.1.1.7 Valve. Needle valve, to regulate sample gas flow rate.

6.1.1.8 Pump. Leak-free diaphragm pump, or equivalent, to pull gas through the train. Install a small surge tank between the pump

and rate meter to negate the pulsation effect of the diaphragm pump on the rate meter.

6.1.1.9 Rate Meter. Rotameter, or equivalent, capable of measuring flow rate to within 2 percent of the selected flow rate of about 1 liter/min (0.035 cfm).

6.1.1.10 Volume Meter. Dry gas meter (DGM), sufficiently accurate to measure the sample volume to within 2 percent, calibrated at the selected flow rate and conditions actually encountered during sampling, and equipped with a temperature sensor (dial thermometer, or equivalent) capable of measuring temperature accurately to within 3 °C (5.4 °F). A critical orifice may be used in place of the DGM specified in this section provided that it is selected, calibrated, and used as specified in Section 16.0.

6.1.2 Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg). See the NOTE in Method 5, Section 6.1.2.

6.1.3 Vacuum Gauge and Rotameter. At least 760-mm Hg (30-in. Hg) gauge and 0- to 40-ml/min rotameter, to be used for leak-check of the sampling train.

6.2 Sample Recovery. The following items are needed for sample recovery:

6.2.1 Wash Bottles. Two polyethylene or glass bottles, 500-ml.

6.2.2 Storage Bottles. Polyethylene bottles, 100-ml, to store impinger samples (one per sample).

6.3 Sample Analysis. The following equipment is needed for sample analysis:

6.3.1 Pipettes. Volumetric type, 5-ml, 20-ml (one needed per sample), and 25-ml sizes.

6.3.2 Volumetric Flasks. 100-ml size (one per sample) and 1000-ml size.

6.3.3 Burettes. 5- and 50-ml sizes.

6.3.4 Erlenmeyer Flasks. 250-ml size (one for each sample, blank, and standard).

6.3.5 Dropping Bottle. 125-ml size, to add indicator.

6.3.6 Graduated Cylinder. 100-ml size.

6.3.7 Spectrophotometer. To measure absorbance at 352 nm.

7.0 Reagents and Standards

NOTE: Unless otherwise indicated, all reagents must conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society. Where such specifications are not available, use the best available grade.

7.1 Sample Collection. The following reagents are required for sample collection:

7.1.1 Water. Deionized distilled to conform to ASTM Specification D 1193–77 or 91 Type 3 (incorporated by reference—see §60.17). The $KMnO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

7.1.2 Isopropanol, 80 Percent by Volume. Mix 80 ml of isopropanol with 20 ml of water.

7.1.2.1 Check each lot of isopropanol for peroxide impurities as follows: Shake 10 ml of isopropanol with 10 ml of freshly prepared 10 percent potassium iodide solution. Prepare a blank by similarly treating 10 ml of water. After 1 minute, read the absorbance at 352 nm on a spectrophotometer using a 1-cm path length. If absorbance exceeds 0.1, reject alcohol for use.

7.1.2.2 Peroxides may be removed from isopropanol by redistilling or by passage through a column of activated alumina; however, reagent grade isopropanol with suitably low peroxide levels may be obtained from commercial sources. Rejection of contaminated lots may, therefore, be a more efficient procedure.

7.1.3 Hydrogen Peroxide (H_2O_2), 3 Percent by Volume. Add 10 ml of 30 percent H_2O_2 to 90 ml of water. Prepare fresh daily.

7.1.4 Potassium Iodide Solution, 10 Percent Weight by Volume (w/v). Dissolve 10.0 g of KI in water, and dilute to 100 ml. Prepare when needed.

7.2 Sample Recovery. The following reagents are required for sample recovery:

7.2.1 Water. Same as in Section 7.1.1.

7.2.2 Isopropanol, 80 Percent by Volume. Same as in Section 7.1.2.

7.3 Sample Analysis. The following reagents and standards are required for sample analysis:

7.3.1 Water. Same as in Section 7.1.1.

7.3.2 Isopropanol, 100 Percent.

7.3.3 Thorin Indicator. 1-(o-arsonophenylazo)-2-naphthol-3,6-disulfonic acid, disodium salt, or equivalent. Dissolve 0.20 g in 100 ml of water.

7.3.4 Barium Standard Solution, 0.0100 N. Dissolve 1.95 g of barium perchlorate trihydrate [$Ba(ClO_4)_2 \cdot 3H_2O$] in 200 ml water, and dilute to 1 liter with isopropanol. Alternatively, 1.22 g of barium chloride dihydrate [$BaCl_2 \cdot 2H_2O$] may be used instead of the barium perchlorate trihydrate. Standardize as in Section 10.5.

7.3.5 Sulfuric Acid Standard. 0.0100 N. Purchase or standardize to ±0.0002 N against 0.0100 N NaOH which has previously been standardized against potassium acid phthalate (primary standard grade).

7.3.6 Quality Assurance Audit Samples. When making compliance determinations, audit samples, if available must be obtained from the appropriate EPA Regional Office or from the responsible enforcement authority and analyzed in conjunction with the field samples.

NOTE: The responsible enforcement authority should be notified at least 30 days prior to the test date to allow sufficient time for sample delivery.

8.0 Sample Collection, Preservation, Storage and Transport

8.1 Preparation of Sampling Train. Measure 15 ml of 80 percent isopropanol into the midget bubbler and 15 ml of 3 percent H_2O_2 into each of the first two midget impingers. Leave the final midget impinger dry. Assemble the train as shown in Figure 6–1. Adjust the probe heater to a temperature sufficient to prevent water condensation. Place crushed ice and water around the impingers.

8.2 Sampling Train Leak-Check Procedure. A leak-check prior to the sampling run is recommended, but not required. A leak-check after the sampling run is mandatory. The leak-check procedure is as follows:

8.2.1 Temporarily attach a suitable (e.g., 0- to 40- ml/min) rotameter to the outlet of the DGM, and place a vacuum gauge at or near the probe inlet. Plug the probe inlet, pull a vacuum of at least 250 mm Hg (10 in. Hg), and note the flow rate as indicated by the rotameter. A leakage rate in excess of 2 percent of the average sampling rate is not acceptable.

NOTE: Carefully (i.e., slowly) release the probe inlet plug before turning off the pump.

8.2.2 It is suggested (not mandatory) that the pump be leak-checked separately, either prior to or after the sampling run. To leak-check the pump, proceed as follows: Disconnect the drying tube from the probe-impinger assembly. Place a vacuum gauge at the inlet to either the drying tube or the pump, pull a vacuum of 250 mm Hg (10 in. Hg), plug or pinch off the outlet of the flow meter, and then turn off the pump. The vacuum should remain stable for at least 30 seconds.

If performed prior to the sampling run, the pump leak-check shall precede the leak-check of the sampling train described immediately above; if performed after the sampling run, the pump leak-check shall follow the sampling train leak-check.

8.2.3 Other leak-check procedures may be used, subject to the approval of the Administrator.

8.3 Sample Collection.

8.3.1 Record the initial DGM reading and barometric pressure. To begin sampling, position the tip of the probe at the sampling point, connect the probe to the bubbler, and start the pump. Adjust the sample flow to a constant rate of approximately 1.0 liter/min as indicated by the rate meter. Maintain this constant rate (±10 percent) during the entire sampling run.

8.3.2 Take readings (DGM volume, temperatures at DGM and at impinger outlet, and rate meter flow rate) at least every 5 minutes. Add more ice during the run to keep the temperature of the gases leaving the last impinger at 20 °C (68 °F) or less.

8.3.3 At the conclusion of each run, turn off the pump, remove the probe from the

stack. and record the final readings. Conduct a leak-check as described in Section 8.2. (This leak-check is mandatory.) If a leak is detected. void the test run or use procedures acceptable to the Administrator to adjust the sample volume for the leakage.

8.3.4 Drain the ice bath, and purge the remaining part of the train by drawing clean ambient air through the system for 15 minutes at the sampling rate. Clean ambient air can be provided by passing air through a charcoal filter or through an extra midget impinger containing 15 ml of 3 percent H_2O_2.

Alternatively. ambient air without purification may be used.

8.4 Sample Recovery. Disconnect the impingers after purging. Discard the contents of the midget bubbler. Pour the contents of the midget impingers into a leak-free polyethylene bottle for shipment. Rinse the three midget impingers and the connecting tubes with water. and add the rinse to the same storage container. Mark the fluid level. Seal and identify the sample container.

9.0   Quality Control

Section	Quality control measure	Effect
7.1.2	Isopropanol check	Ensure acceptable level of peroxide impurities in isopropanol.
8.2, 10.1–10.4	Sampling equipment leak-check and calibration.	Ensure accurate measurement of stack gas flow rate, sample volume.
10.5	Barium standard solution standardization ...	Ensure precision of normality determination.
11.2.3	Replicate titrations	Ensure precision of titration determinations
11.3	Audit sample analysis	Evaluate analyst's technique and standards preparation.

10.0   Calibration and Standardization

10.1   Volume Metering System.

10.1.1   Initial Calibration.

10.1.1.1   Before its initial use in the field, leak-check the metering system (drying tube, needle valve, pump. rate meter, and DGM) as follows: Place a vacuum gauge at the inlet to the drying tube and pull a vacuum of 250 mm Hg (10 in. Hg). Plug or pinch off the outlet of the flow meter, and then turn off the pump. The vacuum must remain stable for at least 30 seconds. Carefully release the vacuum gauge before releasing the flow meter end.

10.1.1.2   Remove the drying tube. and calibrate the metering system (at the sampling flow rate specified by the method) as follows: Connect an appropriately sized wet-test meter (*e.g.*, 1 liter per revolution) to the inlet of the needle valve. Make three independent calibration runs. using at least five revolutions of the DGM per run. Calculate the calibration factor Y (wet-test meter calibration volume divided by the DGM volume. both volumes adjusted to the same reference temperature and pressure) for each run. and average the results (Y_i). If any Y-value deviates by more than 2 percent from (Y_i), the metering system is unacceptable for use. If the metering system is acceptable. use (Y_i) as the calibration factor for subsequent test runs.

10.1.2   Post-Test Calibration Check. After each field test series. conduct a calibration check using the procedures outlined in Section 10.1.1.2, except that three or more revolutions of the DGM may be used. and only two independent runs need be made. If the average of the two post-test calibration factors does not deviate by more than 5 percent from Y_i, then Y_i is accepted as the DGM cali-

bration factor (Y), which is used in Equation 6–1 to calculate collected sample volume (see Section 12.2). If the deviation is more than 5 percent, recalibrate the metering system as in Section 10.1.1, and determine a post-test calibration factor (Y_f). Compare Y_i and Y_f: the smaller of the two factors is accepted as the DGM calibration factor. If recalibration indicates that the metering system is unacceptable for use. either void the test run or use methods. subject to the approval of the Administrator, to determine an acceptable value for the collected sample volume.

10.1.3   DGM as a Calibration Standard. A DGM may be used as a calibration standard for volume measurements in place of the wet-test meter specified in Section 10.1.1.2, provided that it is calibrated initially and recalibrated periodically according to the same procedures outlined in Method 5. Section 10.3 with the following exceptions: (a) the DGM is calibrated against a wet-test meter having a capacity of 1 liter/rev (0.035 ft³/rev) or 3 liters/rev (0.1 ft³/rev) and having the capability of measuring volume to within 1 percent; (b) the DGM is calibrated at 1 liter/min (0.035 cfm); and (c) the meter box of the Method 6 sampling train is calibrated at the same flow rate.

10.2   Temperature   Sensors.   Calibrate against mercury-in-glass thermometers.

10.3   Rate Meter. The rate meter need not be calibrated. but should be cleaned and maintained according to the manufacturer's instructions.

10.4   Barometer. Calibrate against a mercury barometer.

10.5   Barium   Standard   Solution.   Standardize the barium perchlorate or chloride solution against 25 ml of standard sulfuric acid to which 100 ml of 100 percent isopropanol

has been added. Run duplicate analyses. Calculate the normality using the average of duplicate analyses where the titrations agree within 1 percent or 0.2 ml, whichever is larger.

11.0 Analytical Procedure

11.1 Sample Loss Check. Note level of liquid in container and confirm whether any sample was lost during shipment; note this finding on the analytical data sheet. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results.

11.2 Sample Analysis.

11.2.1 Transfer the contents of the storage container to a 100-ml volumetric flask, dilute to exactly 100 ml with water, and mix the diluted sample.

11.2.2 Pipette a 20-ml aliquot of the diluted sample into a 250-ml Erlenmeyer flask and add 80 ml of 100 percent isopropanol plus two to four drops of thorin indicator. While stirring the solution, titrate to a pink endpoint using 0.0100 N barium standard solution.

11.2.3 Repeat the procedures in Section 11.2.2, and average the titration volumes. Run a blank with each series of samples. Replicate titrations must agree within 1 percent or 0.2 ml, whichever is larger.

NOTE: Protect the 0.0100 N barium standard solution from evaporation at all times.

11.3 Audit Sample Analysis.

11.3.1 When the method is used to analyze samples to demonstrate compliance with a source emission regulation, an audit sample, if available, must be analyzed.

11.3.2 Concurrently analyze the audit sample and the compliance samples in the same manner to evaluate the technique of the analyst and the standards preparation.

11.3.3 The same analyst, analytical reagents, and analytical system must be used for the compliance samples and the audit sample. If this condition is met, duplicate auditing of subsequent compliance analyses for the same enforcement agency within a 30-day period is waived. An audit sample set may not be used to validate different sets of compliance samples under the jurisdiction of separate enforcement agencies, unless prior arrangements have been made with both enforcement agencies.

11.4 Audit Sample Results.

11.4.1 Calculate the audit sample concentrations and submit results using the instructions provided with the audit samples.

11.4.2 Report the results of the audit samples and the compliance determination samples along with their identification numbers, and the analyst's name to the responsible enforcement authority. Include this information with reports of any subsequent compli-

ance analyses for the same enforcement authority during the 30-day period.

11.4.3 The concentrations of the audit samples obtained by the analyst must agree within 5 percent of the actual concentration. If the 5 percent specification is not met, reanalyze the compliance and audit samples, and include initial and reanalysis values in the test report.

11.4.4 Failure to meet the 5-percent specification may require retests until the audit problems are resolved. However, if the audit results do not affect the compliance or noncompliance status of the affected facility, the Administrator may waive the reanalysis requirement, further audits, or retests and accept the results of the compliance test. While steps are being taken to resolve audit analysis problems, the Administrator may also choose to use the data to determine the compliance or noncompliance status of the affected facility.

12.0 Data Analysis and Calculations

Carry out calculations, retaining at least one extra significant figure beyond that of the acquired data. Round off figures after final calculation.

12.1 Nomenclature.

C_a=Actual concentration of SO_2 in audit sample, mg/dscm.

C_d=Determined concentration of SO_2 in audit sample, mg/dscm.

C_{SO2}=Concentration of SO_2, dry basis, corrected to standard conditions, mg/dscm (lb/dscf).

N=Normality of barium standard titrant, meq/ml.

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

P_{std}=Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

RE=Relative error of QA audit sample analysis, percent

T_m=Average DGM absolute temperature, °K (°R).

T_{std}=Standard absolute temperature, 293 °K (528 °R).

V_a=Volume of sample aliquot titrated, ml.

V_m=Dry gas volume as measured by the DGM, dcm (dcf).

$V_{m(std)}$=Dry gas volume measured by the DGM, corrected to standard conditions, dscm (dscf).

V_{soln}=Total volume of solution in which the SO2 sample is contained, 100 ml.

V_t=Volume of barium standard titrant used for the sample (average of replicate titration), ml.

V_{tb}=Volume of barium standard titrant used for the blank, ml.

Y=DGM calibration factor.

12.2 Dry Sample Gas Volume, Corrected to Standard Conditions.

$$V_{m(std)} = \frac{\left(V_m\, Y\, T_{std}\, P_{bar}\right)}{\left(T_m\, P_{std}\right)} \qquad \text{Eq. 6-1}$$

$$= \frac{K_1\, Y\, V_m\, P_{bar}}{T_m}$$

Where:

$K_1 = 0.3855$ °K/mm Hg for metric units.
$K_1 = 17.65$ °R/in. Hg for English units.

12.3 SO₂ Concentration.

$$C_{SO_2} = \frac{K_2\, N\, \left(V_t - V_{tb}\right)\left(V_{soln}/V_a\right)}{V_{m(std)}} \qquad \text{Eq. 6-2}$$

Where:

$K_2 = 32.03$ mg SO₂/meq for metric units,
$K_2 = 7.061 \times 10^{-5}$ lb SO₂/meq for English units.

12.4 Relative Error for QA Audit Samples.

$$RE = \frac{100\left(C_d - C_a\right)}{C_a} \qquad \text{Eq. 6-3}$$

13.0 Method Performance

13.1 Range. The minimum detectable limit of the method has been determined to be 3.4 mg SO₂/m³ (2.12×10^{-7} lb/ft³). Although no upper limit has been established, tests have shown that concentrations as high as 80,000 mg/m³ (0.005 lb/ft³) of SO₂ can be collected efficiently at a rate of 1.0 liter/min (0.035 cfm) for 20 minutes in two midget impingers, each containing 15 ml of 3 percent H_2O_2. Based on theoretical calculations, the upper concentration limit in a 20 liter (0.7 ft³) sample is about 93,300 mg/m³ (0.00583 lb/ft³).

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 Alternative Procedures

16.1 Nomenclature. Same as Section 12.1, with the following additions:

B_{ws}=Water vapor in ambient air, proportion by volume.
M_a=Molecular weight of the ambient air saturated at impinger temperature, g/g-mole (lb/lb-mole).
M_s=Molecular weight of the sample gas saturated at impinger temperature, g/g-mole (lb/lb-mole).
P_c=Inlet vacuum reading obtained during the calibration run, mm Hg (in. Hg).
P_{sr}=Inlet vacuum reading obtained during the sampling run, mm Hg (in. Hg).
$\overline{Q}_{std}$=Volumetric flow rate through critical orifice, scm/min (scf/min).
Q_{std}=Average flow rate of pre-test and post-test calibration runs, scm/min (scf/min).

T_{amb}=Ambient absolute temperature of air, °K (°R).
V_{sb}=Volume of gas as measured by the soap bubble meter, m³ (ft³).
$V_{sb(std)}$=Volume of gas as measured by the soap bubble meter, corrected to standard conditions, scm (scf).
θ=Soap bubble travel time, min.
θ_s=Time, min.

16.2 Critical Orifices for Volume and Rate Measurements. A critical orifice may be used in place of the DGM specified in Section 6.1.1.10, provided that it is selected, calibrated, and used as follows:

16.2.1 Preparation of Sampling Train. Assemble the sampling train as shown in Figure 6–2. The rate meter and surge tank are optional but are recommended in order to detect changes in the flow rate.

NOTE: The critical orifices can be adapted to a Method 6 type sampling train as follows: Insert sleeve type, serum bottle stoppers into two reducing unions. Insert the needle into the stoppers as shown in Figure 6–3.

16.2.2 Selection of Critical Orifices.

16.2.2.1 The procedure that follows describes the use of hypodermic needles and stainless steel needle tubings, which have been found suitable for use as critical orifices. Other materials and critical orifice designs may be used provided the orifices act as true critical orifices, (i.e., a critical vacuum can be obtained) as described in this section. Select a critical orifice that is sized to operate at the desired flow rate. The needle sizes and tubing lengths shown in Table 6–1 give the following approximate flow rates.

16.2.2.2 Determine the suitability and the appropriate operating vacuum of the critical orifice as follows: If applicable, temporarily attach a rate meter and surge tank to the outlet of the sampling train, if said equipment is not present (see Section 16.2.1). Turn on the pump and adjust the valve to give an outlet vacuum reading corresponding to about half of the atmospheric pressure. Observe the rate meter reading. Slowly increase the vacuum until a stable reading is

obtained on the rate meter. Record the critical vacuum. which is the outlet vacuum when the rate meter first reaches a stable value. Orifices that do not reach a critical value must not be used.

16.2.3 Field Procedures.

16.2.3.1 Leak-Check Procedure. A leak-check before the sampling run is recommended. but not required. The leak-check procedure is as follows: Temporarily attach a suitable (e.g.. 0–40 ml/min) rotameter and surge tank. or a soap bubble meter and surge tank to the outlet of the pump. Plug the probe inlet, pull an outlet vacuum of at least 250 mm Hg (10 in. Hg). and note the flow rate as indicated by the rotameter or bubble meter. A leakage rate in excess of 2 percent of the average sampling rate ($\overline{Q}_{std}$) is not acceptable. Carefully release the probe inlet plug before turning off the pump.

16.2.3.2 Moisture Determination. At the sampling location. prior to testing. determine the percent moisture of the ambient air using the wet and dry bulb temperatures or. if appropriate, a relative humidity meter.

16.2.3.3 Critical Orifice Calibration. At the sampling location. prior to testing. calibrate the entire sampling train (i.e., determine the flow rate of the sampling train when operated at critical conditions). Attach a 500-ml soap bubble meter to the inlet of the probe, and operate the sampling train at an outlet vacuum of 25 to 50 mm Hg (1 to 2 in. Hg) above the critical vacuum. Record the information listed in Figure 6-4. Calculate the standard volume of air measured by the soap bubble meter and the volumetric flow rate using the equations below:

$$V_{sb(std)} = V_{sb}\left(T_{std}/T_{amb}\right)\left(P_{bar}/P_{std}\right) \quad \text{Eq. 6-4}$$

$$Q_{std} = \frac{V_{sb(std)}}{\theta} \quad \text{Eq. 6-5}$$

16.2.3.4 Sampling.

16.2.3.4.1 Operate the sampling train for sample collection at the same vacuum used during the calibration run. Start the watch and pump simultaneously. Take readings (temperature. rate meter, inlet vacuum, and outlet vacuum) at least every 5 minutes. At the end of the sampling run, stop the watch and pump simultaneously.

16.2.3.4.2 Conduct a post-test calibration run using the calibration procedure outlined in Section 16.2.3.3. If the Q_{std} obtained before and after the test differ by more than 5 percent, void the test run; if not. calculate the volume of the gas measured with the critical orifice using Equation 6-6 as follows:

$$V_{m(std)} = \frac{\overline{Q}_{std}\ \theta_s\ \left(1 - B_{wa}\right)\left(P_{bar} + P_{sr}\right)}{\left(P_{bar} + P_c\right)} \quad \text{Eq. 6-6}$$

16.2.3.4.3 If the percent difference between the molecular weight of the ambient air at saturated conditions and the sample gas is more that ±3 percent. then the molecular weight of the gas sample must be considered in the calculations using the following equation:

$$_{(std)} = \frac{\overline{Q}_{std}\ \theta_s\ \left(1 - B_{wa}\right)\left(P_{bar} + P_{sr}\right)\left(M_a/M_s\right)^{1}}{\left(P_{bar} + P_c\right)} \quad \text{Eq. 6-7}$$

NOTE: A post-test leak-check is not necessary because the post-test calibration run results will indicate whether there is any leakage.

16.2.3.4.4 Drain the ice bath. and purge the sampling train using the procedure described in Section 8.3.4.

247

16.3 Elimination of Ammonia Interference. The following alternative procedures must be used in addition to those specified in the method when sampling at sources having ammonia emissions.

16.3.1 Sampling. The probe shall be maintained at 275 °C (527 °F) and equipped with a high-efficiency in-stack filter (glass fiber) to remove particulate matter. The filter material shall be unreactive to SO_2. Whatman 934AH (formerly Reeve Angel 934AH) filters treated as described in Reference 10 in Section 17.0 of Method 5 is an example of a filter that has been shown to work. Where alkaline particulate matter and condensed moisture are present in the gas stream, the filter shall be heated above the moisture dew point but below 225 °C (437 °F).

16.3.2 Sample Recovery. Recover the sample according to Section 8.4 except for discarding the contents of the midget bubbler. Add the bubbler contents, including the rinsings of the bubbler with water, to a separate polyethylene bottle from the rest of the sample. Under normal testing conditions where sulfur trioxide will not be present significantly, the tester may opt to delete the midget bubbler from the sampling train. If an approximation of the sulfur trioxide concentration is desired, transfer the contents of the midget bubbler to a separate polyethylene bottle.

16.3.3 Sample Analysis. Follow the procedures in Sections 11.1 and 11.2, except add 0.5 ml of 0.1 N HCl to the Erlenmeyer flask and mix before adding the indicator. The following analysis procedure may be used for an approximation of the sulfur trioxide concentration. The accuracy of the calculated concentration will depend upon the ammonia to SO_2 ratio and the level of oxygen present in the gas stream. A fraction of the SO_2 will be counted as sulfur trioxide as the ammonia to SO_2 ratio and the sample oxygen content increases. Generally, when this ratio is 1 or less and the oxygen content is in the range of 5 percent, less than 10 percent of the SO_2 will be counted as sulfur trioxide. Analyze the peroxide and isopropanol sample portions separately. Analyze the peroxide portion as described above. Sulfur trioxide is determined by difference using sequential titration of the isopropanol portion of the sample. Transfer the contents of the isopropanol storage container to a 100-ml volumetric flask, and dilute to exactly 100 ml with water. Pipette a 20-ml aliquot of this solution into a 250-ml Erlenmeyer flask, add 0.5 ml of 0.1 N HCl, 80 ml of 100 percent isopropanol, and two to four drops of thorin indicator. Titrate to a pink endpoint using 0.0100 N barium perchlorate. Repeat and average the titration volumes that agree within 1 percent or 0.2 ml, whichever is larger. Use this volume in Equation 6–2 to determine the sulfur trioxide concentration. From the flask containing the remainder of the isopropanol sample, determine the fraction of SO_2 collected in the bubbler by pipetting 20-ml aliquots into 250-ml Erlenmeyer flasks. Add 5 ml of 3 percent H_2O_2, 100 ml of 100 percent isopropanol, and two to four drips of thorin indicator, and titrate as before. From this titration volume, subtract the titrant volume determined for sulfur trioxide, and add the titrant volume determined for the peroxide portion. This final volume constitutes V_t, the volume of barium perchlorate used for the SO_2 sample.

17.0 References

1. Atmospheric Emissions from Sulfuric Acid Manufacturing Processes. U.S. DHEW. PHS, Division of Air Pollution. Public Health Service Publication No. 999-AP-13. Cincinnati. OH. 1965.

2. Corbett, P.F. The Determination of SO_2 and SO_3 in Flue Gases. Journal of the Institute of Fuel. 24:237–243. 1961.

3. Matty, R.E., and E.K. Diehl. Measuring Flue-Gas SO_2 and SO_3. Power. 101:94–97. November 1957.

4. Patton, W.F., and J.A. Brink, Jr. New Equipment and Techniques for Sampling Chemical Process Gases. J. Air Pollution Control Association. 13:162. 1963.

5. Rom, J.J. Maintenance, Calibration, and Operation of Isokinetic Source Sampling Equipment. Office of Air Programs, U.S. Environmental Protection Agency. Research Triangle Park. NC. APTD–0576. March 1972.

6. Hamil, H.F., and D.E. Camann. Collaborative Study of Method for the Determination of Sulfur Dioxide Emissions from Stationary Sources (Fossil-Fuel Fired Steam Generators). U.S. Environmental Protection Agency, Research Triangle Park, NC. EPA–650/4–74–024. December 1973.

7. Annual Book of ASTM Standards. Part 31; Water, Atmospheric Analysis. American Society for Testing and Materials. Philadelphia, PA. 1974. pp. 40–42.

8. Knoll, J.E., and M.R. Midgett. The Application of EPA Method 6 to High Sulfur Dioxide Concentrations. U.S. Environmental Protection Agency. Research Triangle Park, NC. EPA–600/4–76–038. July 1976.

9. Westlin, P.R., and R.T. Shigehara. Procedure for Calibrating and Using Dry Gas Volume Meters as Calibration Standards. Source Evaluation Society Newsletter. 3(1):17–30. February 1978.

10. Yu, K.K. Evaluation of Moisture Effect on Dry Gas Meter Calibration. Source Evaluation Society Newsletter. 5(1):24–28. February 1980.

11. Lodge, J.P., Jr., et al. The Use of Hypodermic Needles as Critical Orifices in Air Sampling. J. Air Pollution Control Association. 16:197–200. 1966.

12. Shigehara, R.T., and C.B. Sorrell. Using Critical Orifices as Method 5 Calibration Standards. Source Evaluation Society Newsletter. 10:4–15. August 1985.

248

13. Curtis. F.. Analysis of Method 6 Samples in the Presence of Ammonia. Source Evaluation Society Newsletter. 13(1):9–15 February 1988.

18.0   Tables, Diagrams, Flowcharts and Validation Data

TABLE 6–1—APPROXIMATE FLOW RATES FOR VARIOUS NEEDLE SIZES

Needle size (gauge)	Needle length (cm)	Flow rate (ml/min)
21	7.6	1,100
22	2.9	1,000
22	3.8	900
23	3.8	500
23	5.1	450
24	3.2	400
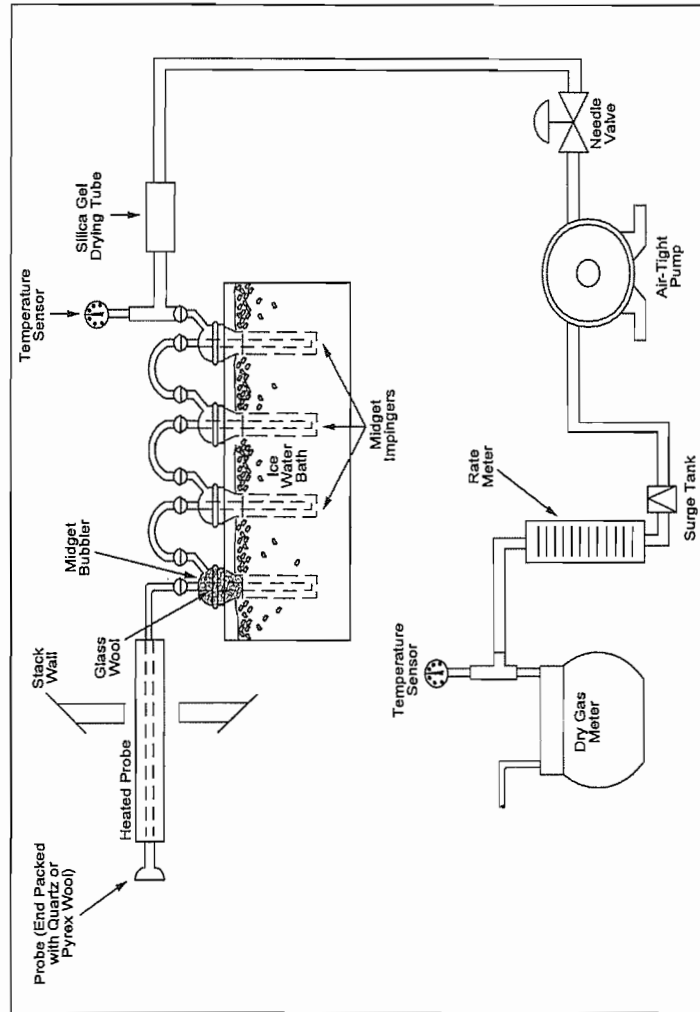
Figure 6-1.   Sulfur Dioxide Sampling Train.
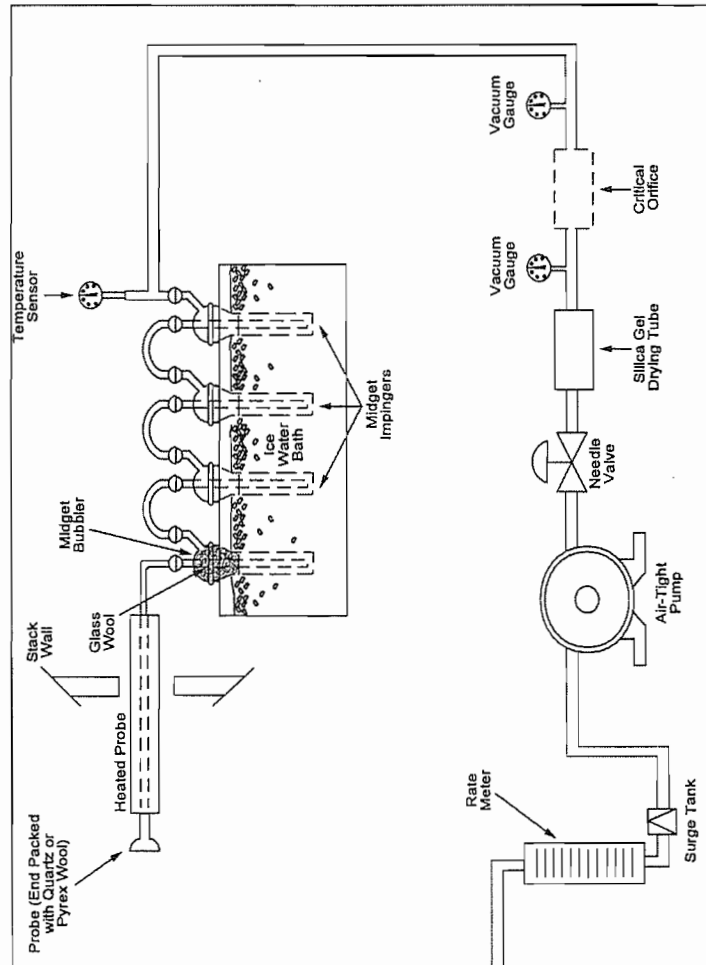
Figure 6-2. Sulfur Dioxide Sampling Train Using a Critical Orifice.
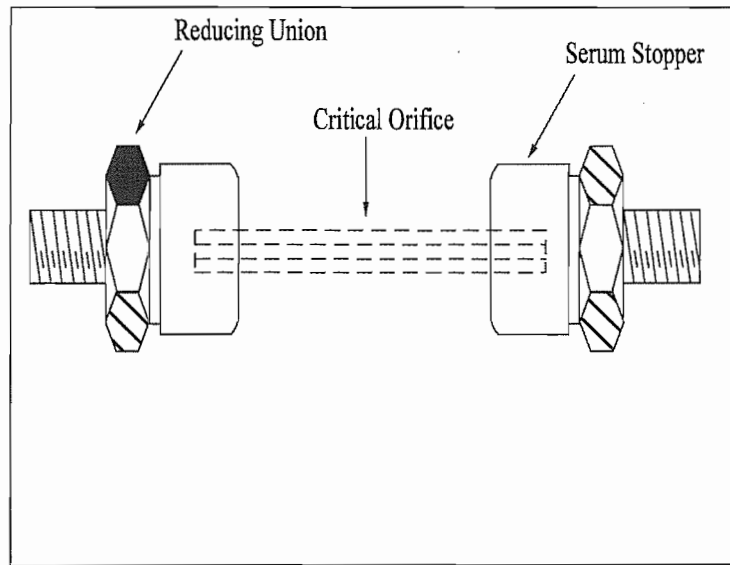
Figure 6-3. Critical Orifice Adaptation for the Method 6
Sampling Train.

18.0 Tables, Diagrams. Flowcharts, and Validation Data [Reserved]

METHOD 6C—DETERMINATION OF SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES (INSTRUMENTAL ANALYZER PROCEDURE)

1.0 Scope and Application

What is Method 6C?

Method 6C is a procedure for measuring sulfur dioxide (SO_2) in stationary source emissions using a continuous instrumental analyzer. Quality assurance and quality control requirements are included to assure that you, the tester, collect data of known quality. You must document your adherence to these specific requirements for equipment, supplies, sample collection and analysis, calculations, and data analysis.

This method does not completely describe all equipment, supplies, and sampling and analytical procedures you will need but refers to other methods for some of the details. Therefore, to obtain reliable results, you should also have a thorough knowledge of these additional test methods which are found in appendix A to this part:

(a) Method 1—Sample and Velocity Traverses for Stationary Sources.

(b) Method 4—Determination of Moisture Content in Stack Gases.

(c) Method 6—Determination of Sulfur Dioxide Emissions from Stationary Sources.

(d) Method 7E—Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure).

1.1 Analytes. What does this method determine? This method measures the concentration of sulfur dioxide.

Analyte	CAS No.	Sensitivity
SO_2	7446-09-5	Typically <2% of Calibration Span.

1.2 Applicability. When is this method required? The use of Method 6C may be required by specific New Source Performance Standards, Clean Air Marketing rules, State Implementation Plans, and permits where SO_2 concentrations in stationary source emissions must be measured, either to determine compliance with an applicable emission standard or to conduct performance testing of a continuous emission monitoring system (CEMS). Other regulations may also require the use of Method 6C.

1.3 Data Quality Objectives. How good must my collected data be? Refer to Section 1.3 of Method 7E.

2.0 Summary of Method

In this method, you continuously sample the effluent gas and convey the sample to an analyzer that measures the concentration of SO_2. You must meet the performance requirements of this method to validate your data.

3.0 Definitions

Refer to Section 3.0 of Method 7E for the applicable definitions.

4.0 Interferences

Refer to Section 4.1 of Method 6.

5.0 Safety

Refer to Section 5.0 of Method 7E.

6.0 Equipment and Supplies

Figure 7E-1 of Method 7E is a schematic diagram of an acceptable measurement system.

6.1 What do I need for the measurement system? The essential components of the measurement system are the same as those in Sections 6.1 and 6.2 of Method 7E, except that the SO_2 analyzer described in Section 6.2 of this method must be used instead of the analyzer described in Section 6.2 of Method 7E. You must follow the noted specifications in Section 6.1 of Method 7E.

6.2 What analyzer must I use? You may use an instrument that uses an ultraviolet, nondispersive infrared, fluorescence, or other detection principle to continuously measure SO_2 in the gas stream and meets the performance specifications in Section 13.0. The low-range and dual-range analyzer provisions in Sections 6.2.8.1 and 6.2.8.2 of Method 7E apply.

7.0 Reagents and Standards

7.1 Calibration Gas. What calibration gases do I need? Refer to Section 7.1 of Method 7E for the calibration gas requirements. Example calibration gas mixtures are listed below.

(a) SO_2 in nitrogen (N_2).

(b) SO_2 in air.

(c) SO_2 and CO_2 in N_2.

(d) SO_2 and O_2 in N_2.

(e) $SO_2/CO_2/O_2$ gas mixture in N_2.

(f) CO_2/NO_X gas mixture in N_2.

(g) $CO_2/SO_2/NO_X$ gas mixture in N_2.

7.2 Interference Check. What additional reagents do I need for the interference check? The test gases for the interference check are listed in Table 7E-3 of Method 7E. For the alternative interference check, you must use the reagents described in Section 7.0 of Method 6.

8.0　Sample Collection, Preservation, Storage, and Transport

8.1　Sampling Site and Sampling Points. You must follow the procedures of Section 8.1 of Method 7E.

8.2　Initial Measurement System Performance Tests. You must follow the procedures in Section 8.2 of Method 7E. If a dilution-type measurement system is used, the special considerations in Section 8.3 of Method 7E also apply.

8.3　Interference Check. You must follow the procedures of Section 8.2.7 of Method 7E to conduct an interference check, substituting SO_2 for NO_x as the method pollutant. For dilution-type measurement systems, you must use the alternative interference check procedure in Section 16 and a co-located, unmodified Method 6 sampling train.

8.4　Sample Collection. You must follow the procedures of Section 8.4 of Method 7E.

8.5　Post-Run System Bias Check and Drift Assessment. You must follow the procedures of Section 8.5 of Method 7E.

9.0　Quality Control

Follow quality control procedures in Section 9.0 of Method 7E.

10.0　Calibration and Standardization

Follow the procedures for calibration and standardization in Section 10.0 of Method 7E.

11.0　Analytical Procedures

Because sample collection and analysis are performed together (see Section 8), additional discussion of the analytical procedure is not necessary.

12.0　Calculations and Data Analysis

You must follow the applicable procedures for calculations and data analysis in Section 12.0 of Method 7E as applicable, substituting SO_2 for NO_x as appropriate.

13.0　Method Performance

13.1　The specifications for the applicable performance checks are the same as in Section 13.0 of Method 7E.

13.2　Alternative Interference Check. The results are acceptable if the difference between the Method 6C result and the modified Method 6 result is less than 7.0 percent of the Method 6 result for each of the three test runs. For the purposes of comparison, the Method 6 and 6C results must be expressed in the same units of measure.

14.0　Pollution Prevention [Reserved]

15.0　Waste Management [Reserved]

16.0　Alternative Procedures

16.1　Alternative Interference Check. You may perform an alternative interference check consisting of at least three comparison runs between Method 6C and Method 6. This check validates the Method 6C results at each particular facility of known potential interferences. When testing under conditions of low concentrations (< 15 ppm), this alternative interference check is not allowed.

NOTE: The procedure described below applies to non-dilution sampling systems only. If this alternative interference check is used for a dilution sampling system, use a standard Method 6 sampling train and extract the sample directly from the exhaust stream at points collocated with the Method 6C sample probe.

(1) Build the modified Method 6 sampling train (flow control valve, two midget impingers containing 3 percent hydrogen peroxide, and dry gas meter) shown in Figure 6C–1. Connect the sampling train to the sample bypass discharge vent. Record the dry gas meter reading before you begin sampling. Simultaneously collect modified Method 6 and Method 6C samples. Open the flow control valve in the modified Method 6 train as you begin to sample with Method 6C. Adjust the Method 6 sampling rate to 1 liter per minute (.10 percent). The sampling time per run must be the same as for Method 6 plus twice the average measurement system response time. If your modified Method 6 train does not include a pump, you risk biasing the results high if you over-pressurize the midget impingers and cause a leak. You can reduce this risk by cautiously increasing the flow rate as sampling begins.

(2) After completing a run, record the final dry gas meter reading, meter temperature, and barometric pressure. Recover and analyze the contents of the midget impingers using the procedures in Method 6. You must analyze performance audit samples as described in Method 6 with this interference check. Determine the average gas concentration reported by Method 6C for the run.

17.0　References

1.　"EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards" September 1997 as amended, EPA–600/R–97/121

18.0　Tables, Diagrams, Flowcharts, and Validation Data

**Figure 6C-1. Modified Method 6
Alternative Interference Check Sampling Train**

METHOD 7—DETERMINATION OF NITROGEN
OXIDE EMISSIONS FROM STATIONARY SOURCES

NOTE: This method does not include all of
the specifications (*e.g.*, equipment and sup-
plies) and procedures (*e.g.*, sampling and ana-
lytical) essential to its performance. Some
material is incorporated by reference from
other methods in this part. Therefore, to ob-
tain reliable results, persons using this
method should have a thorough knowledge of
at least the following additional test meth-
ods: Method 1 and Method 5.

1.0 Scope and Application

1.1 Analytes.

Analyte	CAS No.	Sensitivity
Nitrogen oxides (NO$_x$), as NO$_2$, including:		
Nitric oxide (NO)	10102–43–9	
Nitrogen dioxide (NO$_2$)	10102–44–0	2–400 mg/dscm

1.2 Applicability. This method is applica-
ble for the measurement of nitrogen oxides
(NO$_x$) emitted from stationary sources.

1.3 Data Quality Objectives. Adherence to
the requirements of this method will en-
hance the quality of the data obtained from
air pollutant sample methods.

2.0 Summary of Method

A grab sample is collected in an evacuated
flask containing a dilute sulfuric acid-hydro-
gen peroxide absorbing solution, and the ni-
trogen oxides, except nitrous oxide, are
measured colorimetrically using the
phenoldisulfonic acid (PDS) procedure.

3.0 Definitions [Reserved]

4.0 Interferences

Biased results have been observed when
sampling under conditions of high sulfur di-
oxide concentrations (above 2000 ppm).

5.0 Safety

5.1 Disclaimer. This method may involve
hazardous materials, operations, and equip-
ment. This test method may not address all
of the safety problems associated with its
use. It is the responsibility of the user to es-
tablish appropriate safety and health prac-
tices and to determine the applicability of
regulatory limitations prior to performing
this test method.

5.2 Corrosive Reagents. The following re-
agents are hazardous. Personal protective
equipment and safe procedures are useful in

**Figure 6C-1. Modified Method 6
Alternative Interference Check Sampling Train**

METHOD 7—DETERMINATION OF NITROGEN
OXIDE EMISSIONS FROM STATIONARY SOURCES

NOTE: This method does not include all of the specifications (e.g., equipment and supplies) and procedures (e.g., sampling and analytical) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should have a thorough knowledge of at least the following additional test methods: Method 1 and Method 5.

1.0 Scope and Application

1.1 Analytes.

Analyte	CAS No.	Sensitivity
Nitrogen oxides (NO$_X$), as NO$_2$, including:		
Nitric oxide (NO)	10102–43–9	
Nitrogen dioxide (NO$_2$)	10102–44–0	2–400 mg/dscm

1.2 Applicability. This method is applicable for the measurement of nitrogen oxides (NO$_X$) emitted from stationary sources.

1.3 Data Quality Objectives. Adherence to the requirements of this method will enhance the quality of the data obtained from air pollutant sample methods.

2.0 Summary of Method

A grab sample is collected in an evacuated flask containing a dilute sulfuric acid-hydrogen peroxide absorbing solution, and the nitrogen oxides, except nitrous oxide. are measured colorimetrically using the phenoldisulfonic acid (PDS) procedure.

3.0 Definitions [Reserved]

4.0 Interferences

Biased results have been observed when sampling under conditions of high sulfur dioxide concentrations (above 2000 ppm).

5.0 Safety

5.1 Disclaimer. This method may involve hazardous materials, operations, and equipment. This test method may not address all of the safety problems associated with its use. It is the responsibility of the user to establish appropriate safety and health practices and to determine the applicability of regulatory limitations prior to performing this test method.

5.2 Corrosive Reagents. The following reagents are hazardous. Personal protective equipment and safe procedures are useful in

preventing chemical splashes. If contact occurs, immediately flush with copious amounts of water for at least 15 minutes. Remove clothing under shower and decontaminate. Treat residual chemical burns as thermal burns.

5.2.1   Hydrogen Peroxide (H_2O_2). Irritating to eyes, skin, nose, and lungs.

5.2.2   Phenoldisulfonic Acid. Irritating to eyes and skin.

5.2.3   Sodium Hydroxide (NaOH). Causes severe damage to eyes and skin. Inhalation causes irritation to nose, throat, and lungs. Reacts exothermically with limited amounts of water.

5.2.4   Sulfuric Acid (H_2SO_4). Rapidly destructive to body tissue. Will cause third degree burns. Eye damage may result in blindness. Inhalation may be fatal from spasm of the larynx, usually within 30 minutes. May cause lung tissue damage with edema. 1 mg/m^3 for 8 hours will cause lung damage or, in higher concentrations, death. Provide ventilation to limit inhalation. Reacts violently with metals and organics.

5.2.5   Phenol. Poisonous and caustic. Do not handle with bare hands as it is absorbed through the skin.

6.0   Equipment and Supplies

6.1   Sample Collection. A schematic of the sampling train used in performing this method is shown in Figure 7–1. Other grab sampling systems or equipment, capable of measuring sample volume to within 2.0 percent and collecting a sufficient sample volume to allow analytical reproducibility to within 5 percent, will be considered acceptable alternatives, subject to the approval of the Administrator. The following items are required for sample collection:

6.1.1   Probe. Borosilicate glass tubing, sufficiently heated to prevent water condensation and equipped with an in-stack or heated out-of-stack filter to remove particulate matter (a plug of glass wool is satisfactory for this purpose). Stainless steel or Teflon tubing may also be used for the probe. Heating is not necessary if the probe remains dry during the purging period.

6.1.2   Collection Flask. Two-liter borosilicate, round bottom flask, with short neck and 24/40 standard taper opening, protected against implosion or breakage.

6.1.3   Flask Valve. T-bore stopcock connected to a 24/40 standard taper joint.

6.1.4   Temperature Gauge. Dial-type thermometer, or other temperature gauge, capable of measuring 1 °C (2 °F) intervals from −5 to 50 °C (23 to 122 °F).

6.1.5   Vacuum Line. Tubing capable of withstanding a vacuum of 75 mm (3 in.) Hg absolute pressure, with "T" connection and T-bore stopcock.

6.1.6   Vacuum Gauge. U-tube manometer, 1 meter (39 in.), with 1 mm (0.04 in.) divisions, or other gauge capable of measuring pressure to within 2.5 mm (0.10 in.) Hg.

6.1.7   Pump. Capable of evacuating the collection flask to a pressure equal to or less than 75 mm (3 in.) Hg absolute.

6.1.8   Squeeze Bulb. One-way.

6.1.9   Volumetric Pipette. 25-ml.

6.1.10   Stopcock and Ground Joint Grease. A high-vacuum, high-temperature chlorofluorocarbon grease is required. Halocarbon 25-5S has been found to be effective.

6.1.11   Barometer. Mercury, aneroid, or other barometer capable of measuring atmospheric pressure to within 2.5 mm (0.1 in.) Hg. See NOTE in Method 5, Section 6.1.2.

6.2   Sample Recovery. The following items are required for sample recovery:

6.2.1   Graduated Cylinder. 50-ml with 1 ml divisions.

6.2.2   Storage Containers. Leak-free polyethylene bottles.

6.2.3   Wash Bottle. Polyethylene or glass.

6.2.4   Glass Stirring Rod.

6.2.5   Test Paper for Indicating pH. To cover the pH range of 7 to 14.

6.3   Analysis. The following items are required for analysis:

6.3.1   Volumetric Pipettes. Two 1-ml, two 2-ml, one 3-ml, one 4-ml, two 10-ml, and one 25-ml for each sample and standard.

6.3.2   Porcelain Evaporating Dishes. 175- to 250-ml capacity with lip for pouring, one for each sample and each standard. The Coors No. 45006 (shallowform, 195-ml) has been found to be satisfactory. Alternatively, polymethyl pentene beakers (Nalge No. 1203, 150-ml), or glass beakers (150-ml) may be used. When glass beakers are used, etching of the beakers may cause solid matter to be present in the analytical step; the solids should be removed by filtration.

6.3.3   Steam Bath. Low-temperature ovens or thermostatically controlled hot plates kept below 70 °C (160 °F) are acceptable alternatives.

6.3.4   Dropping Pipette or Dropper. Three required.

6.3.5   Polyethylene Policeman. One for each sample and each standard.

6.3.6   Graduated Cylinder. 100-ml with 1-ml divisions.

6.3.7   Volumetric Flasks. 50-ml (one for each sample and each standard), 100-ml (one for each sample and each standard, and one for the working standard KNO_3 solution), and 1000-ml (one).

6.3.8   Spectrophotometer. To measure at 410 nm.

6.3.9   Graduated Pipette. 10-ml with 0.1-ml divisions.

6.3.10   Test Paper for Indicating pH. To cover the pH range of 7 to 14.

6.3.11   Analytical Balance. To measure to within 0.1 mg.

7.0 Reagents and Standards

Unless otherwise indicated, it is intended that all reagents conform to the specifications established by the Committee on Analytical Reagents of the American Chemical Society, where such specifications are available; otherwise, use the best available grade.

7.1 Sample Collection. The following reagents are required for sampling:

7.1.1 Water. Deionized distilled to conform to ASTM D 1193-77 or 91 Type 3 (incorporated by reference—see § 60.17). The $KMnO_4$ test for oxidizable organic matter may be omitted when high concentrations of organic matter are not expected to be present.

7.1.2 Absorbing Solution. Cautiously add 2.8 ml concentrated H_2SO_4 to a 1-liter flask partially filled with water. Mix well, and add 6 ml of 3 percent hydrogen peroxide, freshly prepared from 30 percent hydrogen peroxide solution. Dilute to 1 liter of water and mix well. The absorbing solution should be used within 1 week of its preparation. Do not expose to extreme heat or direct sunlight.

7.2 Sample Recovery. The following reagents are required for sample recovery:

7.2.1 Water. Same as in 7.1.1.

7.2.2 Sodium Hydroxide, 1 N. Dissolve 40 g NaOH in water, and dilute to 1 liter.

7.3 Analysis. The following reagents and standards are required for analysis:

7.3.1 Water. Same as in 7.1.1.

7.3.2 Fuming Sulfuric Acid. 15 to 18 percent by weight free sulfur trioxide. HANDLE WITH CAUTION.

7.3.3 Phenol. White solid.

7.3.4 Sulfuric Acid. Concentrated, 95 percent minimum assay.

7.3.5 Potassium Nitrate (KNO_3). Dried at 105 to 110 °C (221 to 230 °F) for a minimum of 2 hours just prior to preparation of standard solution.

7.3.6 Standard KNO_3 Solution. Dissolve exactly 2.198 g of dried KNO_3 in water, and dilute to 1 liter with water in a 1000-ml volumetric flask.

7.3.7 Working Standard KNO_3 Solution. Dilute 10 ml of the standard solution to 100 ml with water. One ml of the working standard solution is equivalent to 100 μg nitrogen dioxide (NO_2).

7.3.8 Phenoldisulfonic Acid Solution. Dissolve 25 g of pure white phenol solid in 150 ml concentrated sulfuric acid on a steam bath. Cool, add 75 ml fuming sulfuric acid (15 to 18 percent by weight free sulfur trioxide—HANDLE WITH CAUTION), and heat at 100 °C (212 °F) for 2 hours. Store in a dark, stoppered bottle.

7.3.9 Concentrated Ammonium Hydroxide.

7.3.10 Quality Assurance Audit Samples. When making compliance determinations, and upon availability, audit samples may be obtained from the appropriate EPA Regional Office or from the responsible enforcement authority.

NOTE: The responsible enforcement authority should be notified at least 30 days prior to the test date to allow sufficient time for sample delivery.

8.0 Sample Collection, Preservation, Storage and Transport

8.1 Sample Collection.

8.1.1 Flask Volume. The volume of the collection flask and flask valve combination must be known prior to sampling. Assemble the flask and flask valve, and fill with water to the stopcock. Measure the volume of water to ±10 ml. Record this volume on the flask.

8.1.2 Pipette 25 ml of absorbing solution into a sample flask, retaining a sufficient quantity for use in preparing the calibration standards. Insert the flask valve stopper into the flask with the valve in the "purge" position. Assemble the sampling train as shown in Figure 7-1, and place the probe at the sampling point. Make sure that all fittings are tight and leak-free, and that all ground glass joints have been greased properly with a high-vacuum, high temperature chlorofluorocarbon-based stopcock grease. Turn the flask valve and the pump valve to their "evacuate" positions. Evacuate the flask to 75 mm (3 in.) Hg absolute pressure, or less. Evacuation to a pressure approaching the vapor pressure of water at the existing temperature is desirable. Turn the pump valve to its "vent" position, and turn off the pump. Check for leakage by observing the manometer for any pressure fluctuation. (Any variation greater than 10 mm (0.4 in.) Hg over a period of 1 minute is not acceptable, and the flask is not to be used until the leakage problem is corrected. Pressure in the flask is not to exceed 75 mm (3 in.) Hg absolute at the time sampling is commenced.) Record the volume of the flask and valve (V_f), the flask temperature (T_i), and the barometric pressure. Turn the flask valve counterclockwise to its "purge" position, and do the same with the pump valve. Purge the probe and the vacuum tube using the squeeze bulb. If condensation occurs in the probe and the flask valve area, heat the probe, and purge until the condensation disappears. Next, turn the pump valve to its "vent" position. Turn the flask valve clockwise to its "evacuate" position, and record the difference in the mercury levels in the manometer. The absolute internal pressure in the flask (P_i) is equal to the barometric pressure less the manometer reading. Immediately turn the flask valve to the "sample" position, and permit the gas to enter the flask until pressures in the flask and sample line (i.e., duct, stack) are equal. This will usually require about 15 seconds; a longer period indicates a plug in the probe, which must be corrected before sampling is continued. After collecting the sample, turn the flask valve to

its "purge" position. and disconnect the flask from the sampling train.

8.1.3 Shake the flask for at least 5 minutes.

8.1.4 If the gas being sampled contains insufficient oxygen for the conversion of NO to NO₂ (e.g., an applicable subpart of the standards may require taking a sample of a calibration gas mixture of NO in N₂), then introduce oxygen into the flask to permit this conversion. Oxygen may be introduced into the flask by one of three methods: (1) Before evacuating the sampling flask. flush with pure cylinder oxygen, then evacuate flask to 75 mm (3 in.) Hg absolute pressure or less; or (2) inject oxygen into the flask after sampling; or (3) terminate sampling with a minimum of 50 mm (2 in.) Hg vacuum remaining in the flask, record this final pressure, and then vent the flask to the atmosphere until the flask pressure is almost equal to atmospheric pressure.

8.2 Sample Recovery. Let the flask sit for a minimum of 16 hours, and then shake the contents for 2 minutes.

8.2.1 Connect the flask to a mercury filled U-tube manometer. Open the valve from the flask to the manometer, and record the flask temperature (T_f). the barometric pressure. and the difference between the mercury levels in the manometer. The absolute internal pressure in the flask (P_f) is the barometric pressure less the manometer reading. Transfer the contents of the flask to a leak-free polyethylene bottle. Rinse the flask twice with 5 ml portions of water. and add the rinse water to the bottle. Adjust the pH to between 9 and 12 by adding 1 N NaOH. dropwise (about 25 to 35 drops). Check the pH by dipping a stirring rod into the solution and then touching the rod to the pH test paper. Remove as little material as possible during this step. Mark the height of the liquid level so that the container can be checked for leakage after transport. Label the container to identify clearly its contents. Seal the container for shipping.

9.0 Quality Control

Section	Quality control measure	Effect
10.1	Spectrophotometer calibration	Ensure linearity of spectrophotometer response to standards.
11.4	Audit sample analysis	Evaluate analytical technique, preparation of standards.

10.0 Calibration and Standardization

10.1 Spectrophotometer.

10.1.1 Optimum Wavelength Determination.

10.1.1.1 Calibrate the wavelength scale of the spectrophotometer every 6 months. The calibration may be accomplished by using an energy source with an intense line emission such as a mercury lamp, or by using a series of glass filters spanning the measuring range of the spectrophotometer. Calibration materials are available commercially and from the National Institute of Standards and Technology. Specific details on the use of such materials should be supplied by the vendor; general information about calibration techniques can be obtained from general reference books on analytical chemistry. The wavelength scale of the spectrophotometer must read correctly within 5 nm at all calibration points; otherwise, repair and recalibrate the spectrophotometer. Once the wavelength scale of the spectrophotometer is in proper calibration, use 410 nm as the optimum wavelength for the measurement of the absorbance of the standards and samples.

10.1.1.2 Alternatively. a scanning procedure may be employed to determine the proper measuring wavelength. If the instrument is a double-beam spectrophotometer, scan the spectrum between 400 and 415 nm using a 200 µg NO₂ standard solution in the sample cell and a blank solution in the reference cell. If a peak does not occur. the spectrophotometer is probably malfunctioning and should be repaired. When a peak is obtained within the 400 to 415 nm range, the wavelength at which this peak occurs shall be the optimum wavelength for the measurement of absorbance of both the standards and the samples. For a single-beam spectrophotometer, follow the scanning procedure described above, except scan separately the blank and standard solutions. The optimum wavelength shall be the wavelength at which the maximum difference in absorbance between the standard and the blank occurs.

10.1.2 Determination of Spectrophotometer Calibration Factor K_c. Add 0 ml, 2.0 ml. 4.0 ml, 6.0 ml. and 8.0 ml of the KNO₃ working standard solution (1 ml=100 µg NO₂) to a series of five 50-ml volumetric flasks. To each flask. add 25 ml of absorbing solution and 10 ml water. Add 1 N NaOH to each flask until the pH is between 9 and 12 (about 25 to 35 drops). Dilute to the mark with water. Mix thoroughly. and pipette a 25-ml aliquot of each solution into a separate porcelain evaporating dish. Beginning with the evaporation step. follow the analysis procedure of Section 11.2 until the solution has been transferred to the 100-ml volumetric flask and diluted to the mark. Measure the absorbance of each solution at the optimum wavelength as determined in Section 10.2.1. This calibration procedure must be repeated on

each day that samples are analyzed. Calculate the spectrophotometer calibration factor as shown in Section 12.2.

10.1.3 Spectrophotometer Calibration Quality Control. Multiply the absorbance value obtained for each standard by the K_c factor (reciprocal of the least squares slope) to determine the distance each calibration point lies from the theoretical calibration line. The difference between the calculated concentration values and the actual concentrations (i.e., 100, 200, 300, and 400 µg NO_2) should be less than 7 percent for all standards.

10.2 Barometer. Calibrate against a mercury barometer.

10.3 Temperature Gauge. Calibrate dial thermometers against mercury-in-glass thermometers.

10.4 Vacuum Gauge. Calibrate mechanical gauges, if used, against a mercury manometer such as that specified in Section 6.1.6.

10.5 Analytical Balance. Calibrate against standard weights.

11.0 Analytical Procedures

11.1 Sample Loss Check. Note the level of the liquid in the container, and confirm whether any sample was lost during shipment. Note this on the analytical data sheet. If a noticeable amount of leakage has occurred, either void the sample or use methods, subject to the approval of the Administrator, to correct the final results.

11.2 Sample Preparation. Immediately prior to analysis, transfer the contents of the shipping container to a 50 ml volumetric flask, and rinse the container twice with 5 ml portions of water. Add the rinse water to the flask, and dilute to mark with water; mix thoroughly. Pipette a 25-ml aliquot into the porcelain evaporating dish. Return any unused portion of the sample to the polyethylene storage bottle. Evaporate the 25-ml aliquot to dryness on a steam bath, and allow to cool. Add 2 ml phenoldisulfonic acid solution to the dried residue, and triturate thoroughly with a polyethylene policeman. Make sure the solution contacts all the residue. Add 1 ml water and 4 drops of concentrated sulfuric acid. Heat the solution on a steam bath for 3 minutes with occasional stirring. Allow the solution to cool, add 20 ml water, mix well by stirring, and add concentrated ammonium hydroxide, dropwise, with constant stirring, until the pH is 10 (as determined by pH paper). If the sample contains solids, these must be removed by filtration (centrifugation is an acceptable alternative, subject to the approval of the Administrator) as follows: Filter through Whatman No. 41 filter paper into a 100-ml volumetric flask. Rinse the evaporating dish with three 5-ml portions of water. Filter these three rinses. Wash the filter with at least three 15-ml portions of water. Add the filter washings to the contents of the volumetric flask, and

dilute to the mark with water. If solids are absent, the solution can be transferred directly to the 100-ml volumetric flask and diluted to the mark with water.

11.3 Sample Analysis. Mix the contents of the flask thoroughly, and measure the absorbance at the optimum wavelength used for the standards (Section 10.2.1), using the blank solution as a zero reference. Dilute the sample and the blank with equal volumes of water if the absorbance exceeds A_4, the absorbance of the 400-µg NO_2 standard (see Section 10.2.2).

11.4 Audit Sample Analysis.

11.4.1 When the method is used to analyze samples to demonstrate compliance with a source emission regulation, an audit sample must be analyzed, subject to availability.

11.4.2 Concurrently analyze the audit sample and the compliance samples in the same manner to evaluate the technique of the analyst and the standards preparation.

11.4.3 The same analyst, analytical reagents, and analytical system must be used for the compliance samples and the audit sample. If this condition is met, duplicate auditing of subsequent compliance analyses for the same enforcement agency within a 30-day period is waived. An audit sample set may not be used to validate different sets of compliance samples under the jurisdiction of separate enforcement agencies, unless prior arrangements have been made with both enforcement agencies.

11.5 Audit Sample Results.

11.5.1 Calculate the audit sample concentrations and submit results using the instructions provided with the audit samples.

11.5.2 Report the results of the audit samples and the compliance determination samples along with their identification numbers, and the analyst's name to the responsible enforcement authority. Include this information with reports of any subsequent compliance analyses for the same enforcement authority during the 30-day period.

11.5.3 The concentrations of the audit samples obtained by the analyst must agree within 5 percent of the actual concentration. If the 5 percent specification is not met, reanalyze the compliance and audit samples, and include initial and reanalysis values in the test report.

11.5.4 Failure to meet the 5-percent specification may require retests until the audit problems are resolved. However, if the audit results do not affect the compliance or noncompliance status of the affected facility, the Administrator may waive the reanalysis requirement, further audits, or retests and accept the results of the compliance test. While steps are being taken to resolve audit analysis problems, the Administrator may also choose to use the data to determine the compliance or noncompliance status of the affected facility.

12.0 Data Analysis and Calculations

Carry out the calculations, retaining at least one extra significant figure beyond that of the acquired data. Round off figures after final calculations.

12.1 Nomenclature.

A=Absorbance of sample.

A_1=Absorbance of the 100-μg NO_2 standard.
A_2=Absorbance of the 200-μg NO_2 standard.
A_3=Absorbance of the 300-μg NO_2 standard.
A_4=Absorbance of the 400-μg NO_2 standard.

C=Concentration of NO_X as NO_2, dry basis, corrected to standard conditions, mg/dsm³ (lb/dscf).

C_d=Determined audit sample concentration, mg/dscm.

C_a=Actual audit sample concentration, mg/dscm.

F=Dilution factor (*i.e.*, 25/5, 25/10, etc., required only if sample dilution was needed to reduce the absorbance into the range of the calibration).

K_c=Spectrophotometer calibration factor.

m=Mass of NO_X as NO_2 in gas sample, μg.

P_f=Final absolute pressure of flask, mm Hg (in. Hg).

P_i=Initial absolute pressure of flask, mm Hg (in. Hg).

P_{std}=Standard absolute pressure, 760 mm Hg (29.92 in. Hg).

RE=Relative error for QA audit samples, percent.

T_f=Final absolute temperature of flask, °K (°R).

T_i=Initial absolute temperature of flask, °K (°R).

T_{std}=Standard absolute temperature, 293 °K (528 °R).

V_{sc}=Sample volume at standard conditions (dry basis), ml.

V_f=Volume of flask and valve, ml.

V_a=Volume of absorbing solution, 25 ml.

12.2 Spectrophotometer Calibration Factor.

$$K_c = 100 \frac{A_1 + 2A_2 + 3A_3 + 4A_4}{A_1^2 + A_2^2 + A_3^2 + A_4^2} \qquad \text{Eq. 7-1}$$

12.3 Sample Volume, Dry Basis, Corrected to Standard Conditions.

$$V_{sc} = \left(V_f - V_a\right)\frac{T_{std}}{P_{std}}\left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right] \qquad \text{Eq. 7-2}$$

$$= K_1\left(V_f - 25\right)\left[\frac{P_f}{T_f} - \frac{P_i}{T_i}\right]$$

Where:

K_1=0.3858 °K/mm Hg for metric units.
K_1=17.65 °R/in. Hg for English units.

12.4 Total μg NO_2 per sample.

$$m = 2K_c AF \qquad \text{Eq. 7-3}$$

Where:

2=50/25, the aliquot factor.

NOTE: If other than a 25-ml aliquot is used for analysis, the factor 2 must be replaced by a corresponding factor.

12.5 Sample Concentration, Dry Basis, Corrected to Standard Conditions.

$$C = K_2\left(m/V_{sc}\right) \qquad \text{Eq. 7-4}$$

Where:

K2=10⁶ (mg/m³)/(μg/ml) for metric units.
K_2=6.242 × 10⁻⁵ (lb/scf)/(μg/ml) for English units.

12.6 Relative Error for QA Audit Samples.

$$RE = 100\left(C_d - C_a\right)/C_a \qquad \text{Eq. 7-5}$$

13.0 Method Performance

13.1 Range. The analytical range of the method has been determined to be 2 to 400 milligrams NO_X (as NO_2) per dry standard

269

cubic meter, without having to dilute the sample.

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 References

1. Standard Methods of Chemical Analysis. 6th ed. New York, D. Van Nostrand Co., Inc. 1962. Vol. 1, pp. 329–330.

2. Standard Method of Test for Oxides of Nitrogen in Gaseous Combustion Products (Phenoldisulfonic Acid Procedure). In: 1968 Book of ASTM Standards. Part 26. Philadelphia, PA. 1968. ASTM Designation D 1608–60, pp. 725–729.

3. Jacob, M.B. The Chemical Analysis of Air Pollutants. New York. Interscience Publishers, Inc. 1960. Vol. 10, pp. 351–356.

4. Beatty, R.L., L.B. Berger, and, H.H. Schrenk. Determination of Oxides of Nitrogen by the Phenoldisulfonic Acid Method. Bureau of Mines, U.S. Dept. of Interior. R.I. 3687. February 1943.

5. Hamil. H.F. and D.E. Camann. Collaborative Study of Method for the Determination of Nitrogen Oxide Emissions from Stationary Sources (Fossil Fuel-Fired Steam Generators). Southwest Research Institute Report for Environmental Protection Agency. Research Triangle Park, NC. October 5, 1973.

6. Hamil, H.F. and R.E. Thomas. Collaborative Study of Method for the Determination of Nitrogen Oxide Emissions from Stationary Sources (Nitric Acid Plants). Southwest Research Institute Report for Environmental Protection Agency. Research Triangle Park, NC. May 8, 1974.

7. Stack Sampling Safety Manual (Draft). U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, NC. September 1978.

17.0 Tables, Diagrams, Flowcharts, and Validation Data
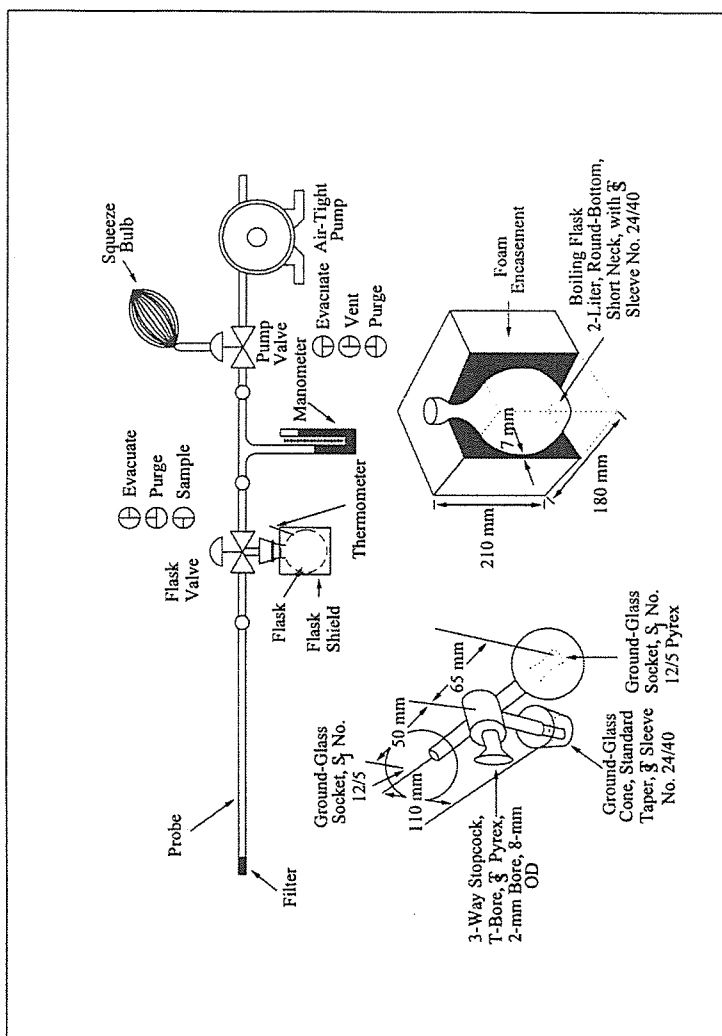
Figure 7-1.   Sampling Train, Flask Valve, and Flask.

METHOD 7A—DETERMINATION OF NITROGEN OXIDE EMISSIONS FROM STATIONARY SOURCES (ION CHROMATOGRAPHIC METHOD)

NOTE: This method does not include all of the specifications (e.g., equipment and supplies) and procedures (e.g., sampling and analytical) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should have a thorough knowledge of at least the following additional test methods: Method 1, Method 3, Method 5, and Method 7.

1.0   Scope and Application

1.1   Analytes.
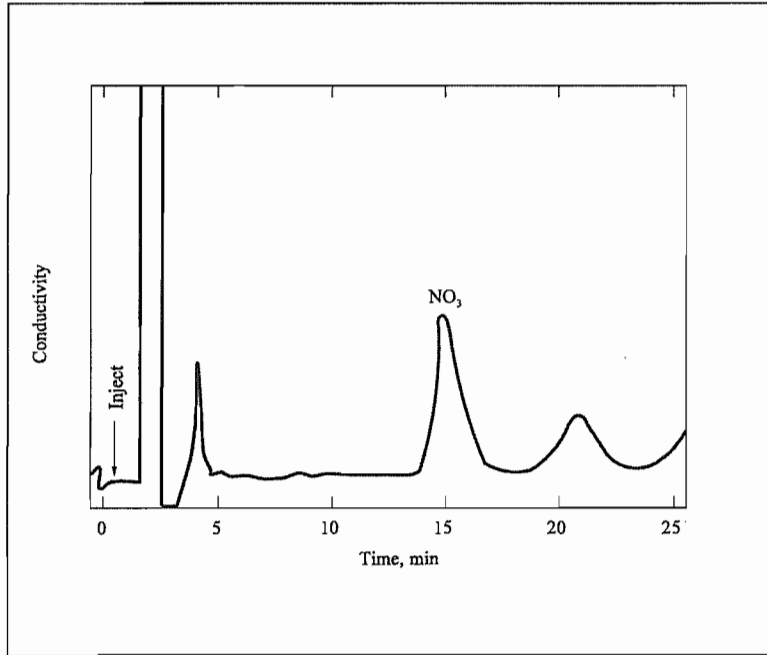
Figure 7D–1.   Ion Chromatograph of a Prepared Sample.

METHOD 7E—DETERMINATION OF NITROGEN OXIDES EMISSIONS FROM STATIONARY SOURCES (INSTRUMENTAL ANALYZER PROCEDURE)

1.0 Scope and Application

What is Method 7E?

Method 7E is a procedure for measuring nitrogen oxides (NO_X) in stationary source emissions using a continuous instrumental analyzer. Quality assurance and quality control requirements are included to assure that you, the tester, collect data of known quality. You must document your adherence to these specific requirements for equipment, supplies. sample collection and analysis. calculations, and data analysis. This method does not completely describe all equipment. supplies, and sampling and analytical procedures you will need but refers to other methods for some of the details. Therefore, to obtain reliable results, you should also have a thorough knowledge of these additional test methods which are found in appendix A to this part:

(a) Method 1—Sample and Velocity Traverses for Stationary Sources.

(b) Method 4—Determination of Moisture Content in Stack Gases.

1.1 Analytes. What does this method determine? This method measures the concentration of nitrogen oxides as NO_2.

Analyte	CAS No.	Sensitivity
Nitric oxide (NO)	10102–43–9	Typically <2% of
Nitrogen dioxide (NO₂)	10102–44–0	Calibration Span.

1.2 Applicability. When is this method required? The use of Method 7E may be required by specific New Source Performance Standards. Clean Air Marketing rules, State Implementation Plans. and permits where measurement of NO_X concentrations in stationary source emissions is required. either to determine compliance with an applicable

289

emissions standard or to conduct performance testing of a continuous monitoring system (CEMS). Other regulations may also require the use of Method 7E.

1.3 Data Quality Objectives (DQO). How good must my collected data be? Method 7E is designed to provide high-quality data for determining compliance with Federal and State emission standards and for relative accuracy testing of CEMS. In these and other applications, the principal objective is to ensure the accuracy of the data at the actual emission levels encountered. To meet this objective, the use of EPA traceability protocol calibration gases and measurement system performance tests are required.

1.4 Data Quality Assessment for Low Emitters. Is performance relief granted when testing low-emission units? Yes. For low-emitting sources, there are alternative performance specifications for analyzer calibration error, system bias, drift, and response time. Also, the alternative dynamic spiking procedure in Section 16 may provide performance relief for certain low-emitting units.

2.0 Summary of Method

In this method, a sample of the effluent gas is continuously sampled and conveyed to the analyzer for measuring the concentration of NO_X. You may measure NO and NO_2 separately or simultaneously together but, for the purposes of this method, NO_X is the sum of NO and NO_2. You must meet the performance requirements of this method to validate your data.

3.0 Definitions

3.1 Analyzer Calibration Error, for non-dilution systems, means the difference between the manufacturer certified concentration of a calibration gas and the measured concentration of the same gas when it is introduced into the analyzer in direct calibration mode.

3.2 Calibration Curve means the relationship between an analyzer's response to the injection of a series of calibration gases and the actual concentrations of those gases.

3.3 Calibration Gas means the gas mixture containing NO_X at a known concentration and produced and certified in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards," September 1997, as amended August 25, 1999, EPA-600/R-97/121 or more recent updates. The tests for analyzer calibration error, drift, and system bias require the use of calibration gas prepared according to this protocol. If a zero gas is used for the low-level gas, it must meet the requirements under the definition for "zero air material" in 40 CFR 72.2 in place of being prepared by the traceability protocol.

3.3.1 Low-Level Gas means a calibration gas with a concentration that is less than 20

percent of the calibration span and may be a zero gas.

3.3.2 Mid-Level Gas means a calibration gas with a concentration that is 40 to 60 percent of the calibration span.

3.3.3 High-Level Gas means a calibration gas with a concentration that is equal to the calibration span.

3.4 Calibration Span means the upper limit of the analyzer's calibration that is set by the choice of high-level calibration gas. No valid run average concentration may exceed the calibration span. To the extent practicable, the measured emissions should be between 20 to 100 percent of the selected calibration span. This may not be practicable in some cases of low-concentration measurements or testing for compliance with an emission limit when emissions are substantially less than the limit. In such cases, calibration spans that are practicable to achieving the data quality objectives without being excessively high should be chosen.

3.5 Centroidal Area means the central area of the stack or duct that is no greater than 1 percent of the stack or duct cross section. This area has the same geometric shape as the stack or duct.

3.6 Converter Efficiency Gas means a calibration gas with a known NO or NO_2 concentration and of Traceability Protocol quality.

3.7 Data Recorder means the equipment that permanently records the concentrations reported by the analyzer.

3.8 Direct Calibration Mode means introducing the calibration gases directly into the analyzer (or into the assembled measurement system at a point downstream of all sample conditioning equipment) according to manufacturer's recommended calibration procedure. This mode of calibration applies to non-dilution-type measurement systems.

3.9 Drift means the difference between the pre- and post-run system bias (or system calibration error) checks at a specific calibration gas concentration level (*i.e.* low-, mid- or high-).

3.10 Gas Analyzer means the equipment that senses the gas being measured and generates an output proportional to its concentration.

3.11 Interference Check means the test to detect analyzer responses to compounds other than the compound of interest, usually a gas present in the measured gas stream, that is not adequately accounted for in the calibration procedure and may cause measurement bias.

3.12 Low-Concentration Analyzer means any analyzer that operates with a calibration span of 20 ppm NO_X or lower. Each analyzer model used routinely to measure low NO_X concentrations must pass a manufacturer's stability test (MST). An MST subjects the analyzer to a range of line voltages and

temperatures that reflect potential field conditions to demonstrate its stability following procedures similar to those provided in 40 CFR 53.23. Ambient-level analyzers are exempt from the MST requirements of Section 16.3. A copy of this information must be included in each test report. Table 7E–5 lists the criteria to be met.

3.13 Measurement System means all of the equipment used to determine the NO_X concentration. The measurement system comprises six major subsystems: Sample acquisition. sample transport, sample conditioning. calibration gas manifold, gas analyzer, and data recorder.

3.14 Response Time means the time it takes the measurement system to respond to a change in gas concentration occurring at the sampling point when the system is operating normally at its target sample flow rate or dilution ratio.

3.15 Run means a series of gas samples taken successively from the stack or duct. A test normally consists of a specific number of runs.

3.16 System Bias means the difference between a calibration gas measured in direct calibration mode and in system calibration mode. System bias is determined before and after each run at the low- and mid- or high-concentration levels. For dilution-type systems, pre- and post-run system calibration error is measured rather than system bias.

3.17 System Calibration Error applies to dilution-type systems and means the difference between the measured concentration of low-, mid-, or high-level calibration gas and the certified concentration for each gas when introduced in system calibration mode. For dilution-type systems. a 3-point system calibration error test is conducted in lieu of the analyzer calibration error test. and 2-point system calibration error tests are conducted in lieu of system bias tests.

3.18 System Calibration Mode means introducing the calibration gases into the measurement system at the probe, upstream of the filter and all sample conditioning components.

3.19 Test refers to the series of runs required by the applicable regulation.

4.0 Interferences

Note that interferences may vary among instruments and that instrument-specific interferences must be evaluated through the interference test.

5.0 Safety

What safety measures should I consider when using this method? This method may require you to work with hazardous materials and in hazardous conditions. We encourage you to establish safety procedures before using the method. Among other precautions, you should become familiar with the safety recommendations in the gas analyzer user's manual. Occupational Safety and Health Administration (OSHA) regulations concerning cylinder and noxious gases may apply. Nitric oxide and NO_2 are toxic and dangerous gases. Nitric oxide is immediately converted to NO_2 upon reaction with air. Nitrogen dioxide is a highly poisonous and insidious gas. Inflammation of the lungs from exposure may cause only slight pain or pass unnoticed, but the resulting edema several days later may cause death. A concentration of 100 ppm is dangerous for even a short exposure, and 200 ppm may be fatal. Calibration gases must be handled with utmost care and with adequate ventilation. Emission-level exposure to these gases should be avoided.

6.0 Equipment and Supplies

The performance criteria in this method will be met or exceeded if you are properly using equipment designed for this application.

6.1 What do I need for the measurement system? You may use any equipment and supplies meeting the following specifications.

(1) Sampling system components that are not evaluated in the system bias or system calibration error test must be glass, Teflon, or stainless steel. Other materials are potentially acceptable, subject to approval by the Administrator.

(2) The interference, calibration error, and system bias criteria must be met.

(3) Sample flow rate must be maintained within 10 percent of the flow rate at which the system response time was measured.

(4) All system components (excluding sample conditioning components. if used) must maintain the sample temperature above the moisture dew point.

Section 6.2 provides example equipment specifications for a NO_X measurement system. Figure 7E–1 is a diagram of an example dry basis measurement system that is likely to meet the method requirements and is provided as guidance. For wet-basis systems, you may use alternative equipment and supplies as needed (some of which are described in Section 6.2), provided that the measurement system meets the applicable performance specifications of this method.

6.2 Measurement System Components

6.2.1 Sample Probe. Glass, stainless steel, or other approved material. of sufficient length to traverse the sample points.

6.2.2 Particulate Filter. An in-stack or out-of-stack filter. The filter must be made of material that is non-reactive to the gas being sampled. The filter media for out-of-stack filters must be included in the system bias test. The particulate filter requirement may be waived in applications where no significant particulate matter is expected (*e.g.*, for emission testing of a combustion turbine firing natural gas).

· 6.2.3 Sample Line. The sample line from the probe to the conditioning system/sample pump should be made of Teflon or other material that does not absorb or otherwise alter the sample gas. For a dry-basis measurement system (as shown in Figure 7E-1), the temperature of the sample line must be maintained at a sufficiently high level to prevent condensation before the sample conditioning components. For wet-basis measurement systems, the temperature of the sample line must be maintained at a sufficiently high level to prevent condensation before the analyzer.

6.2.4 Conditioning Equipment. For dry basis measurements, a condenser, dryer or other suitable device is required to remove moisture continuously from the sample gas. Any equipment needed to heat the probe or sample line to avoid condensation prior to the sample conditioning component is also required.

For wet basis systems, you must keep the sample above its dew point either by: (1) Heating the sample line and all sample transport components up to the inlet of the analyzer (and, for hot-wet extractive systems, also heating the analyzer) or (2) by diluting the sample prior to analysis using a dilution probe system. The components required to do either of the above are considered to be conditioning equipment.

6.2.5 Sampling Pump. For systems similar to the one shown in Figure 7E-1, a leak-free pump is needed to pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. The pump may be constructed of any material that is non-reactive to the gas being sampled. For dilution-type measurement systems, an ejector pump (eductor) is used to create a vacuum that draws the sample through a critical orifice at a constant rate.

6.2.6 Calibration Gas Manifold. Prepare a system to allow the introduction of calibration gases either directly to the gas analyzer in direct calibration mode or into the measurement system, at the probe, in system calibration mode, or both, depending upon the type of system used. In system calibration mode, the system should be able to flood the sampling probe and vent excess gas. Alternatively, calibration gases may be introduced at the calibration valve following the probe. Maintain a constant pressure in the gas manifold. For in-stack dilution-type systems, a gas dilution subsystem is required to transport large volumes of purified air to the sample probe and a probe controller is needed to maintain the proper dilution ratio.

6.2.7 Sample Gas Manifold. For the type of system shown in Figure 7E-1, the sample gas manifold diverts a portion of the sample to the analyzer, delivering the remainder to the by-pass discharge vent. The manifold should also be able to introduce calibration gases directly to the analyzer (except for dilution-type systems). The manifold must be made of material that is non-reactive to the gas sampled or the calibration gas and be configured to safely discharge the bypass gas.

6.2.8 NO_X Analyzer. An instrument that continuously measures NO_X in the gas stream and meets the applicable specifications in Section 13.0. An analyzer that operates on the principle of chemiluminescence with an NO_2 to NO converter is one example of an analyzer that has been used successfully in the past. Analyzers operating on other principles may also be used provided the performance criteria in Section 13.0 are met.

6.2.8.1 Dual Range Analyzers. For certain applications, a wide range of gas concentrations may be encountered, necessitating the use of two measurement ranges. Dual-range analyzers are readily available for these applications. These analyzers are often equipped with automated range-switching capability, so that when readings exceed the full-scale of the low measurement range, they are recorded on the high range. As an alternative to using a dual-range analyzer, you may use two segments of a single, large measurement scale to serve as the low and high ranges. In all cases, when two ranges are used, you must quality-assure both ranges using the proper sets of calibration gases. You must also meet the interference, calibration error, system bias, and drift checks. However, we caution that when you use two segments of a large measurement scale for dual range purposes, it may be difficult to meet the performance specifications on the low range due to signal-to-noise ratio considerations.

6.2.8.2 Low Concentration Analyzer. When an analyzer is routinely calibrated with a calibration span of 20 ppmv or less, the manufacturer's stability test (MST) is required. See Table 7E-5 for test parameters.

6.2.9 Data Recording. A strip chart recorder, computerized data acquisition system, digital recorder, or data logger for recording measurement data may be used.

7.0 Reagents and Standards

7.1 Calibration Gas. What calibration gases do I need? Your calibration gas must be NO in N_2 and certified (or recertified) within an uncertainty of 2.0 percent in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards" September 1997, as amended August 25, 1999, EPA-600/R-97/121. Blended gases meeting the Traceability Protocol are allowed if the additional gas components are shown not to interfere with the analysis. If a zero gas is used for the low-level gas, it must meet the requirements under the definition for "zero air material" in 40 CFR 72.2. The calibration gas must not be used after its expiration date. Except for

applications under part 75 of this chapter. it is acceptable to prepare calibration gas mixtures from EPA Traceability Protocol gases in accordance with Method 205 in appendix M to part 51 of this chapter. For part 75 applications. the use of Method 205 is subject to the approval of the Administrator. The goal and recommendation for selecting calibration gases is to bracket the sample concentrations. The following calibration gas concentrations are required:

7.1.1 *High-Level Gas.* This concentration sets the calibration span and results in measurements being 20 to 100 percent of the calibration span.

7.1.2 *Mid-Level Gas.* 40 to 60 percent of the calibration span.

7.1.3 *Low-Level Gas.* Less than 20 percent of the calibration span.

7.1.4 *Converter Efficiency Gas. What reagents do I need for the converter efficiency test?* The converter efficiency gas is a manufacturer-certified gas with a concentration sufficient to show NO_2 conversion at the concentrations encountered in the source. A test gas concentration in the 40 to 60 ppm range is suggested, but other concentrations may be more appropriate to specific sources. For the test described in Section 8.2.4.1, NO_2 is required. For the alternative converter efficiency tests in Section 16.2, NO is required.

7.2 *Interference Check. What reagents do I need for the interference check?* Use the appropriate test gases listed in Table 7E–3 or others not listed that can potentially interfere (as indicated by the test facility type, instrument manufacturer. etc.) to conduct the interference check. These gases should be manufacturer certified but do not have to be prepared by the EPA traceability protocol.

8.0 Sample Collection, Preservation, Storage, and Transport

Emission Test Procedure

Since you are allowed to choose different options to comply with some of the performance criteria, it is your responsibility to identify the specific options you have chosen, to document that the performance criteria for that option have been met, and to identify any deviations from the method.

8.1 *What sampling site and sampling points do I select?*

8.1.1 Unless otherwise specified in an applicable regulation or by the Administrator, when this method is used to determine compliance with an emission standard, conduct a stratification test as described in Section 8.1.2 to determine the sampling traverse points to be used. For performance testing of continuous emission monitoring systems. follow the sampling site selection and traverse point layout procedures described in the appropriate performance specification or applicable regulation (e.g., Performance Specification 2 in appendix B to this part).

8.1.2 *Determination of Stratification.* Perform a stratification test at each test site to determine the appropriate number of sample traverse points. If testing for multiple pollutants or diluents at the same site, a stratification test using only one pollutant or diluent satisfies this requirement. A stratification test is not required for small stacks that are less than 4 inches in diameter. To test for stratification. use a probe of appropriate length to measure the NO_x (or pollutant of interest) concentration at twelve traverse points located according to Table 1–1 or Table 1–2 of Method 1. Alternatively, you may measure at three points on a line passing through the centroidal area. Space the three points at 16.7. 50.0, and 83.3 percent of the measurement line. Sample for a minimum of twice the system response time (see Section 8.2.6) at each traverse point. Calculate the individual point and mean NO_x concentrations. If the concentration at each traverse point differs from the mean concentration for all traverse points by no more than: (a) ± 5.0 percent of the mean concentration; or (b) ± 0.5 ppm (whichever is less restrictive). the gas stream is considered unstratified and you may collect samples from a single point that most closely matches the mean. If the 5.0 percent or 0.5 ppm criterion is not met, but the concentration at each traverse point differs from the mean concentration for all traverse points by no more than: (a) ± 10.0 percent of the mean: or (b) ± 1.0 ppm (whichever is less restrictive). the gas stream is considered to be minimally stratified. and you may take samples from three points. Space the three points at 16.7, 50.0, and 83.3 percent of the measurement line. Alternatively, if a twelve-point stratification test was performed and the emissions were shown to be minimally stratified (all points within ± 10.0 percent of their mean or within ± 1.0 ppm), and if the stack diameter (or equivalent diameter, for a rectangular stack or duct) is greater than 2.4 meters (7.8 ft), then you may use 3-point sampling and locate the three points along the measurement line exhibiting the highest average concentration during the stratification test. at 0.4. 1.0 and 2.0 meters from the stack or duct wall. If the gas stream is found to be stratified because the 10.0 percent or 1.0 ppm criterion for a 3-point test is not met. locate twelve traverse points for the test in accordance with Table 1–1 or Table 1–2 of Method 1.

8.2 *Initial Measurement System Performance Tests. What initial performance criteria must my system meet before I begin collecting samples?* Before measuring emissions. perform the following procedures:

(a) Calibration gas verification,

(b) Measurement system preparation.

(c) Calibration error test,

(d) NO_2 to NO conversion efficiency test. if applicable.

(e) System bias check,

(f) System response time test, and

(g) Interference check

8.2.1 Calibration Gas Verification. How must I verify the concentrations of my calibration gases? Obtain a certificate from the gas manufacturer documenting the quality of the gas. Confirm that the manufacturer certification is complete and current. Ensure that your calibration gas certifications have not expired. This documentation should be available on-site for inspection. To the extent practicable, select a high-level gas concentration that will result in the measured emissions being between 20 and 100 percent of the calibration span.

8.2.2 Measurement System Preparation. How do I prepare my measurement system? Assemble, prepare, and precondition the measurement system according to your standard operating procedure. Adjust the system to achieve the correct sampling rate or dilution ratio (as applicable).

8.2.3 Calibration Error Test. How do I confirm my analyzer calibration is correct? After you have assembled, prepared and calibrated your sampling system and analyzer, you must conduct a 3-point analyzer calibration error test (or a 3-point system calibration error test for dilution systems) before the first run and again after any failed system bias test (or 2-point system calibration error test for dilution systems) or failed drift test. Introduce the low-, mid-, and high-level calibration gases sequentially. For non-dilution-type measurement systems, introduce the gases in direct calibration mode. For dilution-type measurement systems, introduce the gases in system calibration mode.

(1) For non-dilution systems, you may adjust the system to maintain the correct flow rate at the analyzer during the test, but you may not make adjustments for any other purpose. For dilution systems, you must operate the measurement system at the appropriate dilution ratio during all system calibration error checks, and may make only the adjustments necessary to maintain the proper ratio.

(2) Record the analyzer's response to each calibration gas on a form similar to Table 7E–1. For each calibration gas, calculate the analyzer calibration error using Equation 7E–1 in Section 12.2 or the system calibration error using Equation 7E–3 in Section 12.4 (as applicable). The calibration error specification in Section 13.1 must be met for the low-, mid-, and high-level gases. If the calibration error specification is not met, take corrective action and repeat the test until an acceptable 3-point calibration is achieved.

8.2.4 NO_2 to NO Conversion Efficiency Test. Before or after each field test, you must conduct an NO_2 to NO conversion efficiency test if your system converts NO_2 to NO before analyzing for NO_X. You may risk testing multiple facilities before performing this test provided you pass this test at the conclusion of the final facility test. A failed final conversion efficiency test in this case will invalidate all tests performed subsequent to the test in which the converter efficiency test was passed. Follow the procedures in Section 8.2.4.1, or 8.2.4.2. If desired, the converter efficiency factor derived from this test may be used to correct the test results for converter efficiency if the NO_2 fraction in the measured test gas is known. Use Equation 7E–8 in Section 12.8 for this correction.

8.2.4.1. Introduce NO_2 converter efficiency gas to the analyzer in direct calibration mode and record the NO_X concentration displayed by the analyzer. Calculate the converter efficiency using Equation 7E–7 in Section 12.7. The specification for converter efficiency in Section 13.5 must be met. The user is cautioned that state-of-the-art NO_2 calibration gases may have limited shelf lives, and this could affect the ability to pass the 90-percent conversion efficiency requirement.

8.2.4.2 Alternatively, either of the procedures for determining conversion efficiency using NO in Section 16.2 may be used.

8.2.5 Initial System Bias and System Calibration Error Checks. Before sampling begins, determine whether the high-level or mid-level calibration gas best approximates the emissions and use it as the upscale gas. Introduce the upscale gas at the probe upstream of all sample conditioning components in system calibration mode. Record the time it takes for the measured concentration to increase to a value that is within 95 percent or 0.5 ppm (whichever is less restrictive) of the certified gas concentration. Continue to observe the gas concentration reading until it has reached a final, stable value. Record this value on a form similar to Table 7E–2.

(1) Next, introduce the low-level gas in system calibration mode and record the time required for the concentration response to decrease to a value that is within 5.0 percent or 0.5 ppm (whichever is less restrictive) of the certified low-range gas concentration. If the low-level gas is a zero gas, use the procedures described above and observe the change in concentration until the response is 0.5 ppm or 5.0 percent of the upscale gas concentration (whichever is less restrictive).

(2) Continue to observe the low-level gas reading until it has reached a final, stable value and record the result on a form similar to Table 7E–2. Operate the measurement system at the normal sampling rate during all system bias checks. Make only the adjustments necessary to achieve proper calibration gas flow rates at the analyzer.

(3) From these data, calculate the measurement system response time (see Section 8.2.6) and then calculate the initial system bias using Equation 7E–2 in Section 12.3. For

dilution systems, calculate the system calibration error in lieu of system bias using equation 7E-3 in Section 12.4. See Section 13.2 for acceptable performance criteria for system bias and system calibration error. If the initial system bias (or system calibration error) specification is not met, take corrective action. Then, you must repeat the applicable calibration error test from Section 8.2.3 and the initial system bias (or 2-point system calibration error) check until acceptable results are achieved, after which you may begin sampling.

(NOTE: For dilution-type systems, data from the 3-point system calibration error test described in Section 8.2.3 may be used to meet the initial 2-point system calibration error test requirement of this section, if the calibration gases were injected as described in this section, and if response time data were recorded).

8.2.6 Measurement System Response Time. As described in section 8.2.5, you must determine the measurement system response time during the initial system bias (or 2-point system calibration error) check. Observe the times required to achieve 95 percent of a stable response for both the low-level and upscale gases. The longer interval is the response time.

8.2.7 Interference Check. Conduct an interference response test of the gas analyzer prior to its initial use in the field. If you have multiple analyzers of the same make and model, you need only perform this alternative interference check on one analyzer. You may also meet the interference check requirement if the instrument manufacturer performs this or similar check on the same make and model of analyzer that you use and provides you with documented results.

(1) You may introduce the appropriate interference test gases (that are potentially encountered during a test, see examples in Table 7E-3) into the analyzer separately or as mixtures. Test the analyzer with the interference gas alone at the highest concentration expected at a test source and again with the interference gas and NO_X at a representative NO_X test concentration. For analyzers measuring NO_X greater than 20 ppm, use a calibration gas with an NO_X concentration of 80 to 100 ppm and set this concentration equal to the calibration span. For analyzers measuring less than 20 ppm NO_X, select an NO concentration for the calibration span that reflects the emission levels at the sources to be tested, and perform the interference check at that level. Measure the total interference response of the analyzer to these gases in ppmv. Record the responses and determine the interference using Table 7E-4. The specification in Section 13.4 must be met.

(2) A copy of this data, including the date completed and signed certification, must be available for inspection at the test site and included with each test report. This interference test is valid for the life of the instrument unless major analytical components (e.g., the detector) are replaced with different model parts. If major components are replaced with different model parts, the interference gas check must be repeated before returning the analyzer to service. If major components are replaced, the interference gas check must be repeated before returning the analyzer to service. The tester must ensure that any specific technology, equipment, or procedures that are intended to remove interference effects are operating properly during testing.

8.3 Dilution-Type Systems—Special Considerations. When a dilution-type measurement system is used, there are three important considerations that must be taken into account to ensure the quality of the emissions data. First, the critical orifice size and dilution ratio must be selected properly so that the sample dew point will be below the sample line and analyzer temperatures. Second, a high-quality, accurate probe controller must be used to maintain the dilution ratio during the test. The probe controller should be capable of monitoring the dilution air pressure, eductor vacuum, and sample flow rates. Third, differences between the molecular weight of calibration gas mixtures and the stack gas molecular weight must be addressed because these can affect the dilution ratio and introduce measurement bias.

8.4 Sample Collection.

(1) Position the probe at the first sampling point. Purge the system for at least two times the response time before recording any data. Then, traverse all required sampling points, sampling at each point for an equal length of time and maintaining the appropriate sample flow rate or dilution ratio (as applicable). You must record at least one valid data point per minute during the test run.

(2) Each time the probe is removed from the stack and replaced, you must recondition the sampling system for at least two times the system response time prior to your next recording. If the average of any run exceeds the calibration span value, that run is invalid.

(3) You may satisfy the multipoint traverse requirement by sampling sequentially using a single-hole probe or a multi-hole probe designed to sample at the prescribed points with a flow within 10 percent of mean flow rate. Notwithstanding, for applications under part 75 of this chapter, the use of multi-hole probes is subject to the approval of the Administrator.

8.5 Post-Run System Bias Check and Drift Assessment.

How do I confirm that each sample I collect is valid? After each run, repeat the system bias check or 2-point system calibration

error check (for dilution systems) to validate the run. Do not make adjustments to the measurement system (other than to maintain the target sampling rate or dilution ratio) between the end of the run and the completion of the post-run system bias or system calibration error check. Note that for all post-run system bias or 2-point system calibration error checks, you may inject the low-level gas first and the upscale gas last, or vice-versa. You may risk sampling for multiple runs before performing the post-run bias or system calibration error check provided you pass this test at the conclusion of the group of runs. A failed final test in this case will invalidate all runs subsequent to the last passed test.

(1) If you do not pass the post-run system bias (or system calibration error) check, then the run is invalid. You must diagnose and fix the problem and pass another calibration error test (Section 8.2.3) and system bias (or 2-point system calibration error) check (Section 8.2.5) before repeating the run. Record the system bias (or system calibration error) results on a form similar to Table 7E–2.

(2) After each run, calculate the low-level and upscale drift, using Equation 7E–4 in Section 12.5. If the post-run low- and upscale bias (or 2-point system calibration error) checks are passed, but the low-or upscale drift exceeds the specification in Section 13.3, the run data are valid, but a 3-point calibration error test and a system bias (or 2-point system calibration error) check must be performed and passed before any more test runs are done.

(3) For dilution systems, data from a 3-point system calibration error test may be used to met the pre-run 2-point system calibration error requirement for the first run in a test sequence. Also, the post-run bias (or 2-point calibration error) check data may be used as the pre-run data for the next run in the test sequence at the discretion of the tester.

8.6 Alternative Interference and System Bias Checks (Dynamic Spike Procedure). If I want to use the dynamic spike procedure to validate my data, what procedure should I follow? Except for applications under part 75 of this chapter, you may use the dynamic spiking procedure and requirements provided in Section 16.1 during each test as an alternative to the interference check and the pre- and post-run system bias checks. The calibration error test is still required under this option. Use of the dynamic spiking procedure for Part 75 applications is subject to the approval of the Administrator.

8.7 Moisture correction. You must determine the moisture content of the flue gas and correct the measured gas concentrations to a dry basis using Method 4 or other appropriate methods, subject to the approval of the Administrator, when the moisture basis (wet or dry) of the measurements made with this method is different from the moisture basis of either: (1) The applicable emissions limit; or (2) the CEMS being evaluated for relative accuracy. Moisture correction is also required if the applicable limit is in lb/mmBtu and the moisture basis of the Method 7E NO_x analyzer is different from the moisture basis of the Method 3A diluent gas (CO_2 or O_2) analyzer.

9.0 Quality Control

What quality control measures must I take?

The following table is a summary of the mandatory, suggested, and alternative quality assurance and quality control measures and the associated frequency and acceptance criteria. All of the QC data, along with the sample run data, must be documented and included in the test report.

SUMMARY TABLE OF AQ/QC

Status	Process or element	QA/QC specification	Acceptance criteria	Checking frequency
S	Identify Data User		Regulatory Agency or other primary end user of data.	Before designing test.
S	Analyzer Design	Analyzer resolution or sensitivity.	< 2.0% of full-scale range	Manufacturer design.
M		Interference gas check.	Sum of responses ≤ 2.5% of calibration span Alternatively, sum of responses: ≤ 0.5 ppmv for calibration spans of 5 to 10 ppmv. ≤ 0.2 ppmv for calibration spans < 5 ppmv. See Table 7E–3.	
M	Calibration Gases	Traceability protocol (G1, G2).	Valid certificate required Uncertainty ≤ 2.0% of tag value.	
M		High-level gas	Equal to the calibration span	Each test.
M		Mid-level gas	40 to 60% of calibration span	Each test.
M		Low-level gas	< 20% of calibration span	Each test.
S	Data Recorder Design.	Data resolution	≤ 0.5% of full-scale range	Manufacturer design.
S	Sample Extraction ...	Probe material	SS or quartz if stack > 500 °F	East test.
M	Sample Extraction ...	Probe, filter and sample line temperature.	For dry-basis analyzers, keep sample above the dew point by heating, prior to sample conditioning.	Each run.

SUMMARY TABLE OF AQ/QC—Continued

Status	Process or element	QA/QC specification	Acceptance criteria	Checking frequency
			For wet-basis analyzers, keep sample above dew point at all times, by heating or dilution.	
S	Sample Extraction ...	Calibration valve material.	SS	Each test.
S	Sample Extraction ...	Sample pump material.	Inert to sample constituents	Each test.
S	Sample Extraction ...	Manifolding material	Inert to sample constituents	Each test.
S	Moisture Removal	Equipment efficiency	< 5% target compound removal	Verified through system bias check.
S	Particulate Removal	Filter inertness	Pass system bias check	Each bias check.
M	Analyzer & Calibration Gas Performance.	Analyzer calibration error (of 3-point system calibration error for dilution systems).	Within $\pm$ 2.0 percent of the calibration span of the analyzer for the low-, mid-, and high-level calibration gases.	Before initial run and after a failed system bias test or drift test.
			Alternative specification: $\leq$ 0.5 ppmv absolute difference.	
M	System Performance	System bias (or pre- and post-run 2-point system calibration error for dilution (Systems).	Within $\pm$ 5.0% of the analyzer calibration span for low-sacle and upscale calibration gases.	Before and after each run.
			Alternative specification: $\leq$ 0.5 ppmv absolute difference.	
M	System Performance	System response time.	Determines minimum sampling time per point.	During initial sampling system bias test.
M	System Performance	Drift	$\leq$ 3.0% of calibration span for low-level and mid- or high-level gases. Alternative specification: $\leq$ 0.5 ppmv absolute difference.	After each test run.
M	System Performance	NO_2-NO conversion efficiency.	$\geq$ 90% of certified test gas concentration ..	Before or after each test.
M	System Performance	Purge time	$\geq$ 2 times system response time	Before starting the first run and when probe is removed from and re-inserted into the stack.
M	System Performance	Minimum sample time at each point.	Two times the system response time	Each sample point.
M	System Performance	Stable sample flow rate (surrogate for maintaining system response time).	Within 10% of flow rate established during system response time check.	Each run.
M	Sample Point Selection.	Stratification test	All points within:	Prior to first run.
			$\pm$ 5% of mean for 1-point sampling. $\pm$ 10% of mean for 3-point. Alternatively, all points within: $\pm$ 0.5 ppm of mean for 1-point sampling. $\pm$ 1.0 ppm of mean for 3-point sampling.	
A	Multiple sample points simultaneously.	No. of openings in probe.	Multi-hole probe with verifiable constant flow through all holes within 10% of mean flow rate (requires Administrative approval for Part 75).	Each run.
M	Data Recording	Frequency	$\leq$ 1 minute average	During run.
S	Data Parameters	Sample concentration range.	All 1-minute averages within calibration span.	Each run.
M	Date Parameters	Average concentration for the run.	Run average $\leq$ calibration span	Each run.

S = Suggest.
M = Mandatory.
A = Alternative.
Agency.

10.0 Calibration and Standardization

What measurement system calibrations are required?

(1) The initial 3-point calibration error test as described in Section 8.2.3 and the system bias (or system calibration error) checks described in Section 8.2.5 are required and must meet the specifications in Section 13 before you start the test. Make all necessary adjustments to calibrate the gas analyzer and data recorder. Then, after the test commences, the system bias or system calibration error checks described in Section 8.5 are required before and after each run. Your analyzer must be calibrated for all species of NO_X that it detects. Analyzers that measure NO and NO_2 separately without using a converter must be calibrated with both NO and NO_2.

(2) You must include a copy of the manufacturer's certification of the calibration gases used in the testing as part of the test report. This certification must include the 13 documentation requirements in the EPA Traceability Protocol For Assay and Certification of Gaseous Calibration Standards.

When Method 205 is used to produce diluted calibration gases, you must document that the specifications for the gas dilution system are met for the test. You must also include the date of the most recent dilution system calibration against flow standards and the name of the person or manufacturer who carried out the calibration in the test report.

11.0 Analytical Procedures

Because sample collection and analysis are performed together (see Section 8), additional discussion of the analytical procedure is not necessary.

12.0 Calculations and Data Analysis

You must follow the procedures for calculations and data analysis listed in this section.

12.1 *Nomenclature.* The terms used in the equations are defined as follows:

ACE = Analyzer calibration error, percent of calibration span.

B_{WS} = Moisture content of sample gas as measured by Method 4 or other approved method, percent/100.

C_{Avg} = Average unadjusted gas concentration indicated by data recorder for the test run, ppmv.

C_D = Pollutant concentration adjusted to dry conditions, ppmv.

C_{Dir} = Measured concentration of a calibration gas (low, mid, or high) when introduced in direct calibration mode, ppmv.

C_{Gas} = Average effluent gas concentration adjusted for bias, ppmv.

C_M = Average of initial and final system calibration bias (or 2-point system calibration

error) check responses for the upscale calibration gas, ppmv.

C_{MA} = Actual concentration of the upscale calibration gas, ppmv.

C_{Native} = NO_X concentration in the stack gas as calculated in Section 12.6. ppmv.

C_O = Average of the initial and final system calibration bias (or 2-point system calibration error) check responses from the low-level (or zero) calibration gas, ppmv.

C_{OA} = Actual concentration of the low-level calibration gas, ppmv.

C_S = Measured concentration of a calibration gas (low, mid, or high) when introduced in system calibration mode, ppmv.

C_{SS} = Concentration of NO_X measured in the spiked sample, ppmv.

C_{Spike} = Concentration of NO_X in the undiluted spike gas, ppmv.

C_{Calc} = Calculated concentration of NO_X in the spike gas diluted in the sample, ppmv.

C_V = Manufacturer certified concentration of a calibration gas (low, mid, or high), ppmv.

C_W = Pollutant concentration measured under moist sample conditions, wet basis, ppmv.

CS = Calibration span, ppmv.

D = Drift assessment, percent of calibration span.

DF = Dilution system dilution factor or spike gas dilution factor, dimensionless.

Eff_{NO2} = NO_2 to NO converter efficiency, percent.

NO_{XCorr} = The NO_X concentration corrected for the converter efficiency, ppmv.

NOX_{Final} = The final NO_X concentration observed during the converter efficiency test in Section 16.2.2, ppmv.

NO_{XPeak} = The highest NO_X concentration observed during the converter efficiency test in Section 16.2.2, ppmv.

Q_{Spike} = Flow rate of spike gas introduced in system calibration mode, L/min.

Q_{Total} = Total sample flow rate during the spike test, L/min.

R = Spike recovery, percent.

SB = System bias, percent of calibration span.

SB_i = Pre-run system bias, percent of calibration span.

SB_{final} = Post-run system bias, percent of calibration span.

SCE = System calibration error, percent of calibration span.

SCE_i = Pre-run system calibration error, percent of calibration span.

SCE_{Final} = Post-run system calibration error, percent of calibration span.

12.2 *Analyzer Calibration Error.* For non-dilution systems, use Equation 7E-1 to calculate the analyzer calibration error for the low-, mid-, and high-level calibration gases.

$$ACE = \frac{C_{Dir} - C_v}{CS} \times 100 \qquad Eq. \ 7E-1$$

12.3 System Bias. For non-dilution systems. use Equation 7E-2 to calculate the system bias separately for the low-level and upscale calibration gases.

$$SB = \frac{C_S - C_{Dir}}{CS} \times 100 \qquad Eq.\ 7E\text{-}2$$

12.4 System Calibration Error. Use Equation 7E-3 to calculate the system calibration error for dilution systems. Equation 7E-3 applies to both the initial 3-point system calibration error test and the subsequent 2-point calibration error checks between test runs. In this equation, the term "C_v" refers to the diluted calibration gas concentration measured by the analyzer.

$$SCE = \frac{(C_S \cdot DF) - C_V}{CS} \times 100 \qquad Eq.\ 7E\text{-}3$$

12.5 Drift Assessment. Use Equation 7E-4 to separately calculate the low-level and upscale drift over each test run. For dilution systems. replace "SB_{final}" and "SB_i" with "SCE_{final}" and "SCE_i", respectively, to calculate and evaluate drift.

$$D = |SB_{final} - SB_i| \qquad Eq.\ 7E\text{-}4$$

12.6 Effluent Gas Concentration. For each test run, calculate C_{avg}, the arithmetic average of all valid NO_X concentration values (*e.g.*, 1-minute averages). Then adjust the value of C_{avg} for bias using Equation 7E-5a if you use a non-zero gas as your low-level calibration gas, or Equation 7E-5b if you use a zero gas as your low-level calibration gas.

$$C_{Gas} = \left(C_{Avg} - C_M\right)\frac{C_{MA} - C_{OA}}{C_M - C_O} + C_{MA} \qquad Eq.\ 7E\text{-}5a$$

$$C_{Gas} = \left(C_{Avg} - C_O\right)\frac{C_{MA}}{C_M - C_O} \qquad Eq.\ 7E\text{-}5b$$

12.7 NO_2—NO Conversion Efficiency. If the NO_X converter efficiency test described in Section 8.2.4.1 is performed. calculate the efficiency using Equation 7E-7.

$$Eff_{NO2} = \frac{C_{Dir}}{C_V} \times 100 \qquad Eq.\ 7E\text{-}7$$

12.8 NO_2—NO Conversion Efficiency Correction. If desired. calculate the total NO_X concentration with a correction for converter efficiency using Equations 7E-8.

$$NO_{XCorr} = NO + \frac{NO_X - NO}{Eff_{NO2}} \times 100 \qquad Eq.\ 7E\text{-}8$$

12.9 Alternative NO_2 Converter Efficiency. If the alternative procedure of Section 16.2.2 is used, determine the NO_X concentration decrease from NO_{XPeak} after the minimum 30-minute test interval using Equation 7E-9. This decrease from NO_{XPeak} must meet the requirement in Section 13.5 for the converter to be acceptable.

$$\% \ Decrease = \frac{NO_{XPeak} - NO_{XFinal}}{NO_{XPeak}} \times 100 \qquad Eq.\ 7E\text{-}9$$

12.10 Moisture Correction. Use Equation 7E–10 if your measurements need to be corrected to a dry basis.

$$C_D = \frac{C_w}{1 - B_{ws}} \qquad \text{Eq. 7E-10}$$

12.11 Calculated Spike Gas Concentration and Spike Recovery for the Example Alternative

Dynamic Spiking Procedure in Section 16.1.3. Use Equation 7E–11 to determine the calculated spike gas concentration. Use Equation 7E–12 to calculate the spike recovery.

$$C_{Calc} = \frac{\left(C_{Spike}\right)\left(Q_{Spike}\right)}{Q_{Total}} \qquad \text{Eq. 7E-11}$$

$$R = \frac{DF\left(C_{ss} - C_{native}\right) + C_{native}}{C_{Spike}} \times 100 \qquad \text{Eq. 7E-12}$$

13.0 Method Performance

13.1 Calibration Error. This specification is applicable to both the analyzer calibration error and the 3-point system calibration error tests described in Section 8.2.3. At each calibration gas level (low, mid, and high) the calibration error must either be within ± 2.0 percent of the calibration span. Alternatively, the results are acceptable if $|C_{dir} - C_v|$ or $|C_x - C_v|$ (as applicable) is ≤0.5 ppmv.

13.2 System Bias. This specification is applicable to both the system bias and 2-point system calibration error tests described in Section 8.2.5 and 8.5. The pre- and post-run system bias (or system calibration error) must be within ± 5.0 percent of the calibration span for the low-level and upscale calibration gases. Alternatively, the results are acceptable if $|C_s - C_{dir}|$ is ≤ 0.5 ppmv or if $|C_s - C_v|$ is ≤0.5 ppmv (as applicable).

13.3 Drift. For each run, the low-level and upscale drift must be less than or equal to 3.0 percent of the calibration span. The drift is also acceptable if the pre- and post-run bias (or the pre- and post-run system calibration error) responses do not differ by more than 0.5 ppmv at each gas concentration (i.e. $|C_{s\ post-run} - C_{s\ pre-run}| \le 0.5$ ppmv).

13.4 Interference Check. The total interference response (i.e., the sum of the interference responses of all tested gaseous components) must not be greater than 2.50 percent of the calibration span for the analyzer tested. In summing the interferences, use the larger of the absolute values obtained for the interferent tested with and without the pollutant present. The results are also acceptable if the sum of the responses does not exceed 0.5 ppmv for a calibration span of 5 to 10 ppmv, or 0.2 ppmv for a calibration span < 5 ppmv.

13.5 NO$_2$ to NO Conversion Efficiency Test (as applicable). The NO$_2$ to NO conversion efficiency, calculated according to Equation 7E–7, must be greater than or equal to 90 percent. The alternative conversion efficiency check, described in Section 16.2.2 and cal-

culated according to Equation 7E–9, must not result in a decrease from NO$_{XPeak}$ by more than 2.0 percent.

13.6 Alternative Dynamic Spike Procedure. Recoveries of both pre-test spikes and post-test spikes must be within 100 ± 10 percent. If the absolute difference between the calculated spike value and measured spike value is equal to or less than 0.20 ppmv, then the requirements of the ADSC are met.

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 Alternative Procedures

16.1 Dynamic Spike Procedure. Except for applications under part 75 of this chapter, you may use a dynamic spiking procedure to validate your test data for a specific test matrix in place of the interference check and pre- and post-run system bias checks. For part 75 applications, use of this procedure is subject to the approval of the Administrator. Best results are obtained for this procedure when source emissions are steady and not varying. Fluctuating emissions may render this alternative procedure difficult to pass. To use this alternative, you must meet the following requirements.

16.1.1 Procedure Documentation. You must detail the procedure you followed in the test report, including how the spike was measured, added, verified during the run, and calculated after the test.

16.1.2 Spiking Procedure Requirements. The spikes must be prepared from EPA Traceability Protocol gases. Your procedure must be designed to spike field samples at two target levels both before and after the test. Your target spike levels should bracket the average sample NO$_x$ concentrations. The higher target concentration must be less than the calibration span. You must collect at least 5 data points for each target concentration. The spiking procedure must be performed before the first run and repeated after the last run of the test program.

16.1.3 Example Spiking Procedure. Determine the NO concentration needed to generate concentrations that are 50 and 150 percent of the anticipated NO_X concentration in the stack at the total sampling flow rate while keeping the spike flow rate at or below 10 percent of this total. Use a mass flow meter (accurate within 2.0 percent) to generate these NO spike gas concentrations at a constant flow rate. Use Equation 7E–11 in Section 12.11 to determine the calculated spike concentration in the collected sample.

(1) Prepare the measurement system and conduct the analyzer calibration error test as described in Sections 8.2.2 and 8.2.3. Following the sampling procedures in Section 8.1, determine the stack NO_X concentration and use this concentration as the average stack concentration (C_{avg}) for the first spike level, or if desired, for both pre-test spike levels. Introduce the first level spike gas into the system in system calibration mode and begin sample collection. Wait for at least two times the system response time before measuring the spiked sample concentration. Then record at least five successive 1-minute averages of the spiked sample gas. Monitor the spike gas flow rate and maintain at the determined addition rate. Average the five 1-minute averages and determine the spike recovery using Equation 7E–12. Repeat this procedure for the other pre-test spike level. The recovery at each level must be within the limits in Section 13.6 before proceeding with the test.

(2) Conduct the number of runs required for the test. Then repeat the above procedure for the post-test spike evaluation. The last run of the test may serve as the average stack concentration for the post-test spike test calculations. The results of the post-test spikes must meet the limits in Section 13.6.

16.2 Alternative NO_2 to NO Conversion Efficiency Procedures. You may use either of the following procedures to determine converter efficiency in place of the procedure in Section 8.2.4.1.

16.2.1 The procedure for determining conversion efficiency using NO in 40 CFR 86.123–78.

16.2.2 Tedlar Bag Procedure. Perform the analyzer calibration error test to document the calibration (both NO and NO_X modes, as applicable). Fill a Tedlar bag approximately half full with either ambient air, pure oxygen, or an oxygen standard gas with at least 19.5 percent by volume oxygen content. Fill the remainder of the bag with mid- to high-level NO in N_2 (or other appropriate concentration) calibration gas. (Note that the concentration of the NO standard should be sufficiently high enough for the diluted concentration to be easily and accurately measured on the scale used. The size of the bag should be large enough to accommodate the procedure and time required.)

(1) Immediately attach the bag to the inlet of the NO_X analyzer (or external converter if used). In the case of a dilution-system, introduce the gas at a point upstream of the dilution assembly. Measure the NO_X concentration for a period of 30 minutes. If the NO_X concentration drops more than 2 percent absolute from the peak value observed, then the NO_x converter has failed to meet the criteria of this test. Take corrective action. The highest NO_X value observed is considered to be NO_{XPeak}. The final NO_X value observed is considered to be NO_{XFinal}.

(2) [Reserved]

16.3 Manufacturer's Stability Test. A manufacturer's stability test is required for all analyzers that routinely measure emissions below 20 ppmv and is optional but recommended for other analyzers. This test evaluates each analyzer model by subjecting it to the tests listed in Table 7E–5 following procedures similar to those in 40 CFR 53.23 for thermal stability and insensitivity to supply voltage variations. If the analyzer will be used under temperature conditions that are outside the test conditions in Table B–4 of Part 53.23, alternative test temperatures that better reflect the analyzer field environment should be used. Alternative procedures or documentation that establish the analyzer's stability over the appropriate line voltages and temperatures are acceptable.

17.0 References

1. "ERA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards" September 1997 as amended, ERA–600/R–97/121.

18.0 Tables, Diagrams, Flowcharts, and Validation Data

Figure 7E-1. Measurement System
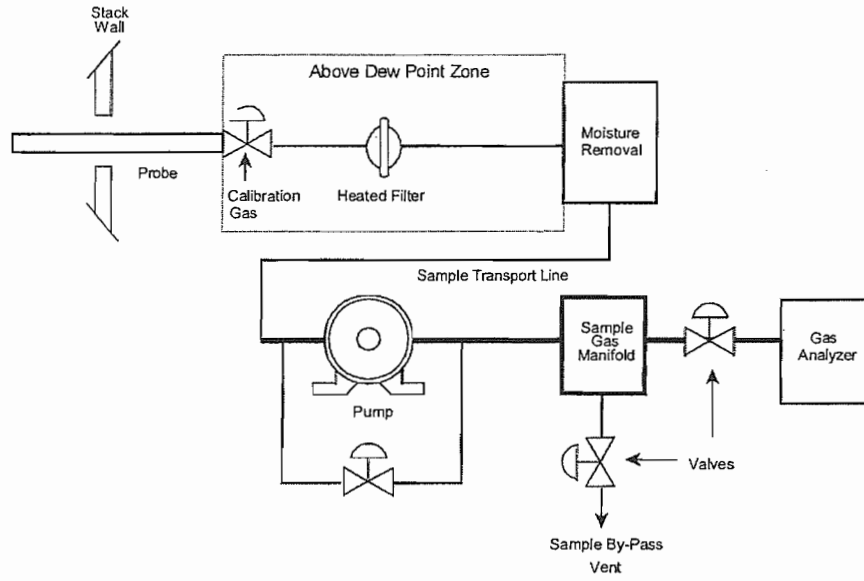
Figure 7E-2. Testing Flow Chart

```
        ┌──────────────────────────────┐
        │  Calibration Gas Verification │
        └──────────────────────────────┘
                      │
                      ▼
        ┌──────────────────────────────┐          ┌──────────────────────┐
        │      Pre-Test Preparation     │◄─────────│  Corrective Action   │
        └──────────────────────────────┘          └──────────────────────┘
                      │                                  ▲            ▲
                      ▼                                  │            │
        ┌──────────────────────────────┐                │            │
        │   Analyzer Calibration Error  │    Fail        │            │
        │      (or 3-point System       │────────────────┘            │
        │     Calibration Error)[1]     │                             │
        └──────────────────────────────┘                             │
                      │ Pass                                          │
                      ▼                         ┌──────────────┐      │
        ┌──────────────────────────────┐  Fail  │   Discard    │      │
        │   Initial System Bias Check   │───────▶│     Run      │      │
        │  (or 2-point System Calibration│       └──────────────┘      │
        │          Error)[1]            │             ▲                │
        └──────────────────────────────┘             │                │
                      │ Pass                          │                │
                      ▼                               │                │
        ┌──────────────────────────────┐             │                │
        │        Collect Run Data       │             │                │
        └──────────────────────────────┘             │                │
                      │                               │                │
                      ▼                               │                │
        ┌──────────────────────────────┐    Fail     │                │
        │   Post-run System Bias Check  │─────────────┘                │
        │      (or 2-point System       │                             │
        │     Calibration Error)[1]     │                             │
        └──────────────────────────────┘                             │
                      │ Pass                                          │
                      ▼                                               │
        ┌──────────────────────────────┐         Fail                 │
        │       Drift Evaluation        │──────────────────────────────┘
        └──────────────────────────────┘
                      │ Pass
                      ▼
        ┌──────────────────────────────┐
        │     Proceed to next run[2]    │
        └──────────────────────────────┘
```

[1] For dilution-type systems
[2] Continue until test is completed

303

Table 7E-1 - Analyzer (or System) Calibration Error Data

Source Identification: _____ Test personnel: _____ Date: _____ Time: _____	Analyzer[1] or System[2] calibration error data for sampling runs: _____ Analyzer Model No. _____ Serial No. _____ Calibration Span (CS):			
	Manufacturer Certified Cylinder Value (indicate units) A	Analyzer calibration response (indicate units) B	Absolute difference (indicate units) A–B	Calibration Error (percent of calibration span) $\frac{A-B}{CS} \times 100$
Low-level (or zero) calibration gas	....	....	....	....
Mid-level calibration gas	....	....	....	....
High-level calibration gas	....	....	....	....

[1] Refers to data from the analyzer calibration error test of a non-dilution system.
[2] Refers to data from a 3-point system calibration error test of a dilution system.

Table 7E-2 - System Bias (or System Calibration Error) and Drift Data

Source Identification: _____ Run Number: _____
Test personnel: _____ Calibration Span: _____
Date: _____ Response Time: _____
Analyzer Model No. _____ Serial No. _____

		Initial values			Final values		
Calibration Gas Level	Certified Calibration gas value (indicate units)	System Response (indicate units)	System Bias[1] or Calibration Error[2] (% of calibration span)	System response (indicate units)	System Bias[1] or Calibration Error[2] (% of calibration span)	Drift (% of calibration span)
Low-level gas..........						
Upscale (high- or mid-) level gas..........						

[1] Refers to the pre- and post-run system bias checks of a non-dilution system.
[2] Refers to the pre- and post-run system calibration error checks of a dilution system.

304

TABLE 7E–3—EXAMPLE INTERFERENCE CHECK GAS CONCENTRATIONS

Potential interferent gas [1]	Concentrations [2] sample conditioning type	
	Hot wet	Dried
CO_2	5 and 15%	5 and 15%
H_2O	25%	1%
NO	15 ppmv	15 ppmv
NO_2	15 ppmv	15 ppmv
N_2O	10 ppmv	10 ppmv
CO	50 ppmv	50 ppmv
NH_3	10 ppmv	10 ppmv
CH_4	50 ppmv	50 ppmv
SO_2	20 ppmv	20 ppmv
H_2	50 ppmv	50 ppmv
HCl	10 ppmv	10 ppmv

[1] Any applicable gas may be eliminated or tested at a reduced level if the manufacturer has provided reliable means for limiting or scrubbing that gas to a specified level.
[2] As practicable, gas concentrations should be the highest expected at test sites.

TABLE 7E–4—INTERFERENCE RESPONSE

Date of Test: _____

Analyzer Type: _____
Model No.: _____
Serial No: _____
Calibration Span: _____

Test gas type	Concentration (ppm)	Analyzer response
	Sum of Responses	
	% of Calibration Span	

TABLE 7E–5.—MANUFACTURER STABILITY TEST

Test description	Acceptance criteria (note 1)
Thermal Stability	Temperature range when drift does not exceed 3.0% of analyzer range over a 12-hour run when measured with NO_X present @ 80% of calibration span.
Fault Conditions	Identify conditions which, when they occur, result in performance which is not in compliance with the Manufacturer's Stability Test criteria. These are to be indicated visually or electrically to alert the operator of the problem.
Insensitivity to Supply Voltage Variations.	± 10.0% (or manufacturers alternative) variation from nominal voltage must produce a drift of ≤ 2.0% of calibration span for either zero or concentration ≥ 80% NO_X present.
Analyzer Calibration Error.	For a low-, medium-, and high-calibration gas, the difference between the manufacturer certified value and the analyzer response in direct calibration mode, no more than 2.0% of calibration span.

Note 1: If the instrument is to be used as a Low Range analyzer, all tests must be performed at a calibration span of 20 ppm or less.

METHOD 8—DETERMINATION OF SULFURIC ACID AND SULFUR DIOXIDE EMISSIONS FROM STATIONARY SOURCES

NOTE: This method does not include all of the specifications (e.g., equipment and supplies) and procedures (e.g., sampling and analytical) essential to its performance. Some material is incorporated by reference from other methods in this part. Therefore, to obtain reliable results, persons using this method should have a thorough knowledge of at least the following additional test methods: Method 1, Method 2, Method 3, Method 5, and Method 6.

1.0 Scope and Application

1.1 Analytes.

Analyte	CAS No.	Sensitivity
Sulfuric acid, including: Sulfuric acid (H_2SO_4) mist, Sulfur trioxide (SO_3).	7664–93–9, 7449–11–9	0.05 mg/m³ (0.03×10^{-7} lb/ft³).
Sulfur dioxide (SO_2)	7449–09–5	1.2 mg/m³ (3×10^{-7} lb/ft³).

1.2 Applicability. This method is applicable for the determination of H_2SO_4 (including H_2SO_4 mist and SO_3) and gaseous SO_2 emissions from stationary sources.

NOTE: Filterable particulate matter may be determined along with H_2SO_4 and SO_2 (subject to the approval of the Administrator) by inserting a heated glass fiber filter between the probe and isopropanol impinger (see Section 6.1.1 of Method 6). If this option is chosen, particulate analysis is gravimetric only; sulfuric acid is not determined separately.

Attachment H

formed. If no bubbles are observed, the source is presumed to have no detectable emissions or leaks as applicable. If any bubbles are observed, the instrument techniques

of Section 8.3.1 or 8.3.2 shall be used to determine if a leak exists, or if the source has detectable emissions, as applicable.

9.0 Quality Control

Section	Quality control measure	Effect
8.1.2	Instrument calibration precision check	Ensure precision and accuracy, respectively, of instrument response to standard.
10.0	Instrument calibration.	

10.0 Calibration and Standardization

10.1 Calibrate the VOC monitoring instrument as follows. After the appropriate warmup period and zero internal calibration procedure, introduce the calibration gas into the instrument sample probe. Adjust the instrument meter readout to correspond to the calibration gas value.

NOTE: If the meter readout cannot be adjusted to the proper value, a malfunction of the analyzer is indicated and corrective actions are necessary before use.

11.0 Analytical Procedures [Reserved]

12.0 Data Analyses and Calculations [Reserved]

13.0 Method Performance [Reserved]

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 References

1. Dubose, D.A., and G.E. Harris. Response Factors of VOC Analyzers at a Meter Reading of 10,000 ppmv for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park. NC. Publication No. EPA 600/2-81051. September 1981.

2. Brown. G.E.. et al. Response Factors of VOC Analyzers Calibrated with Methane for Selected Organic Compounds. U.S. Environmental Protection Agency, Research Triangle Park. NC. Publication No. EPA 600/2-81-022. May 1981.

3. DuBose, D.A. et al. Response of Portable VOC Analyzers to Chemical Mixtures. U.S. Environmental Protection Agency, Research Triangle Park, NC. Publication No. EPA 600/2-81-110. September 1981.

4. Handbook of Hazardous Materials: Fire, Safety. Health. Alliance of American Insurers. Schaumberg. IL. 1983.

17.0 Tables, Diagrams, Flowcharts, and Validation Data [Reserved]

METHOD 22—VISUAL DETERMINATION OF FUGITIVE EMISSIONS FROM MATERIAL SOURCES AND SMOKE EMISSIONS FROM FLARES

NOTE: This method is not inclusive with respect to observer certification. Some mate-

rial is incorporated by reference from Method 9.

1.0 Scope and Application

This method is applicable for the determination of the frequency of fugitive emissions from stationary sources, only as specified in an applicable subpart of the regulations. This method also is applicable for the determination of the frequency of visible smoke emissions from flares.

2.0 Summary of Method

2.1 Fugitive emissions produced during material processing, handling, and transfer operations or smoke emissions from flares are visually determined by an observer without the aid of instruments.

2.2 This method is used also to determine visible smoke emissions from flares used for combustion of waste process materials.

2.3 This method determines the amount of time that visible emissions occur during the observation period (i.e., the accumulated emission time). This method does not require that the opacity of emissions be determined. Since this procedure requires only the determination of whether visible emissions occur and does not require the determination of opacity levels, observer certification according to the procedures of Method 9 is not required. However, it is necessary that the observer is knowledgeable with respect to the general procedures for determining the presence of visible emissions. At a minimum, the observer must be trained and knowledgeable regarding the effects of background contrast, ambient lighting, observer position relative to lighting, wind, and the presence of uncombined water (condensing water vapor) on the visibility of emissions. This training is to be obtained from written materials found in References 1 and 2 or from the lecture portion of the Method 9 certification course.

3.0 Definitions

3.1 Emission frequency means the percentage of time that emissions are visible during the observation period.

3.2 Emission time means the accumulated amount of time that emissions are visible during the observation period.

3.3 *Fugitive emissions* means emissions generated by an affected facility which is not collected by a capture system and is released to the atmosphere. This includes emissions that (1) escape capture by process equipment exhaust hoods; (2) are emitted during material transfer; (3) are emitted from buildings housing material processing or handling equipment; or (4) are emitted directly from process equipment.

3.4 *Observation period* means the accumulated time period during which observations are conducted, not to be less than the period specified in the applicable regulation.

3.5 *Smoke emissions* means a pollutant generated by combustion in a flare and occurring immediately downstream of the flame. Smoke occurring within the flame, but not downstream of the flame, is not considered a smoke emission.

4.0 Interferences

4.1 Occasionally, fugitive emissions from sources other than the affected facility (*e.g.*, road dust) may prevent a clear view of the affected facility. This may particularly be a problem during periods of high wind. If the view of the potential emission points is obscured to such a degree that the observer questions the validity of continuing observations, then the observations shall be terminated, and the observer shall clearly note this fact on the data form.

5.0 Safety

5.1 Disclaimer. This method may involve hazardous materials, operations, and equipment. This test method may not address all of the safety problems associated with its use. It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this test method.

6.0 Equipment

6.1 Stopwatches (two). Accumulative type with unit divisions of at least 0.5 seconds.

6.2 Light Meter. Light meter capable of measuring illuminance in the 50 to 200 lux range, required for indoor observations only.

7.0 Reagents and Supplies [Reserved]

8.0 Sample Collection, Preservation, Storage, and Transfer [Reserved]

9.0 Quality Control [Reserved]

10.0 Calibration and Standardization [Reserved]

11.0 Analytical Procedure

11.1 Selection of Observation Location. Survey the affected facility, or the building or structure housing the process to be observed, and determine the locations of potential emissions. If the affected facility is located inside a building, determine an observation location that is consistent with the requirements of the applicable regulation (*i.e.*, outside observation of emissions escaping the building/structure or inside observation of emissions directly emitted from the affected facility process unit). Then select a position that enables a clear view of the potential emission point(s) of the affected facility or of the building or structure housing the affected facility, as appropriate for the applicable subpart. A position at least 4.6 m (15 feet), but not more than 400 m (0.25 miles), from the emission source is recommended. For outdoor locations, select a position where the sunlight is not shining directly in the observer's eyes.

11.2 Field Records.

11.2.1 Outdoor Location. Record the following information on the field data sheet (Figure 22-1): Company name, industry, process unit, observer's name, observer's affiliation, and date. Record also the estimated wind speed, wind direction, and sky condition. Sketch the process unit being observed, and note the observer location relative to the source and the sun. Indicate the potential and actual emission points on the sketch.

11.2.2 Indoor Location. Record the following information on the field data sheet (Figure 22-2): Company name, industry, process unit, observer's name, observer's affiliation, and date. Record as appropriate the type, location, and intensity of lighting on the data sheet. Sketch the process unit being observed, and note the observer location relative to the source. Indicate the potential and actual fugitive emission points on the sketch.

11.3 Indoor Lighting Requirements. For indoor locations, use a light meter to measure the level of illumination at a location as close to the emission source(s) as is feasible. An illumination of greater than 100 lux (10 foot candles) is considered necessary for proper application of this method.

11.4 Observations.

11.4.1 Procedure. Record the clock time when observations begin. Use one stopwatch to monitor the duration of the observation period. Start this stopwatch when the observation period begins. If the observation period is divided into two or more segments by process shutdowns or observer rest breaks (see Section 11.4.3), stop the stopwatch when a break begins and restart the stopwatch without resetting it when the break ends. Stop the stopwatch at the end of the observation period. The accumulated time indicated by this stopwatch is the duration of observation period. When the observation period is completed, record the clock time. During the observation period, continuously watch the emission source. Upon observing an emission (condensed water vapor is not

considered an emission), start the second accumulative stopwatch; stop the watch when the emission stops. Continue this procedure for the entire observation period. The accumulated elapsed time on this stopwatch is the total time emissions were visible during the observation period (*i.e.*, the emission time.)

11.4.2 Observation Period. Choose an observation period of sufficient length to meet the requirements for determining compliance with the emission standard in the applicable subpart of the regulations. When the length of the observation period is specifically stated in the applicable subpart, it may not be necessary to observe the source for this entire period if the emission time required to indicate noncompliance (based on the specified observation period) is observed in a shorter time period. In other words, if the regulation prohibits emissions for more than 6 minutes in any hour, then observations may (optional) be stopped after an emission time of 6 minutes is exceeded. Similarly, when the regulation is expressed as an emission frequency and the regulation prohibits emissions for greater than 10 percent of the time in any hour, then observations may (optional) be terminated after 6 minutes of emission are observed since 6 minutes is 10 percent of an hour. In any case, the observation period shall not be less than 6 minutes in duration. In some cases, the process operation may be intermittent or cyclic. In such cases, it may be convenient for the observation period to coincide with the length of the process cycle.

11.4.3 Observer Rest Breaks. Do not observe emissions continuously for a period of more than 15 to 20 minutes without taking a rest break. For sources requiring observation periods of greater than 20 minutes, the observer shall take a break of not less than 5 minutes and not more than 10 minutes after every 15 to 20 minutes of observation. If continuous observations are desired for extended time periods, two observers can alternate between making observations and taking breaks.

11.5 Recording Observations. Record the accumulated time of the observation period on the data sheet as the observation period duration. Record the accumulated time emissions were observed on the data sheet as the emission time. Record the clock time the observation period began and ended, as well as the clock time any observer breaks began and ended.

12.0 Data Analysis and Calculations

If the applicable subpart requires that the emission rate be expressed as an emission frequency (in percent), determine this value as follows: Divide the accumulated emission time (in seconds) by the duration of the observation period (in seconds) or by any minimum observation period required in the applicable subpart, if the actual observation period is less than the required period, and multiply this quotient by 100.

13.0 Method Performance [Reserved]

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 References

1. Missan, R., and A. Stein. Guidelines for Evaluation of Visible Emissions Certification, Field Procedures, Legal Aspects, and Background Material. EPA Publication No. EPA-340/1-75-007. April 1975.

2. Wohlschlegel, P., and D.E. Wagoner. Guideline for Development of a Quality Assurance Program: Volume IX—Visual Determination of Opacity Emissions from Stationary Sources. EPA Publication No. EPA-650/4-74-005i. November 1975.

17.0 Tables, Diagrams, Flowcharts, and Validation Data

```
+---------------------------------------------------------------+
|              FUGITIVE OR SMOKE EMISSION INSPECTION            |
|                      OUTDOOR LOCATION                          |
+-------------------------------------+-------------------------+
| Company                             | Observer                |
| Location                            | Affiliation             |
| Company Rep.                        | Date                    |
+-------------------------------------+-------------------------+
| Sky Conditions                      | Wind Direction          |
| Precipitation                       | Wind Speed              |
+-------------------------------------+-------------------------+
| Industry                            | Process Unit            |
+-------------------------------------+-------------------------+
| Sketch process unit:  indicate observer position relative     |
| to source; indicate potential emission points and/or          |
| actual emission points.                                       |
|     +-----------------------------------------------------+   |
|     |                                                     |   |
|     |                                                     |   |
|     |                                                     |   |
|     |                                                     |   |
|     |                                                     |   |
|     +-----------------------------------------------------+   |
|                                                               |
|                               Observation    Accumulated      |
|   OBSERVATIONS                  period          emission      |
|                    Clock        duration,       time,         |
|                    Time         min:sec         min:sec       |
|                                                               |
|   Begin                                                       |
|   Observation    _____    _____    _____      |
|                  _____    _____    _____      |
|                  _____    _____    _____      |
|                  _____    _____    _____      |
|                  _____    _____    _____      |
|                  _____    _____    _____      |
|                  _____    _____    _____      |
|                  _____    _____    _____      |
|                  _____    _____    _____      |
|                  _____    _____    _____      |
|   End            _____                                    |
|   Observation                 _____    _____      |
|                                                               |
|                  _____                                    |
|                          Figure 22-1                          |
+---------------------------------------------------------------+
```

```
┌──────────────────────────────────────────────────────────────────┐
│              FUGITIVE OR SMOKE EMISSION INSPECTION                 │
│                     ·INDOOR LOCATION                               │
├────────────────────────────────────┬───────────────────────────────┤
│ Company                            │ Observer                      │
│ Location                           │ Affiliation                   │
│ Company Rep.                       │ Date                          │
├────────────────────────────────────┼───────────────────────────────┤
│ Industry                           │ Process Unit                  │
├────────────────────────────────────┴───────────────────────────────┤
│ Light type (fluorescent, incandescent, natural)                    │
│ Light location (overhead, behind observer, etc.)                   │
│ Illuminance (lux or footcandles)                                   │
│ Sketch process unit:  indicate observer position relative to       │
│ source; indicate potential emission points and/or actual           │
│ emission points.                                                   │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                                                                    │
│                     Observation      Accumulated                   │
│  OBSERVATIONS        period          emission                      │
│              Clock   duration,       time,                         │
│              Time    min:sec         min:sec                       │
│                                                                    │
│  Begin       _____  _____      _____                    │
│                                                                    │
│              _____  _____      _____                    │
│                                                                    │
│              _____  _____      _____                    │
│                                                                    │
│              _____  _____      _____                    │
│                                                                    │
│              _____  _____      _____                    │
│                                                                    │
│              _____  _____      _____                    │
│                                                                    │
│              _____  _____      _____                    │
│                                                                    │
│              _____  _____      _____                    │
│                                                                    │
│              _____  _____      _____                    │
│                                                                    │
│              _____  _____      _____                    │
│                                                                    │
│  End Observation  _____                                           │
│                    Figure 22-2                                     │
└──────────────────────────────────────────────────────────────────┘
```

METHOD 23—DETERMINATION OF POLY-CHLORINATED DIBENZO-P-DIOXINS AND POLYCHLORINATED DIBENZOFURANS FROM STATIONARY SOURCES

1. Applicability and Principle

1.1 Applicability. This method is applicable to the determination of polychlorinated dibenzo-p-dioxins (PCDD's) and poly-chlorinated dibenzofurans (PCDF's) from stationary sources.

1.2 Principle. A sample is withdrawn from the gas stream isokinetically and collected in the sample probe, on a glass fiber filter, and on a packed column of adsorbent material. The sample cannot be separated into a particle vapor fraction. The PCDD's and

485