

Add 310 CMR 7.00: Appendix D by adding the text below.

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310 CMR 7.00: Appendix D MERCURY MONITORING AND TESTING PROGRAM

The Standards of Performance for New Stationary Sources and Continuous Emissions Monitoring at 310 CMR 7.00: Appendix D, refer to various sections of Title 40 of the Code of Federal Regulations (CFR). Wherever 310 CMR 7.00: Appendix D refers to a specific section of the CFR, the reference is made to that version of the section as of the amended date provided for that section in 310 CMR 7.00 Appendix D: Table 1. The Department hereby incorporates by reference each of the sections of Title 40 CFR that are listed in Table 1 as of such section's respective Amended Date.

<u>310 CMR 7.00: Appendix D Table 1</u>		
<u>40 CFR Section</u>	<u>Title</u>	<u>Section Amended Date</u>
<u>Part 60 Standards of Performance for New Stationary Sources</u>		
<u>Appendix A-1 Method 2 Determination of Stack Gas Velocity and Volumetric Flow Rate</u>		
<u>§ 10.2</u>	<u>Temperature Sensor</u>	<u>Dec. 23, 1971</u>
<u>Appendix A-3 Method 5 Determination of Particulate Matter Emissions from Stationary Sources</u>		
<u>§ 10.3.1</u>	<u>Metering System Calibration Prior to Use.</u>	<u>Dec. 23, 1971</u>
<u>§ 16</u>	<u>Alternative Procedures.</u>	<u>Dec. 23, 1971</u>
<u>Appendix A-8 Test Method 30A Determination of Total Vapor Phase Mercury Emissions from Stationary Sources</u>		
		<u>Sept. 7, 2007</u>
<u>Appendix A-8 Test Method 30B Determination of Total Vapor Phase Mercury Emissions from Coal-fired Combustion Sources Using Carbon Sorbent Traps</u>		
		<u>Sept. 7, 2007</u>
<u>Part 72 Permits Regulation</u>		
<u>§ 72.2</u>	<u>Definitions</u>	<u>Jan. 24, 2008</u>
<u>Part 75 Continuous Emissions Monitoring Subpart A—General</u>		
<u>§ 75.1</u>	<u>Purpose and scope.</u>	<u>June 12, 2002</u>
<u>§ 75.2</u>	<u>Applicability.</u>	<u>May 18, 2005</u>
<u>§ 75.4</u>	<u>Compliance dates.</u>	<u>Jan. 24, 2008</u>
<u>§ 75.5</u>	<u>Prohibitions.</u>	<u>May 26, 1999</u>
<u>Subpart B—Monitoring Provisions</u>		
<u>§ 75.10</u>	<u>General operating requirements.</u>	<u>May 18, 2005</u>
<u>§ 75.11</u>	<u>Specific provisions for monitoring SO<sub>2</sub> emissions (SO<sub>2</sub> and flow monitors)</u>	<u>Jan. 24, 2008</u>
<u>Subpart C—Operation and Maintenance Requirements</u>		
<u>§ 75.20</u>	<u>Initial certification and recertification procedures.</u>	<u>Jan. 24, 2008</u>
<u>§ 75.24</u>	<u>Out-of-control periods and adjustment for system bias.</u>	<u>May 18, 2005</u>
<u>Subpart D—Missing Data Substitution Procedures</u>		
<u>§ 75.30</u>	<u>General provisions.</u>	<u>June 12, 2002</u>
<u>§ 75.31</u>	<u>Initial missing data procedures.</u>	<u>Jan. 24, 2008</u>
<u>§ 75.32</u>	<u>Determination of monitor data availability for standard missing data procedures.</u>	<u>Jan. 24, 2008</u>
<u>§ 75.33</u>	<u>Standard missing data procedures for Hg</u>	<u>Jan. 24, 2008</u>
<u>§ 75.34</u>	<u>Units with add-on emission controls.</u>	<u>Jan. 24, 2008</u>

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<u>Subpart F—Recordkeeping Requirements</u>		
<u>§ 75.53</u>	<u>Monitoring plan.</u>	<u>Jan. 24, 2008</u>
<u>§ 75.58</u>	<u>General recordkeeping provisions for specific situations.</u>	<u>Jan. 24, 2008</u>
<u>§ 75.59</u>	<u>Certification, quality assurance, and quality control record provisions.</u>	<u>Jan. 24, 2008</u>
<u>Subpart G—Reporting Requirements</u>		
<u>§ 75.61</u>	<u>Notice Requirements</u>	<u>Jan. 24, 2008</u>
<u>§ 75.62</u>	<u>Monitoring plan submittals</u>	<u>Jan. 24, 2008</u>
<u>§ 75.63</u>	<u>Initial certification or recertification application.</u>	<u>Jan. 24, 2008</u>
<u>§ 75.64</u>	<u>Quarterly reports</u>	<u>Jan. 24, 2008</u>
<u>§ 75.66</u>	<u>Petitions to the Department</u>	<u>Jan. 24, 2008</u>
<u>§ 75.67</u>	<u>Retired units petitions</u>	<u>Oct. 24, 1997</u>
<u>Appendix A—Specifications and Test Procedures</u>		
<u>§ 1.1</u>	<u>Installation and Measurement Location Hg Monitors</u>	<u>May 18, 2005</u>
<u>§ 2.1.1.2(c)</u>	<u>Maximum Expected Concentration</u>	<u>May 17, 1995</u>
<u>§ 2.1.3</u>	<u>CO2 and O2 Monitors</u>	<u>May 17, 1995</u>
<u>§ 2.1.4</u>	<u>Flow Monitors</u>	<u>May 22, 1996</u>
<u>§ 6.1.1</u>	<u>Pretest Preparation</u>	<u>Jan. 24, 2008</u>
<u>§§ 6.2, 6.2(g)</u>	<u>Linearity Check (General Procedures) Hg Monitors</u>	<u>Jan. 24, 2008</u>
<u>§ 6.3.1</u>	<u>Gas Monitor 7-Day Calibration Error Test</u>	<u>Jan. 24, 2008</u>
<u>§ 6.4</u>	<u>Cycle Time Test</u>	<u>Jan. 24, 2008</u>
<u>§§ 6.5-6.5.8</u>	<u>Relative Accuracy and Bias Tests (General Procedures)</u>	<u>Jan. 24, 2008</u>
<u>§ 7.3</u>	<u>Relative Accuracy Calculations for Hg Monitoring Systems</u>	<u>June 12, 2002</u>
<u>§ 7.6.4</u>	<u>Bias Test</u>	<u>May 26, 1999</u>

All documentation referenced in the CFR Title 40 sections listed in Table 1, including but not limited to American Society for Testing and Materials (ASTM) D6911-03 “Standard Guide for Packaging and Shipping Environmental Samples for Laboratory Analysis”, ASTM D4840-99 (reapproved 2004) “Standard Guide for Sample Chain-of-Custody Procedures”, and ASTM D6784 - 02(2008) “Standard Test Method for Elemental, Oxidized, Particle-Bound and Total Mercury in Flue Gas Generated from Coal-Fired Stationary Sources (Ontario Hydro Method)”, are also hereby incorporated by reference.

#### A. Quarterly Reporting of Mercury Monitoring

A.1 Quarterly Reports - *Electronic submission.* As required by 310 CMR 7.29(7)(h) and 310 CMR 7.02(3)(o), the person who owns, leases, operates or controls a solid fossil fuel- or ash-fired unit shall electronically report hourly data and information for each Hg monitoring system to the Department quarterly, in a spreadsheet showing all calculations. See C.11 and D.12 for details of the information required to be submitted.

A.1.1 Quarterly Reports - *Shutdown and long-term cold storage units.* For a solid fossil fuel- or ash-fired unit that is shutdown or has been placed in long-term cold storage (as defined in 40 CFR 72.2), quarterly reports are not required. In such cases, quarterly reports for the unit shall be submitted beginning with the data from the quarter in which the unit recommences commercial operation (where the initial quarterly report contains hourly data beginning with the first hour of recommenced commercial operation of the unit). For units placed into long-term cold storage during a reporting quarter, the exemption from submitting quarterly reports begins with the calendar quarter following the date that the unit is placed into long-term cold storage.

#### B. Monitoring Plan Submittal Requirements

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## B.1 Scope and Application

Each primary, redundant backup, and non-redundant backup monitoring system shall be represented in the monitoring plan required under 310 CMR 7.29(5)(a)3.g. and 310 CMR 7.02(3)(o) with unique system and component identification numbers. When temporary like-kind replacement Hg, O<sub>2</sub> and CO<sub>2</sub> analyzers are used, these analyzers shall be represented in the monitoring plan as described in 40 CFR 75.20(d). See C.8.1.3.

## B.2 Monitoring Plan Submission

### B.2.1 Electronic

Using a format acceptable to the Department, a complete, electronic, up-to-date monitoring plan file shall be submitted to the Department as follows: no later than 45 days prior to the initial certification tests; at the time of each certification or recertification application submission; and prior to or concurrent with the submittal of the electronic quarterly report for a reporting quarter where an update of the electronic monitoring plan information is required under 40 CFR 75.53(b).

### B.2.2 Hardcopy

The hardcopy information required under 40 CFR 75.53 shall be submitted to the Department prior to initial certification. Thereafter, hardcopy information shall be submitted only if that portion of the monitoring plan is revised. The required hardcopy information shall be submitted as follows: no later than 45 days prior to the initial certification test; with any certification or recertification application, if a hardcopy monitoring plan change is associated with the certification or recertification event; and within 30 days of any other event with which a hardcopy monitoring plan change is associated, pursuant to 40 CFR 75.53(b).

## 2.3 Contents

Monitoring plans shall contain the applicable information specified in 40 CFR 75.53 and 40 CFR 75.20(d). Electronic storage of all monitoring plan information, including hardcopy portions, is permissible provided that a paper copy of the hardcopy portions can be furnished upon request.

## C. Measurement and Reporting of Vapor Phase Mercury Emissions, Using a Continuous Emission Monitoring System

### C.1 Scope and Application

The requirements provided here are applicable to the performance-based monitoring of vapor-phase mercury (Hg) emissions in combustion flue gas streams, using a continuous emission monitoring system (CEMS) for Hg concentration. Requirements are also provided for reporting emissions data from the Hg CEMS and for using the data to demonstrate compliance with applicable Hg emission limits. The performance-based approach allows for use of various suitable sampling and analytical technologies while maintaining a specified and documented level of data quality through performance criteria. Persons using section C. should have a thorough working knowledge of Methods 1, 2, 3, 4 and 5 in appendices A-1 through A-3 to 40 CFR Part 60.

#### C.1.1 Analytes

The analyte measured by these procedures and specifications is total vapor-phase Hg in the flue gas, which represents the sum of elemental Hg (Hg<sup>0</sup>, CAS Number 7439-97-6) and oxidized forms of Hg, in mass concentration units of micrograms per standard cubic meter (µg/scm).

### C.1.2 Applicability

These performance criteria and procedures are applicable to monitoring of vapor-phase Hg emissions from coal-fired steam generators, under relatively low-dust conditions (i.e., sampling in the stack or duct after all pollution control devices).

### C.2 Principle

A representative sample of flue gas is extracted continuously from a stack or duct. Particulate matter is removed and the gas sample is transported to an analyzer capable of measuring the total vapor phase Hg concentration. Elemental and oxidized mercury (i.e., Hg<sup>0</sup> and Hg<sup>+2</sup>) may be measured separately or simultaneously, but total vapor phase Hg is the sum of Hg<sup>0</sup> and Hg<sup>+2</sup>. To validate data from the CEMS, the performance specifications in C.8 and C.9 must be met.

### C.3 Definitions

C.3.1 Mercury Continuous Emission Monitoring System or Hg CEMS means all of the equipment used to determine the total vapor phase Hg concentration. The measurement system may generally include the following major subsystems: sample acquisition, Hg<sup>+2</sup> to Hg<sup>0</sup> converter, sample transport, sample conditioning, flow control/gas manifold, gas analyzer, and data recorder.

C.3.2 Gas Analyzer means the equipment that detects the total vapor phase Hg being measured and generates an output proportional to its concentration

C.3.3 Converter means a device that reduces oxidized mercury (Hg<sup>+2</sup>) to elemental mercury (Hg<sup>0</sup>).

C.3.4 NIST means the National Institute of Standards and Technology, located in Gaithersburg, Maryland.

C.3.5 NIST-traceable elemental Hg standards means either: (1) compressed gas cylinders having known concentrations of elemental Hg, which have been prepared according to the “EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards”; or (2) calibration gases having known concentrations of elemental Hg, produced by a generator that meets the performance requirements of the “EPA Traceability Protocol for Qualification and Certification of Elemental Mercury Gas Generators,” or an interim version of that protocol.

C.3.6 NIST-traceable source of oxidized Hg means a generator that is capable of providing known concentrations of vapor phase mercury chloride (HgCl<sub>2</sub>), and that meets the performance requirements of the “EPA Traceability Protocol for Qualification and Certification of Mercuric Chloride Gas Generators,” or an interim version of that protocol.

C.3.7 Calibration Gas means a gas standard containing Hg<sup>0</sup> or HgCl<sub>2</sub> at a known concentration that is produced and certified in accordance with an EPA traceability protocol for certification of Hg calibration standards.

C.3.8 Span value means the upper limit of valid instrument response when the CEMS is measuring the Hg concentration of flue gas or calibration gas (see C.7.2).

C.3.9 Zero-Level Gas means calibration gas with a Hg concentration that is below the level detectable by the monitoring system.

C.3.10 Low-Level Gas means calibration gas with a Hg concentration that is 20 to 30 percent of the span value.

C.3.11 Mid-Level Gas means calibration gas with a Hg concentration that is 50 to 60 percent of the span value.

C.3.12 High-Level Gas means calibration gas with a Hg concentration that is 80 to 100 percent of the span value.

C.3.13 Calibration Error Test means a test designed to assess the ability of a Hg CEMS to accurately measure the Hg concentrations of calibration gases. A zero-level gas and an upscale gas (mid-level or high-level) are required for this test. The upscale gas may either be an elemental or oxidized Hg standard.

C.3.14 Linearity Check means a test designed to determine whether the response of a Hg analyzer is linear across its measurement range. Three elemental Hg gas standards (i.e., low, mid, and high-level gases) are required for this test.

C.3.15 System Integrity Check means a test designed to assess the efficiency with which a converter reduces oxidized Hg to elemental Hg. Oxidized Hg standards are used for this test. For a 3-level system integrity check, low, mid, and high-level calibration gases are required. For a single-level check, either a mid-level gas or a high-level gas may be used.

C.3.16 Cycle Time Test means a test designed to measure the amount of time it takes for a CEMS, while operating normally, to respond to a known step change in gas concentration. For the cycle time test of a Hg CEMS, a zero gas and a high-level gas are required. The high-level gas may be either an elemental or an oxidized Hg standard.

C.3.17 Relative Accuracy Test Audit or RATA means a series of nine or more test runs, directly comparing readings from a CEMS to measurements made with a reference stack test method. The relative accuracy (RA) of the CEMS is expressed as the absolute mean difference between the CEMS and reference method measurements plus the absolute value of the 2.5 percent error confidence coefficient, divided by the mean value of the reference method measurements.

C.3.18 Range means either the upper boundary of a measurement scale or the upper boundary of a segment of a measurement scale.

## C.4 Safety

### C.4.1 Site Hazards

Site hazards must be thoroughly considered in advance of applying these procedures/specifications in the field; advance coordination with the site is critical to understand the conditions and applicable safety policies. At a minimum, portions of the sampling system will be hot, requiring appropriate gloves, long sleeves, and caution in handling this equipment.

### C.4.2 Toxicity or Carcinogenicity

The toxicity or carcinogenicity of any reagents used must be considered. Depending upon the sampling and analytical technologies selected, this measurement may involve hazardous materials, operations, and equipment and D.4 does not address all of the safety problems associated with implementing this approach. It is the responsibility of the user to establish appropriate safety and health practices and determine the applicable regulatory limitations prior to performance. Any chemical should be regarded as a potential health hazard and exposure to these compounds should be minimized. Users should refer to the Material Safety Data Sheet (MSDS) for each chemical used.

## C.5 Equipment and Supplies

The following list is presented as an example of key equipment and supplies likely required to perform vapor-phase Hg monitoring using a CEMS. It is recognized that additional equipment and supplies may be needed.

### C.5.1 Continuous Emission Monitoring System for Hg Concentration

A typical Hg CEMS is shown in Figure 1. The CEMS in Figure 1 is a dilution extractive system, which measures Hg concentration on a wet basis, and is the most commonly-used type of Hg CEMS. Other system designs may be used, provided that the CEMS meets the performance specifications in C.8.

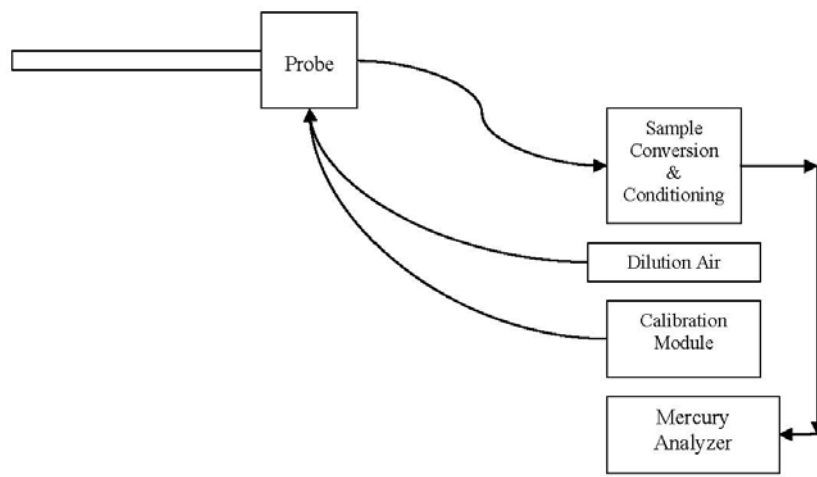


Figure 1. Typical Hg CEMS

#### C.5.1.1 Materials of Construction

All wetted sampling system components, including probe components prior to the point at which the calibration gas is introduced, must be chemically inert to all Hg species. Materials such as perfluoroalkoxy (PFA) Teflon™, quartz, treated stainless steel (SS) are examples of such materials.

(Note: These materials of construction are required because components prior to the calibration gas injection point are not included in the system calibration error, linearity, system integrity, and cycle time tests.)

#### C.5.1.2 Temperature Considerations

All system components prior to the Hg<sup>+2</sup> to Hg<sup>0</sup> converter must be maintained at a sample temperature above the acid gas dew point.

#### C.5.1.3 Measurement System Components

##### C.5.1.3.1 Sample Probe

The probe must be made of the appropriate materials as noted in C.5.1.1, heated when necessary (see C.5.1.2), configured with ports for introduction of calibration gases.

##### C.5.1.3.2 Filter or Other Particulate Removal Device

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The filter or other particulate removal device is part of the measurement system, must be made of appropriate materials, as noted in C.5.1.1, and must be included in all system tests.

#### C.5.1.3.3 Sample Line

The sample line that connects the probe to the converter, conditioning system and analyzer must be made of appropriate materials, as noted in C.5.1.1.

#### C.5.1.3.4 Conditioning Equipment

C.5.1.3.4.1 For wet basis systems, such as the one shown in Figure 1, the sample must be kept above its dew point either by: (a) 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 (b) by diluting the sample prior to analysis using a dilution probe system. The components required to do either (a) or (b) are considered to be conditioning equipment.

C.5.1.3.4.2 For dry basis measurements, a condenser, dryer or other suitable device is required to remove moisture continuously from the sample gas, and any equipment needed to heat the probe or sample line to avoid condensation prior to the moisture removal component is also required.

#### C.5.1.3.5 Sampling Pump

A pump is needed to push or pull the sample gas through the system at a flow rate sufficient to minimize the response time of the measurement system. If a mechanical sample pump is used and its surfaces are in contact with the sample gas prior to detection, the pump must be leak free and must be constructed of a material that is non-reactive to the gas being sampled (see C.5.1.1). For dilution-type measurement systems, such as the system shown in Figure 1, an ejector pump (eductor) may be used to create a sufficient vacuum that sample gas will be drawn through a critical orifice at a constant rate. The ejector pump may be constructed of any material that is non-reactive to the gas being sampled.

#### C.5.1.3.6 Calibration Gas System(s)

Design and equip each Hg monitor to permit the introduction of known concentrations of elemental Hg and HgCl<sub>2</sub> separately, at a point immediately preceding the sample extraction filtration system, such that the entire measurement system can be checked. If the Hg monitor does not have a converter, the HgCl<sub>2</sub> injection capability is not required. The calibration gas system(s) must be able to flood the sampling probe sufficiently to prevent entry of stack gas from the effluent stream.

#### C.5.1.3.7 Sample Gas Delivery

The sample line may feed directly to a converter, to a by-pass valve (for speciating systems), or to a sample manifold. All valve and/or manifold components must be made of material that is non-reactive to the gas sampled and the calibration gas, and must be configured to safely discharge any excess gas.

#### C.5.1.3.8 Hg Analyzer

An instrument is required that continuously measures the total vapor phase Hg concentration in the gas stream. The analyzer may also be capable of measuring elemental and oxidized Hg separately.

#### C.5.1.3.9 Data Recorder

A recorder, such as a computerized data acquisition and handling system (DAHS), digital recorder, or data logger, is

required for recording measurement data.

### C.5.2 Auxiliary Monitoring Systems

When the auxiliary monitoring systems described in C.5.2.1 through C.5.2.2, are needed to convert the Hg concentrations measured with the Hg CEMS to the units of the emission standards in 310 CMR 7.29(5)(a)3. or 310 CMR 7.02(3)(o), then all auxiliary monitoring systems shall be certified and quality-assured according to 40 CFR Part 75.

#### C.5.2.1 Mass Emission Limits

To demonstrate compliance with the total annual mercury emission limit of 310 CMR 7.29(5)(a)3.c.i. or 310 CMR 7.02(3)(o), a certified stack gas volumetric flow monitor is required. Further, if the Hg concentration is measured on a dry basis, the stack gas moisture content must also be accounted for. In that case, either: (a) determine the stack gas moisture content using a moisture monitoring system that is certified according to 40 CFR Part 75; or (b) use the appropriate fuel-specific moisture default value provided in 40 CFR 75.11(b) (see C.10.2.1.1).

#### C.5.2.2 Heat Input-Based Removal Efficiency

To demonstrate compliance with the removal efficiency standards of 310 CMR 7.29(5)(a)3.e.i. and f.i. using Equation C.6.B, a method of quantifying unit heat input is needed. In such case, in addition to the auxiliary monitoring systems described in C.5.2.1, a certified diluent gas (CO<sub>2</sub> or O<sub>2</sub>) monitor and a fuel-specific F-factor are required to determine the hourly heat input.

### C.6 Reagents and Standards

#### C.6.1 NIST Traceability

Only NIST-certified or NIST-traceable calibration gas standards and reagents (as defined in C.3.5 and C.3.6) shall be used for the required tests and procedures. Calibration gases with known concentrations of Hg<sup>0</sup> and HgCl<sub>2</sub> are required. Special reagents and equipment may be needed to prepare the Hg<sup>0</sup> and HgCl<sub>2</sub> gas standards (e.g., NIST-traceable solutions of HgCl<sub>2</sub> and gas generators equipped with mass flow controllers).

Note: The certification and on-going QA tests specified in C.8 and C.9 for Hg CEMS may be conducted without NIST-certified or NIST-traceable calibration standards until the later of: (1) the date on which traceability protocols cited in C.3.5 and C.3.6 are published; or (2) January 1, 2010.

#### C.6.2 Required Calibration Gas Concentrations

##### 6.2.1 Zero-Level Gas

A zero-level calibration gas with a Hg concentration below the detectable limit of the analyzer is required for calibration error tests and cycle time tests of the CEMS.

##### C.6.2.2 Low-Level Gas

A low-level calibration gas with a Hg concentration of 20 to 30 percent of the span value is required for linearity checks and 3-level system integrity checks of the CEMS. Elemental Hg standards are required for the linearity checks and oxidized Hg standards are required for the system integrity checks.

##### C.6.2.3 Mid-Level Gas

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A mid-level calibration gas with a Hg concentration of 50 to 60 percent of the span value: (a) is required for linearity checks and 3-level system integrity checks of the CEMS; and (b) is optional for calibration error tests and single-level system integrity checks. Elemental Hg standards are required for the linearity checks, oxidized Hg standards are required for the system integrity checks, and either elemental or oxidized Hg standards may be used for the calibration error tests.

#### C.6.2.4 High-Level Gas

A high-level calibration gas with a Hg concentration of 80 to 100 percent of the span value: (a) is required for linearity checks, 3-level system integrity checks, and cycle time tests of the CEMS; and (b) is optional for calibration error tests and single-level system integrity checks. Elemental Hg standards are required for the linearity checks, oxidized Hg standards are required for the system integrity checks, and either elemental or oxidized Hg standards may be used for the calibration error and cycle time tests.

### C.7 Preliminary Procedures

#### 7.1 Installation and Measurement Location

##### C.7.1.1 Hg CEMS

For the Hg CEMS, select a monitoring location that is representative of the Hg emissions from the source, where the CEMS is likely to pass the relative accuracy test audit (RATA) e.g., a location that: (a) conforms to the guidelines in section 8.1.1 of Performance Specification 2 in appendix B to 40 CFR Part 60; and/or (b) is shown to be free of stratification or minimally stratified through measurement traverses for Hg or other gases such as SO<sub>2</sub> and NO<sub>x</sub>. If the CEMS is unable to pass the RATA and the measurement location is determined to be the cause, relocate the probe.

##### C.7.1.2 Auxiliary Monitors

For any auxiliary monitors that are needed to convert Hg concentrations to the desired units of measure (i.e., flow monitors, CO<sub>2</sub> or O<sub>2</sub> monitors, and/or moisture monitors, as applicable), follow the installation and measurement location guidelines in section 1 of appendix A to 40 CFR Part 75.

#### C.7.2 Monitor Span and Range Requirements

##### C.7.2.1 Hg CEMS

Determine the appropriate span and range value(s) for each Hg CEMS as described in C.7.2.1.1 through C.7.2.1.3, so that all potential and expected Hg concentrations can be accurately measured.

##### C.7.2.1.1 Maximum Potential Concentration

There are two options for determining the maximum potential Hg concentration (MPC): (a) use one of the following default values: 9 µg/scm for bituminous coal; 10 µg/scm for sub-bituminous coal; 16 µg/scm for lignite, and 1 µg/scm for waste coal, i.e., anthracite culm or bituminous gob. If different coals are blended, use the highest MPC for any fuel in the blend; or (b) base the MPC on the results of site-specific emission testing using one of the Hg reference methods in C.8.1.1.5.1. Option (b) may only be used if the unit does not have add-on Hg emission controls or a flue gas desulfurization (FGD) system, or if testing is performed upstream of all emission control devices. At least 3 test runs are required, at the normal operating load, and the highest Hg concentration obtained in any of the tests shall be the MPC.

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### C.7.2.1.2 Maximum Expected Concentration

For units with flue gas desulfurization (FGD) systems that significantly reduce Hg emissions (including fluidized bed units that use limestone injection) and for units equipped with add-on Hg emission controls (e.g., carbon injection), determine the maximum expected Hg concentration (MEC) during normal, stable operation of the unit and emission controls. To calculate the MEC, substitute the MPC value from C.7.2.1.1, into Equation A-2 in section 2.1.1.2 of appendix A to 40 CFR Part 75. For units with add-on Hg emission controls, base the percent removal efficiency on design engineering calculations. For units with FGD systems, use the best available estimate of the Hg removal efficiency of the FGD system.

### C.7.2.1.3 Span and Range Requirements

#### C.7.2.1.3.1 High Span and Range

For each Hg monitor, determine a high span value, by rounding the MPC value from C.7.2.1.1 upward to the next highest multiple of 5.0 µg/scm, unless the MPC is already a multiple of 5.0 µg/scm. Therefore, if the option to use the default MPC value in C.7.2.1.1 is selected, the high span value shall be 10.0 µg/scm for bituminous coal and sub-bituminous coal, 5.0 µg/scm for waste coal, and 20.0 µg/scm for lignite. Set the “high range value” equal to the high span value.

#### C.7.2.1.3.2 Low Span and Range

For a unit equipped with a flue gas desulfurization system (FGD) or a unit with add-on Hg emission controls, compare the MEC value from C.7.2.1.2 to the high range value from C.7.2.1.3.1. If the MEC is greater than 20 percent of the high range value, a second (low) span value is not required. However, if: (a) the MEC is less than or equal to 20 percent of the high range value; and (b) the high range value is greater than or equal to 10.0 µg/scm, a second, low span value must be defined. Set the low span value to the lowest multiple of 5.0 µg/scm that is above the MEC. For example, if the high range value is 10.0 µg/scm and the MEC is 1.5 µg/scm, set the low span value at 5.0 µg/scm. Set the “low range value” equal to the low span value.

#### C.7.2.1.3.3 Dual Range Considerations

When two span values are required, either: (a) record the Hg concentration data on two separate measurement ranges, with full-scale values equal to the high and low range values from C.7.2.1.3.1 and C.7.2.1.3.2 (e.g., 0-10 µg/scm and 0-5 µg/scm); or (b) quality-assure two segments of a single measurement scale, where the upper boundaries of the two segments are the high and low range values.

### C.7.2.2 Auxiliary Monitoring Systems

Determine the span and range requirements for auxiliary CO<sub>2</sub> (or O<sub>2</sub>) and flow monitoring systems (as applicable) in accordance with sections 2.1.3 and 2.1.4 of appendix A to 40 CFR Part 75. For a continuous moisture sensor, there is no span value requirement; set the range of the instrument according to the manufacturer’s instructions.

## C.8 Initial Certification and Recertification

### C.8.1 Certification Requirements

#### C.8.1.1 Hg CEMS

Table C.1 summarizes the certification test requirements and performance specifications for a Hg CEMS. The

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CEMS may not be used to report quality-assured data until these performance criteria are met. C.8.1.1.1 through C.8.1.1.5 provide specific instructions for the required tests. C.8.1.2 gives general certification instructions for the auxiliary monitoring systems. Recertification is discussed in C.8.2.

**Table C.1: Required Certification Tests and Performance Specifications for Hg CEMS**

<u>For this required certification test.....</u>	<u>The main performance specification<sup>1</sup> is.....</u>	<u>The alternate performance specification<sup>1</sup> is.....</u>	<u>And the conditions of the alternate specification are.....</u>
7-day calibration error test <sup>2</sup>	5.0% of span value, on each of the 7 days	$ R - A  \leq 1.0 \mu\text{g}/\text{scm}$	Span value $\leq 10 \mu\text{g}/\text{scm}$
Linearity check <sup>3</sup>	$ R - A_{\text{avg}}  \leq 10.0\%$ of the reference gas concentration at each calibration gas level	$ R - A_{\text{avg}}  \leq 0.8 \mu\text{g}/\text{scm}$	The alternate specification may be used at any gas level
3-level system integrity check <sup>4</sup>	$ R - A_{\text{avg}}  \leq 10.0\%$ of the reference gas concentration at each calibration gas level	$ R - A_{\text{avg}}  \leq 0.8 \mu\text{g}/\text{scm}$	The alternate specification may be used at any gas level
RATA and bias test	20.0% RA	$ RM_{\text{avg}} - C_{\text{avg}}  \leq 1.0 \mu\text{g}/\text{scm}^{**}$	$RM_{\text{avg}} \leq 5.0 \mu\text{g}/\text{scm}$
Cycle time test <sup>5</sup>	15 minutes <sup>5</sup>	-----	-----

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<sup>1</sup> Note that  $|R - A|$  is the absolute value of the difference between the reference gas value and the analyzer reading.  $|R - A_{\text{avg}}|$  is the absolute value of the between the reference gas concentration and the average of the analyzer responses, at a particular gas level.

<sup>2</sup> Use either elemental or oxidized Hg standards. For dual-span applications, perform the test on both measurement ranges.

<sup>3</sup> Use elemental Hg standards. For dual-span applications, perform the test on both measurement ranges.

<sup>4</sup> Use oxidized Hg standards. For dual-span applications, perform the test on both measurement ranges. Not required if the CEMS does not have a converter.

<sup>5</sup> Stability criteria: readings change by  $\leq 2.0\%$  of span or by  $\leq 0.5 \mu\text{g}/\text{m}^3$ , for 2 minutes. For dual-span applications, perform the test on both measurement ranges.

\*\* Note that  $|RM_{\text{avg}} - C_{\text{avg}}|$  is the absolute difference between the mean reference method value and the mean CEMS value from the RATA. The difference between  $RM_{\text{avg}}$  and  $C_{\text{avg}}$  can be either + or -.

#### C.8.1.1.1 7-Day Calibration Error Test

Perform the 7-day calibration error test, using a zero-level gas and either a high-level or a mid-level calibration gas standard (as defined in C.6.2). Follow the procedures in sections 6.1.1 and 6.3.1 of appendix A to 40 CFR Part 75. Either elemental or oxidized NIST-traceable Hg standards (as defined in C.3.5 and C.3.6) may be used for the test. If moisture and/or chlorine is added to the calibration gas, the dilution effect of the moisture and/or chlorine addition on the calibration gas concentration must be accounted for in an appropriate manner. For dual-span applications, perform the test on both measurement ranges. Calculate the calibration error (CE) on each day of the test using Equation A-5 in section 7.2.1 of appendix A to 40 CFR Part 75. To evaluate the alternative CE specification, use the term  $|R - A|$  from the numerator of Equation A-5.

#### C.8.1.1.2 Linearity Check

Perform the linearity check using low, mid, and high-level concentrations of NIST-traceable elemental Hg standards (as defined in C.3.5 and C.6.2). Follow the general procedures in sections 6.1.1 and 6.2 of appendix A to 40 CFR Part 75. If moisture and/or chlorine is added to the calibration gas, the dilution effect of the moisture and/or chlorine addition on the calibration gas concentration must be accounted for in an appropriate manner. For dual-span applications, perform the test on both measurement ranges. Calculate the linearity error (LE) using Equation A-4 in section 7.1 of appendix A to 40 CFR Part 75. To evaluate the alternative LE specification, use the term  $|R - A|$  from the numerator of Equation A-4.

#### C.8.1.1.3 Three-Level System Integrity Check

Perform the 3-level system integrity check using low, mid, and high-level calibration gas concentrations generated by a NIST-traceable source of oxidized Hg (as defined in C.3.6 and C.6.2). Follow the procedures and instructions in sections 6.1.1, 6.2, and 6.2(g) of appendix A to 40 CFR Part 75. If moisture and/or chlorine is added to the

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calibration gas, the dilution effect of the moisture and/or chlorine addition on the calibration gas concentration must be accounted for in an appropriate manner. For dual-span applications, perform the test on both measurement ranges. To calculate the results of the test, use Equation A-4 in section 7.1 of appendix A to 40 CFR Part 75, replacing the term “LE” (linearity error) with “SIE” (system integrity error). To evaluate the alternative performance specification, use the term  $|R - A|$  from the numerator of Equation A-4.

(Note: This test is not required if the CEMS does not have a converter).

#### C.8.1.1.4 Cycle Time Test

Perform the cycle time test, using a zero-level gas and a high-level calibration gas (as defined in C.6.2). Follow the procedures in sections 6.1.1 and 6.4 of appendix A to 40 CFR Part 75. Either elemental or oxidized NIST-traceable Hg standards (as defined in C.3.5 and C.3.6) may be used for the test. Use the following criterion to determine when a stable reading of stack emissions or calibration gas has been attained: the reading is stable if it changes by no more than 2.0 percent of the span value or 0.5  $\mu\text{g}/\text{scm}$  (whichever is less restrictive) for two minutes. For dual-span applications, perform the test on both measurement ranges and report the longer of the two cycle times as the system cycle time. To calculate the cycle time, use Figures 6a and 6b and the associated text in appendix A to 40 CFR Part 75.

#### C.8.1.1.5 Relative Accuracy Test Audit (RATA)

Perform the RATA of the Hg CEMS according to the general procedures for gas monitoring system RATAs described in sections 6.5 through 6.5.8 of appendix A to 40 CFR Part 75, supplemented by the special instructions in C.8.1.1.5.1 through C.8.1.1.5.4.

##### C.8.1.1.5.1 Reference Methods

Acceptable Hg reference methods for the RATA of a Hg concentration monitoring system include ASTM D6784-02(2008) (the Ontario Hydro Method), Method 30A in appendix A-8 to 40 CFR Part 60, and Method 30B in appendix A-8 to 40 CFR Part 60.

C.8.1.1.5.1.1 When Method 30A is used, calibration standards not traceable to NIST may be used until the later of: (1) the date on which traceability protocols cited in C.3.5 and C.3.6 are published; or (2) January 1, 2010. The minimum time per run is 21 minutes if Method 30A is used.

C.8.1.1.5.1.2 When Method 30B is used, install a new pair of sorbent traps prior to each test run. The time per run must be long enough to collect a sufficient mass of Hg to analyze.

C.8.1.1.5.1.3 When ASTM D6784-02(2008) is used, paired sampling trains are required. The time per run must be long enough to collect a sufficient mass of Hg to analyze. To validate an ASTM D6784-02(2008) test run, calculate the relative deviation (RD) as follows:

$$RD = \frac{C_a - C_b}{C_a + C_b} \times 100$$

Where:

RD = Relative deviation between the Hg concentrations of samples “a” and “b” (percent)

$C_a$  = Hg concentration of Hg sample “a,” micrograms per dry standard cubic meter ( $\mu\text{g}/\text{dscm}$ )

$C_b$  = Hg concentration of Hg sample “b” ( $\mu\text{g}/\text{dscm}$ )

The RD must not exceed 10 percent, when the average concentration is greater than 1.0  $\mu\text{g}/\text{dscm}$ . If the average

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concentration is  $\leq 1.0$   $\mu\text{g}/\text{dscm}$ , the RD must not exceed 20 percent. The RD results are also acceptable if the absolute difference between the Hg concentrations measured by the paired trains does not exceed  $0.03$   $\mu\text{g}/\text{dscm}$ . If the RD criterion is met, the run is valid. For each valid run, average either the vapor phase or total Hg concentrations measured by the two trains, for use in calculating RA and BAF as specified in C.8.1.1.5.5.

#### C.8.1.1.5.2 Special Considerations

The RATA must be done at normal load (as defined in section 6.5.2.1 of appendix A to 40 CFR Part 75), while combusting solid fossil fuel or ash. Locate the reference method (RM) sampling points according to section 6.5.6(b) in appendix A to 40 CFR Part 75. If stratification testing is deemed necessary to justify using fewer RM sample points or alternative RM point locations, follow the applicable procedures in sections 8.1.3 through 8.1.3.5 of Method 30A in appendix A-8 to 40 CFR Part 60. A minimum of 9 valid test runs are required for each RATA, directly comparing the CEMS measurements to the reference method. If more than 9 runs are performed, a maximum of three runs may be discarded. Complete the RATA within 168 unit operating hours, except when ASTM D6784-02(2008) is used, in which case up to 336 operating hours may be taken to finish the test.

#### C.8.1.1.5.3 Calculation of RATA Results

Calculate the relative accuracy (RA) of the monitoring system, on a  $\mu\text{g}/\text{scm}$  basis, according to section 7.3 in appendix A to 40 CFR Part 75. For a unit that qualifies as a low emitter of Hg (i.e., the mean reference method (RM) concentration during the RATA is  $< 5$   $\mu\text{g}/\text{scm}$ ), if the calculated RA exceeds 20.0%, the results of the RATA are still acceptable if the absolute difference between the mean RM and CEMS concentrations does not exceed  $1.0$   $\mu\text{g}/\text{scm}$ . All comparisons of RM and monitoring system data must be made on a consistent moisture basis (dry or wet).

#### C.8.1.1.5.4 Bias Adjustment

To ensure that Hg concentration is not under-reported, the bias test described in section 7.6.4 of appendix A to 40 CFR Part 75 shall be performed each time that a RATA of the Hg CEMS is done. If the bias test is failed, a bias adjustment factor (BAF) must be calculated in accordance with section 7.6.5(a) of appendix A to 40 CFR Part 75, and applied to the hourly data from the CEMS, beginning with the hour after the RATA is completed. For low emitting sources (mean RM concentration during the RATA  $< 5$   $\mu\text{g}/\text{scm}$ ), if the calculated BAF exceeds 1.250, a BAF of 1.250 may be used for reporting purposes.

#### C.8.1.1.5.5 Particulate-bound Hg Adjustment

To ensure that total Hg concentration is reported, including particulate-bound Hg, as required by 310 CMR 7.29(5)(a)3. and 310 CMR 7.02(3)(o), Hg CEMS that measure only vapor-phase Hg shall follow C.8.1.1.5.5.1 if conducting a RATA with Method 30B or ASTM D6784-02(2008) measuring the total of vapor phase and particulate-bound Hg, and shall follow C.8.1.1.5.5.2 if conducting a RATA with Method 30A or ASTM D6784-02(2008) measuring only vapor phase Hg.

C.8.1.1.5.5.1 When a RATA is performed with Method 30B or ASTM D6784-02(2008), perform the relative accuracy calculations in C.8.1.1.5.3 and the bias tests and adjustments in C.8.1.1.5.4 using the total Hg concentration (i.e., vapor phase plus particulate-bound Hg).

C.8.1.1.5.5.2 When a RATA is performed with Method 30A, or using only the vapor phase Hg results from ASTM D6784-02(2008), perform the relative accuracy calculations in C.8.1.1.5.3 and the bias tests and adjustments in C.8.1.1.5.4 using vapor phase Hg, and in subsequent reporting of hourly Hg concentrations, increase  $C_h$  in Equation C.1.A, C.1.B, C.6.A or C.7.A for each hour by adding the average particulate-bound Hg concentration measured during the most recent stack test, or certification test or RATA for the Hg monitoring system, as required by 310

CMR 7.29(5)(a)3.d.iii. and 310 CMR 7.02(3)(o). The added particulate-bound Hg concentration must be on the same moisture basis (wet or dry) as the vapor phase Hg concentration measured by the CEMS. Correct the particulate-bound Hg concentration for moisture using the following formula:

$$C_d = \frac{C_w}{1 - B_{ws}}$$

Where:

C<sub>d</sub> = Dry-basis particulate-bound Hg concentration (µg/dscm)

C<sub>w</sub> = Wet-basis particulate-bound Hg concentration (µg/wscm)

B<sub>ws</sub> = Stack gas moisture content, expressed as a decimal, i.e., % H<sub>2</sub>O/100

Moisture measurements from the most recent stack test or from the RATA may be used to determine B<sub>ws</sub>. Alternatively, the appropriate fuel-specific default moisture percentage from 40 CFR 75.11(b) may be used.

#### C.8.1.2 Auxiliary Monitoring Systems

##### C.8.1.2.1 Certification Test Requirements

Auxiliary monitoring systems that are used to measure stack gas volumetric flow rate and/or diluent gas concentration and/or moisture must be certified. The certification test procedures and performance specifications for these systems are found in 40 CFR 75.20(c), and in sections 3 and 6 of appendix A to 40 CFR Part 75.

##### C.8.1.2.2 Bias Adjustment

For a flow monitor that is certified and quality-assured according to 40 CFR Part 75, bias adjustment is mandatory, in accordance with sections 7.6.4 and 7.6.5 of appendix A to 40 CFR Part 75. Bias adjustment is not required for diluent gas monitors or moisture monitoring systems.

#### C.8.1.3 Backup Monitoring Systems and Analyzers

##### C.8.1.3.1 Redundant Backup Systems

Redundant backup Hg, flow rate, CO<sub>2</sub>, O<sub>2</sub>, and moisture monitoring systems shall be installed, certified, maintained, operated, and quality-assured in the same manner as the primary monitoring systems.

##### C.8.1.3.2 Non-redundant Backup Monitoring Systems and Analyzers

Non-redundant backup Hg, flow rate, CO<sub>2</sub>, O<sub>2</sub>, and moisture monitoring systems and temporary like-kind replacement Hg, CO<sub>2</sub>, and O<sub>2</sub> analyzers shall be maintained, operated, and quality-assured in accordance with 40 CFR 75.20(d)(2)(i) through (d)(2)(viii) and C.8.1.3.3.

##### C.8.1.3.3 Special Instructions for Non-redundant Backup Hg Monitors

For non-redundant backup Hg CEMS and sorbent trap monitoring systems, and for like-kind replacement Hg analyzers, the following provisions apply in addition to, or, in some cases, in lieu of, the general requirements in 40 CFR 75.20(d)(2)(i) through (d)(2)(viii):

C.8.1.3.3.1 When a certified sorbent trap monitoring system is brought into service as a regular non-redundant backup monitoring system, the system shall be operated according to the procedures in section D of this appendix:

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C.8.1.3.3.2 When a regular non-redundant backup Hg CEMS or a temporary like-kind replacement Hg analyzer is brought into service, a linearity check with elemental Hg standards and a single-point system integrity check shall be performed. Alternatively, a 3-level system integrity check may be performed in lieu of these two tests.

C.8.1.3.3.3 Weekly single-point system integrity checks are required as long as a non-redundant backup Hg CEMS or a temporary like-kind replacement Hg analyzer remains in service, unless the daily calibrations of the Hg CEMS or like-kind replacement analyzer are done using a NIST-traceable source of oxidized Hg.

### C.8.2 Recertification

Whenever a replacement, modification, or change in a certified Hg CEMS or auxiliary monitoring system is made that may significantly affect the ability of the system to accurately measure or record the Hg concentration, stack gas volumetric flow rate, CO<sub>2</sub> concentration, O<sub>2</sub> concentration, or percent moisture, the monitoring system shall be recertified. Furthermore, whenever a replacement, modification, or change to the flue gas handling system or the unit operation is made that may significantly change the flow or concentration profile, the monitoring system shall be recertified. The same tests performed for the initial certification of the monitoring system shall be repeated for recertification. The conditional data validation provisions in 40 CFR 75.20(b)(3) may be used for recertification events. Examples of changes that require recertification include: (a) replacement of a gas analyzer; and (b) change in location or orientation of the sampling probe.

## C.9 On-Going Quality Assurance (QA) and Data Validation

### C.9.1 Hg CEMS

#### C.9.1.1 Required QA Tests

Periodic QA testing of the Hg CEMS is required following initial certification. The required tests, the test frequencies, and the performance specifications that must be met are summarized in Table C.2.

**Table C.2: On-Going QA Test Requirements for Hg CEMS**

<b>Perform this type of QA test</b>	<b>At this frequency</b>	<b>With these qualifications and exceptions</b>	<b>Acceptance criteria</b>
Calibration error test	Daily	<ul style="list-style-type: none"> <li>Use either a mid-or high-level gas</li> <li>Use either elemental or oxidized Hg</li> <li>For dual span applications, test both ranges</li> <li>Calibrations are not required when the unit is not in operation</li> </ul>	$5.0\%$ of span value or $ R - A  \leq 1.0 \mu\text{g}/\text{scm}$
Single-level system integrity check	Weekly <sup>1</sup>	<ul style="list-style-type: none"> <li>Required only for systems with converters</li> <li>Use oxidized Hg, either mid-or high-level</li> <li>For dual span applications, test both ranges</li> <li>Not required if daily calibrations are done with a NIST-traceable source of oxidized Hg</li> </ul>	$ R - A_{\text{avg}}  \leq 10.0\%$ of the reference gas value or $ R - A_{\text{avg}}  \leq 0.8 \mu\text{g}/\text{scm}$
Linearity check or 3-level system integrity check	Quarterly <sup>3</sup>	<ul style="list-style-type: none"> <li>Required only in "QA operating quarters"<sup>2</sup>, but no less than once a year</li> <li>168 operating hour grace period available</li> <li>Use elemental Hg for linearity check</li> <li>Use oxidized Hg for system integrity check</li> <li>For dual span applications, test both ranges</li> <li>For system integrity check, CEMS must have a converter</li> </ul>	$ R - A_{\text{avg}}  \leq 10.0\%$ of the reference gas value, at each calibration gas level or $ R - A_{\text{avg}}  \leq 0.8 \mu\text{g}/\text{scm}$
RATA and Bias test	Annual <sup>4</sup>	<ul style="list-style-type: none"> <li>720 operating hour grace period available</li> </ul>	$20.0\%$ RA or $ RM_{\text{avg}} - C_{\text{avg}}  \leq 1.0 \mu\text{g}/\text{scm}$ , if $RM_{\text{avg}} < 5.0 \mu\text{g}/\text{scm}$

<sup>1</sup> "Weekly" means once every 168 unit operating hours.

<sup>2</sup> A "QA operating quarter," as defined in 40 CFR 72.2, is a calendar quarter with at least 168 hours of unit operation.

<sup>3</sup> "Quarterly" means once every QA operating quarter (see 40 CFR Part 75, appendix B, section 2.2.1).

<sup>4</sup> "Annual" means once every four QA operating quarters (see 40 CFR Part 75, appendix B, section 2.3.1.2).

**C.9.1.2 Test Frequency**

Perform calibration error tests and linearity checks of the Hg CEMS at the frequencies specified for gas monitors in sections 2.1 and 2.2 of appendix B to 40 CFR Part 75. The dual span provisions in those sections of appendix B to 40 CFR Part 75 apply to the Hg CEMS. The test frequency for 3-level system integrity checks (if performed in lieu of linearity checks, see third column in Table C.2) is the same as for linearity checks. The weekly system integrity check (if required, see third column in Table C.2) must be done at least once every 168 unit operating hours. For dual span applications, perform the test on both measurement scales. The test frequency for RATAs of the Hg CEMS shall be annual (i.e., once every four "QA operating quarters," as defined in 40 CFR 72.2). Use Equation A-5 in section 7.2.1 of appendix A to 40 CFR Part 75 to evaluate the calibration error tests, Equation A-4 in section 7.1 of appendix A to 40 CFR Part 75 to evaluate linearity checks and system integrity checks, and calculate RATA results according to section 7.3 of appendix A to 40 CFR Part 75.

**C.9.1.3 Data Validation**

Data validation for calibration error tests, linearity checks, and RATAs of the Hg CEMS shall be done in accordance with sections 2.1.4, 2.1.5, 2.2.3, and 2.3.2 of appendix B to 40 CFR Part 75. Data validation for 3-level system integrity checks (if performed in lieu of linearity checks) shall be the same as for linearity checks. For weekly system integrity checks, if the performance specifications in Table C.2 are not met, the monitoring system is considered out-of-control, from the hour of the failed check until a subsequent system integrity check is passed. Also, if a required weekly system integrity check is not performed and passed within 168 unit or stack operating hours of the last successful check, the monitoring system is considered to be out-of-control, beginning with the 169th unit or stack operating hour after the last successful check, and continuing until a subsequent system integrity check is passed.

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#### C.9.1.4 Grace Periods

The grace periods for calibration error tests, linearity checks, and RATAs described in sections 2.1.5.2, 2.2.4, and 2.3.3 of appendix B to 40 CFR Part 75 apply to the Hg CEMS. The grace period in section 2.2.4 of appendix B to Part 75 applies to quarterly 3-level system integrity checks of the Hg CEMS. There is no grace period for weekly system integrity checks.

#### C.9.1.5 Overscaling and Adjustment of Span

Whenever the measured Hg concentration exceeds the high range value or the low range value defined in C.7.2.1.3 and the “overscaling” is not caused by a malfunction of the CEMS, proceed as follows:

C.9.1.5.1 For Hg monitors with a single (high) span and range, report 200 percent of the high range value until the readings are back “on-scale,” i.e., at or below the high range value.

C.9.1.5.2 For Hg monitors with two span and range values, when the low range value is exceeded, no further action is required, provided that the high range is available and is not out-of-control or out-of-service. However, if the high range is not able to provide quality assured data at the time of the low range exceedance or at any time during the continuation of the exceedance (e.g., if its most recent calibration error test, linearity check, or system integrity check has expired), report the MPC until the readings return to the low range or until the high range is able to provide quality assured data, with one exception. If the reason that the high-scale range is not able to provide quality assured data is that the high range value has also been exceeded, follow the procedures in C.9.1.5.1.

C.9.1.5.3 If deemed appropriate (e.g., when the high range value is exceeded for more than 2 percent of the unit operating hours in a calendar quarter), make adjustments to the MPC, high span value, and high range value to prevent future overscaling.

#### C.9.2 Auxiliary Monitoring Systems

On-going QA testing of the auxiliary monitoring systems (if used) shall be performed according to appendix B to 40 CFR Part 75. The data validation and grace period provisions in appendix B to Part 75 apply to these monitoring systems. Provisions addressing overscaling and adjustment of span and range are found in sections 2.1.3.3 and 2.1.4.3 of appendix A to 40 CFR Part 75.

#### C.9.3 QA/QC Program

A quality assurance/quality control (QA/QC) program shall be developed and implemented for the Hg CEMS and (if applicable) for the auxiliary monitoring systems used to convert Hg concentration data from the Hg CEMS to the appropriate units of measure. At a minimum, include in the QA/QC program a written plan that describes in detail (or that refers to separate documents containing) complete, step-by-step procedures and operations for the following activities. Electronic storage of the QA/QC plan is permissible, provided that the information can be made available in hard copy to auditors and inspectors.

##### C.9.3.1 General Requirements

###### C.9.3.1.1 Preventive Maintenance

Keep a written record of procedures needed to maintain the monitoring system in proper operating condition and a schedule for those procedures. This shall, at a minimum, include procedures specified by the manufacturers of the equipment and, if applicable, additional or alternate procedures developed for the equipment.

### C.9.3.1.2 Record Keeping and Reporting

Keep a written record describing procedures that will be used to implement the recordkeeping and reporting requirements of 310 CMR 7.29 and 310 CMR 7.02(3)(o).

### C.9.3.1.3 Maintenance Records

Keep a record of all testing, maintenance, or repair activities performed on any Hg CEMS and any auxiliary monitoring systems (if used) in a location and format suitable for inspection. A maintenance log may be used for this purpose. The following records shall be maintained: date, time, and description of any testing, adjustment, repair, replacement, or preventive maintenance action performed and records of any corrective actions associated with a monitor outage period. Additionally, any adjustment that recharacterizes a system's ability to record and report emissions data must be recorded (e.g., changing of flow monitor or moisture monitoring system polynomial coefficients, K factors or mathematical algorithms, changing of temperature and pressure coefficients and dilution ratio settings), and a written explanation of the procedures used to make the adjustment(s) shall be kept.

### C.9.3.2 Specific Requirements

#### C.9.3.2.1 Daily Calibrations, Linearity Checks and System Integrity Checks

Keep a written record of the procedures used for daily calibrations of the Hg CEMS and all auxiliary monitoring systems. If moisture and/or chlorine is added to the Hg calibration gas, explain how the dilution effect of the moisture and/or chlorine addition on the calibration gas concentration is accounted for. Also keep records of the procedures used to perform linearity checks (of the Hg CEMS and, if applicable, the CO<sub>2</sub> or O<sub>2</sub> monitor) and the procedures for system integrity checks of the Hg CEMS. Explain how the test results are calculated and evaluated.

#### C.9.3.2.2 Monitoring System Adjustments

Explain how each component of the continuous emission monitoring system will be adjusted to provide correct responses to calibration gases or reference signals after routine maintenance, repairs, or corrective actions.

#### C.9.3.2.3 Relative Accuracy Test Audits

Keep a written record of procedures used for RATAs of the monitoring systems. Indicate the reference methods used and explain how the test results are calculated and evaluated.

#### C.9.3.2.4 Verification of Emission Controls Performance

For units and common stack configurations that have flue gas desulfurization (FGD) systems or add-on Hg emission controls, if parametric data are used to verify proper control device operation during missing data periods (see C.10.2.2), the QA plan shall identify the parameters that are monitored and the acceptable range of values for each parameter. If data from a certified SO<sub>2</sub> CEMS are used to verify proper FGD operation, the SO<sub>2</sub> monitoring system must be included in the QA plan.

### C.10 Data Reduction and Calculations

#### C.10.1 Data Reduction

Reduce the data from the Hg CEMS and (if applicable) from the auxiliary monitoring systems to hourly averages, in accordance with 40 CFR 75.10(d).

C.10.2 Calculation of Hg Mass Emissions, Emission Rates and Removal Efficiency

For determining compliance with 310 CMR 7.29(5)(a)3. and 310 CMR 7.02(3)(o), use the calculation methods in C.10.2.1.1 through C.10.2.1.7. To ensure that the methods in C.10.2.1.1 through C.10.2.1.7 are applied correctly, the missing data substitution provisions of C.10.2.2 must be taken into account.

C.10.2.1 Hg Mass Emissions

C.10.2.1.1 Calculate the Hg mass emissions for each unit for each hour, using Equation C.1.A (for wet-basis measurements of Hg concentration) or Equation C.1.B (for dry-basis measurements), as applicable:

$$M_h = KC_hQ_h t_h \text{ (Equation C.1.A)}$$

Where:

$M_h$  = Hg mass emissions for the hour, pounds (lb)

$K$  = Units conversion constant,  $6.236 \times 10^{-11}$ , pound-standard cubic meter per microgram-standard cubic foot (lb-scm/ $\mu$ g-scf)

$C_h$  = Hourly average Hg concentration, wet basis, as measured by the CEMS, increased for bias and particulate-bound Hg, if necessary ( $\mu$ g/scm)

$Q_h$  = Hourly average stack gas volumetric flow rate, increased for bias, if necessary, standard cubic feet per hour (scfh)

$t_h$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

or

$$M_h = KC_hQ_h t_h (1-B_{ws}) \text{ (Equation C.1.B)}$$

Where:

$M_h$  = Hg mass emissions for the hour (lb)

$K$  = Units conversion constant,  $6.236 \times 10^{-11}$  lb-scm/ $\mu$ g-scf

$C_h$  = Hourly average Hg concentration, dry basis, as measured by the CEMS, increased for bias and particulate-bound Hg, if necessary ( $\mu$ g/dscm)

$Q_h$  = Hourly average stack gas volumetric flow rate, increased for bias, if necessary (scfh)

$t_h$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

$B_{ws}$  = Moisture fraction of the stack gas, expressed as a decimal (equal to % H<sub>2</sub>O/100)

When using Equations C.1.A and C.1.B, calculate the hourly Hg mass emissions on a clock hour basis. For non-operating hours, the Hg mass emissions will, of course, be zero. Use the appropriate substitute data values for  $C_h$  and/or  $Q_h$  and/or  $B_{ws}$  for operating hours in which a quality-assured value of any of these parameters is unavailable.

C.10.2.1.2 Use Equation C.2 to calculate Hg mass emissions over each month and 12-month period for each unit, as required by 310 CMR 7.29(7)(b)1. or over each year as required by 310 CMR 7.02(3)(o), and to demonstrate compliance with 310 CMR 7.29(5)(a)3.c.i. or 310 CMR 7.02(3)(o) at facilities with a single solid fossil fuel- or ash-fired unit:

$$M_u = \sum_{h=1}^n M_h \text{ (Equation C.2)}$$

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Where:

$M_u$  = Hg mass emissions for the unit and time period, i.e., month or 12-month period (lb)

$M_h$  = Hg mass emissions for hour “h” in the specified time period, from Equation C.1.A or C.1.B, as applicable (lb)

$n$  = Number of hours in the month or 12-month period

C.10.2.1.3 For facilities with more than one solid fossil fuel- or ash-fired unit, use Equation C.3 to calculate Hg mass emissions over each month and 12-month period for the facility, as required by 310 CMR 7.29(7)(b)1. or over each year as required by 310 CMR 7.02(3)(o), and to demonstrate annual compliance with 310 CMR 7.29(5)(a)3.e.i. or 310 CMR 7.02(3)(o):

$$M_f = \sum_{u=1}^v M_u \text{ (Equation C.3)}$$

Where:

$M_f$  = Hg mass emissions for the facility and time period, i.e., month or 12-month period (lb)

$M_u$  = Hg mass emissions for a particular unit “u” and time period, i.e., month or 12-month period (lb)

$v$  = Number of solid fossil fuel- or ash-fired units at the facility

C.10.2.1.4 Use Equation C.4 to calculate the output-based Hg emission rate over each month and 12-month period for each unit, as required by 310 CMR 7.29(7)(b)3., and to demonstrate compliance with 310 CMR 7.29(5)(a)3.e.ii. and f.ii. over each 12-month period, at facilities with a single solid fossil fuel- or ash-fired unit:

$$E_u = \frac{M_u}{GWh_u} \text{ (Equation C.4)}$$

Where:

$E_u$  = Hg emission rate for the unit and time period, i.e., month or 12-month period, pounds per gigawatt-hour (lb/GWh)

$M_u$  = Hg mass emissions for the unit and time period, i.e., month or 12-month period (lb)

$GWh_u$  = Net electrical output for the unit and time period, i.e., month or 12-month period (GWh)

C.10.2.1.5 For facilities with more than one solid fossil fuel- or ash-fired unit, use Equation C.5 to calculate the output-based Hg emission rate over each month and 12-month period for the facility, as required by 310 CMR 7.29(7)(b)3., and to demonstrate compliance with 310 CMR 7.29(5)(a)3.e.ii. and f.ii. over each 12-month period:

$$E_f = \frac{\sum_{u=1}^v M_u}{\sum_{u=1}^v GWh_u} \text{ (Equation C.5)}$$

Where:

$E_f$  = Hg emission rate for the facility and time period, i.e., month or 12-month period (lb/GWh)

$M_u$  = Hg mass emissions for a particular unit “u” and time period, i.e., month or 12-month period (lb)

$GWh_u$  = Net electrical output for a particular unit “u” and time period, i.e., month or 12-month period (GWh)

$v$  = Number of solid fossil fuel- or ash-fired units at the facility

C.10.2.1.6 When choosing to comply with the removal efficiency standards of 310 CMR 7.29(5)(a)3.e.i. or f.i., use

Equation C.6.A or C.6.B to calculate the average total Hg removal efficiency over each month and 12-month period for each unit, as required by 310 CMR 7.29(7)(b)5., and to demonstrate compliance with 310 CMR 7.29(5)(a)3.e.i. and f.i. over each 12-month period at facilities with a single solid fossil fuel- or ash-fired unit:

$$RE_u = \frac{C_u - \frac{\sum_{h=1}^i C_h t_h}{\sum_{h=1}^i t_h}}{C_u} \times 100 \quad \text{(Equation C.6.A)}$$

Where:

$RE_u$  = Hg removal efficiency for the unit and time period (%)

$C_u$  = Historic total Hg inlet concentration, listed in Table C.3 for each unit, dry basis ( $\mu\text{g}/\text{dscm}$ )

$C_h$  = Average Hg stack outlet concentration for operating hour “h” in the specified time period, as measured by the CEMS, increased for moisture (using the formula in C.8.1.1.5.5.2, if the CEMS measures Hg concentration on a wet basis), bias and particulate-bound Hg, if necessary, dry basis ( $\mu\text{g}/\text{dscm}$ )

$t_h$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

$i$  = Number of operating hours for the unit in the month or 12-month period

or

$$RE_u = \frac{E_u - \sum_{h=1}^i \frac{M_h}{HI_h t_h}}{E_u} \times 100 \quad \text{(Equation C.6.B)}$$

Where:

$RE_u$  = Hg removal efficiency for the unit and time period (%)

$E_u$  = Historic total Hg inlet emission rate, listed in Table C.3 for each unit, pounds per million British thermal units (lb/mmBtu)

$M_h$  = Hg mass emissions for operating hour “h” in the specified time period, from Equation C.1.A or C.1.B, as applicable (lb)

$HI_h$  = Hourly heat input rate, for operating hour “h” in the specified time period, calculated from measurements of stack gas flow rate, diluent gas concentration, and moisture (if needed), or appropriate substitute data values for these parameters, together with a fuel-specific F-factor and an appropriate equation from section 5.2 of appendix F to 40 CFR Part 75, million British thermal units per hour (mmBtu/hr)

$t_h$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

$i$  = Number of operating hours for the unit in the month or 12-month period

C.10.2.1.7 When choosing to comply with the removal efficiency standards of 310 CMR 7.29(5)(a)3.e.i. or f.i. for a facility with more than one solid fossil fuel- or ash-fired unit, use Equation C.7.A or C.7.B to calculate the average total Hg removal efficiency over each month and 12-month period for each facility, as required by 310 CMR 7.29(7)(b)5., and to demonstrate compliance with 310 CMR 7.29(5)(a)3.e.i. and f.i. over each 12-month period:

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$$RE_f = \frac{C_f - \frac{\sum_{h=1, u=1}^{i, v} C_{h, u} t_{h, u}}{\sum_{h=1, u=1}^{i, v} t_{h, u}}}{C_f} \times 100 \text{ (Equation C.7.A)}$$

Where:

$RE_f$  = Hg removal efficiency for the facility and time period (%)

$C_f$  = Average historic total Hg inlet concentration for the facility, i.e., average of the unit-level concentration ( $C_u$ ) values listed in Table C.3, dry basis ( $\mu\text{g}/\text{dscm}$ )

$C_{h, u}$  = Average Hg stack outlet concentration for operating hour “h” in the specified time period, for a particular unit “u,” as measured by the CEMS, increased for moisture (using the formula in C.8.1.1.5.5.2, if the CEMS measures Hg concentration on a wet basis), bias and particulate-bound Hg, if necessary, dry basis ( $\mu\text{g}/\text{dscm}$ )

$t_{h, u}$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

$i$  = Number of operating hours for a particular unit “u” in the month or 12-month period

$v$  = Number of solid fossil fuel- or ash-fired units at the facility

or

$$RE_f = \frac{E_f - \sum_{h=1, u=1}^{i, v} \frac{M_{h, u}}{HI_{h, u} t_{h, u}}}{E_f} \times 100 \text{ (Equation C.6.B)}$$

Where:

$RE_f$  = Hg removal efficiency for the facility and time period (%)

$E_f$  = Average historic total Hg inlet emission rate for the facility, i.e., average of the unit-level emission rate ( $E_u$ ) values listed in Table C.3, pounds per million British thermal units (lb/mmBtu)

$M_{h, u}$  = Hg mass emissions for operating hour “h” in the specified time period, for a particular unit “u,” from Equation C.1.A or C.1.B, as applicable (lb)

$HI_{h, u}$  = Hourly heat input rate, for operating hour “h” in the specified time period, for a particular unit “u,” calculated from measurements of stack gas flow rate, diluent gas concentration, and moisture (if needed), or appropriate substitute data values for these parameters, together with a fuel-specific F-factor and an appropriate equation from section 5.2 of appendix F to 40 CFR Part 75, million British thermal units per hour (mmBtu/hr)

$t_{h, u}$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

$i$  = Number of operating hours for a particular unit “u” in the month or 12-month period

$v$  = Number of solid fossil fuel- or ash-fired units at the facility

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**Table C.3 Historic Total Hg Inlet Concentrations and Emission Rates**

<b>Unit</b>	<b>C<sub>u</sub> (µg/dscm)</b>	<b>E<sub>u</sub> (lb/mmBtu)</b>
Brayton Point unit 1	4.35	3.76 x 10 <sup>-6</sup>
Brayton Point unit 2	4.67	4.34 x 10 <sup>-6</sup>
Brayton Point unit 3	4.98	5.42 x 10 <sup>-6</sup>
Salem Harbor unit 1	4.80	4.97 x 10 <sup>-6</sup>
Salem Harbor unit 2	4.66	4.84 x 10 <sup>-6</sup>
Salem Harbor unit 3	4.82	5.46 x 10 <sup>-6</sup>
Mt. Tom	2.29	3.11 x 10 <sup>-6</sup>
NRG Somerset	4.87	4.20 x 10 <sup>-6</sup>

C.10.2.2 Missing Data Provisions

Missing data substitution is required whenever a measured value of a parameter needed to calculate the hourly Hg mass emissions or removal efficiency is not available. Use the following procedures to provide substitute data values when essential data from Hg CEMS, auxiliary monitoring systems, certified backup monitoring systems or reference methods (as applicable) are unavailable.

C.10.2.2.1 Hg CEMS

C.10.2.2.1.1 Definition of a Missing Data Period

For a certified Hg CEMS, a missing data period occurs whenever a quality-assured hour of Hg concentration data is not obtained during unit operation (e.g., during a monitoring system malfunction or when the system undergoes maintenance), and quality-assured Hg concentration data from a certified backup Hg monitoring system or Hg reference method are not available.

C.10.2.2.1.2 Initial Missing Data Procedures

Immediately following the initial certification of a Hg CEMS, apply the initial missing SO<sub>2</sub> concentration, CO<sub>2</sub> concentration, and moisture data algorithms in 40 CFR 75.31(b) to Hg concentration, until 720 hours of quality-assured Hg concentration data have been collected. Calculate, and update hourly, the percent monitor data availability (PMA) for Hg concentration, in accordance with 40 CFR 75.32.

C.10.2.2.1.3 Standard Missing Data Procedures

Once 720 quality-assured hours of Hg concentration data have been obtained following initial certification, provide substitute data for Hg concentration in accordance with the standard missing data procedures in 40 CFR 75.33(b)(1) through (b)(4), except that the term “Hg concentration” shall apply rather than “SO<sub>2</sub> concentration,” the term “Hg CEMS” shall apply rather than “SO<sub>2</sub> pollutant concentration monitor,” the term “maximum potential Hg concentration” shall apply rather than “maximum potential SO<sub>2</sub> concentration,” and the 95.0, 90.0 and 80.0 percent monitor data availability trigger conditions prescribed in 40 CFR 75.33(b)(1) through (b)(4) shall be replaced, respectively, with 90.0, 80.0 and 70.0 percent (see Table C.4).

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**Table C.4: Standard Missing Data Procedures for Hg Concentration**

Trigger Conditions		Calculation Routines	
Percent Monitor Data Availability (PMA)	Duration (N) of Monitor Outage (Hours)	Method	Lookback Period
90 or more	$N \leq 24$	Average of HB and HA	None
	$N > 24$	The greater of: • Average of HB and HA; or • 90th percentile value	None 720 hours*
80 or more, but below 90	$N \leq 8$	Average of HB and HA	None
	$N > 8$	The greater of: • Average of HB and HA; or • 95th percentile value	None 720 hours*
70 or more, but below 80	$N > 0$	Maximum value	720 hours*
Below 70	$N > 0$	Maximum potential concentration	None

<sup>1</sup> HB and HA = Quality-assured Hg concentrations in the hour before and hour after the monitor outage.

\* Quality-assured monitor operating hours, during unit operation

C.10.2.2.1.4 Special Considerations for Units With Emission Controls

For a unit equipped with a flue gas desulfurization (FGD) system that significantly reduces the concentration of Hg emitted to the atmosphere (including circulating fluidized bed units that use limestone injection), or for a unit equipped with add-on Hg emission controls (e.g., carbon injection), the standard missing data procedures in C.10.2.2.1.3 may only be used for hours in which the SO<sub>2</sub> or Hg emission controls are documented to be operating properly, based on parametric data recorded during the missing data period. Hourly SO<sub>2</sub> concentration data from a certified CEMS may be used to demonstrate that a FGD system is working properly. For any hour(s) in the missing data period for which this documentation is unavailable, report the maximum potential Hg concentration (MPC), as defined in C.7.2.1.1.

However, when the PMA is less than 80.0 percent, but greater than or equal to 70.0 percent, and a missing data period occurs, the maximum controlled Hg concentration in the previous 720 hours of quality-assured data may be reported, in lieu of reporting the maximum value in the 720-hour lookback, for each missing data hour in which the FGD or Hg emission controls are documented to be operating properly. Further, when the PMA is less than 70.0 percent and a missing data period occurs, the greater of: (a) the maximum expected Hg concentration (MEC); or (b) 1.25 times the maximum controlled Hg concentration recorded in the previous 720 quality-assured hours of data may be reported, for each missing data hour in which the FGD or Hg emission controls are documented to be operating properly. The MEC shall be determined in accordance with C.7.2.1.2.

C.10.2.2.2 Auxiliary Monitoring Systems

For the auxiliary monitoring systems (flow rate, diluent gas, and moisture), follow the applicable missing data procedures in Subpart D of 40 CFR Part 75.

C.11 Reporting

Quarterly electronic reporting of data from the certified Hg CEMS and, if applicable, auxiliary monitoring systems is required. At a minimum, the following data elements must be reported electronically:

C.11.1 Unit Information

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Report unit information, including, but not limited to, the unit ID number, the maximum rated heat input capacity, the operating range (in terms of load), the normal operating load(s), the type(s) of fuel combusted, and the type(s) of emission controls.

#### C.11.2 Stack Information

For units that share a monitored common stack or for units with monitored multiple stack exhaust configurations, report the stack ID number(s) and show the unit/stack relationships.

#### C.11.3 Monitoring System Information

Report information for each monitoring system, including, but not limited to, system location, parameter monitored, system and component ID numbers, and component data (e.g., component type, manufacturer, model, serial number, installation date, etc.).

#### C.11.4 Span and Range Information

Report span and range information for the Hg CEMS and (as applicable) the auxiliary monitoring systems.

#### C.11.5 Formulas

Report the mathematical formulas that are used to calculate hourly Hg mass emissions.

#### C.11.6 Operating Data

Report hourly unit operating data including, but not limited to, date and hour, unit (or stack) operating time, unit load, and the type of fuel combusted.

#### C.11.7 Emissions Data

##### C.11.7.1 Hourly Data

Report hourly Hg concentration data from the Hg CEMS and (if applicable) hourly data from the auxiliary monitoring systems that are used to calculate Hg mass emissions. Where bias adjustment is required, report both the unadjusted and bias-adjusted values. Report the hour-by-hour percent monitor data availability (PMA) for all monitored parameters. Indicate which hourly values of each monitored parameter are quality-assured and which are substitute data values. Also report the calculated hourly Hg mass emissions.

##### C.11.7.2 Cumulative and Average Values

Report the cumulative monthly, quarterly and year-to-date Hg mass emissions.

#### C.11.8 QA Test Data and Results

Report, as applicable, detailed quality assurance test data and summarized results, for the following QA tests of the Hg CEMS and auxiliary monitoring systems: calibration error tests, linearity checks, system integrity checks and RATAs. For QA tests that use Hg calibration gas standards, indicate whether elemental or oxidized Hg was used.

#### D. Measurement and Reporting of Total Mercury Emissions, Using a Sorbent Trap Monitoring System

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## D.1 Scope and Application

The requirements provided here are applicable to the performance-based monitoring of total mercury (Hg) emissions in combustion flue gas streams, using a sorbent trap monitoring system. Requirements are also provided for reporting emissions data from the Hg sorbent trap systems and for using the data to demonstrate compliance with applicable Hg emission limits. The performance-based approach allows for use of various suitable sampling and analytical technologies while maintaining a specified and documented level of data quality through performance criteria. Persons using section D. should have a thorough working knowledge of Methods 1, 2, 3, 4 and 5 in appendices A-1 through A-3 to 40 CFR Part 60, as well as the determinative technique selected for analysis.

### D.1.1 Analytes

The analyte measured by these procedures and specifications is total Hg in the flue gas, which represents the sum of elemental Hg (Hg<sup>0</sup>, CAS Number 7439-97-6), oxidized forms of Hg, and particulate-bound Hg, in mass concentration units of micrograms per dry standard cubic meter (µg/dscm).

### D.1.2 Applicability

These performance criteria and procedures are applicable to monitoring of Hg emissions under relatively low-dust conditions (i.e., sampling in the stack or duct after all pollution control devices), from coal-fired steam generators. Individual sample collection times can range from 30 minutes to several days in duration, depending on the Hg concentration in the stack. The monitoring system must achieve the performance criteria specified in D.8 and the sorbent media capture ability must not be exceeded. The sampling rate must be maintained at a constant proportion to the total stack flow rate to ensure that a representative sample is collected. Failure to achieve certain performance criteria will result in invalid Hg emissions monitoring data.

## D.2 Principle

Known volumes of flue gas are continuously extracted from a stack or duct through paired, in-stack, pre-spiked sorbent media traps at an appropriate nominal flow rate. Collection of Hg on the sorbent media in the stack mitigates potential loss of Hg during transport through a probe/sample line. Paired train sampling is required to determine measurement precision and verify acceptability of the measured emissions data. The sorbent traps are recovered from the sampling system, prepared for analysis, as needed, and analyzed by any suitable determinative technique that can meet the performance criteria. For quality-assurance purposes, a section of each sorbent trap is spiked with Hg<sup>0</sup> prior to sampling. This section is analyzed separately and a specified percentage of the spike must be recovered.

## D.3 Clean Handling and Contamination

To avoid Hg contamination of the samples, special attention must be paid to cleanliness during transport, field handling, sampling, recovery, and laboratory analysis, as well as during preparation of the sorbent cartridges. Collection and analysis of blank samples (field, trip, lab) is useful in verifying the absence of contaminant Hg.

## D.4 Safety

### D.4.1 Site Hazards

Site hazards must be thoroughly considered in advance of applying these procedures/specifications in the field; advance coordination with the site is critical to understand the conditions and applicable safety policies. At a minimum, portions of the sampling system will be hot, requiring appropriate gloves, long sleeves, and caution in handling this equipment.

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#### D.4.2 Laboratory safety policies

Laboratory safety policies should be in place to minimize risk of chemical exposure and to properly handle waste disposal. Personnel shall wear appropriate laboratory attire according to a Chemical Hygiene Plan established by the laboratory.

#### D.4.3 Toxicity or Carcinogenicity

The toxicity or carcinogenicity of any reagents used must be considered. Depending upon the sampling and analytical technologies selected, this measurement may involve hazardous materials, operations, and equipment and D.4 does not address all of the safety problems associated with implementing this approach. It is the responsibility of the user to establish appropriate safety and health practices and determine the applicable regulatory limitations prior to performance. Any chemical should be regarded as a potential health hazard and exposure to these compounds should be minimized. Users should refer to the Material Safety Data Sheet (MSDS) for each chemical used.

#### D.5 Equipment and Supplies

The following list is presented as an example of key equipment and supplies likely required to perform Hg monitoring using a sorbent trap monitoring system. It is recognized that additional equipment and supplies may be needed. Collection of paired samples is required. A certified stack gas volumetric flow monitor is required to ensure that the sample flow rate is maintained proportional to the stack gas flow rate and to demonstrate compliance with the total annual mercury emission limit of 310 CMR 7.29(5)(a)3.c.i. or 310 CMR 7.02(3)(o). Also to demonstrate compliance with the total annual mercury emission limit of 310 CMR 7.29(5)(a)3.c.i. or 310 CMR 7.02(3)(o), the moisture content of the stack gas must be determined (see D.7.2.4). To demonstrate compliance with the removal efficiency standards of 310 CMR 7.29(5)(a)3.e.i. and f.i. using Equation D.12.B, a method of quantifying unit heat input is required. One acceptable way of measuring heat input is to use data from a certified diluent gas (CO<sub>2</sub> or O<sub>2</sub>) monitor together with data from the flow monitor, moisture data (if needed), and an appropriate F-factor.

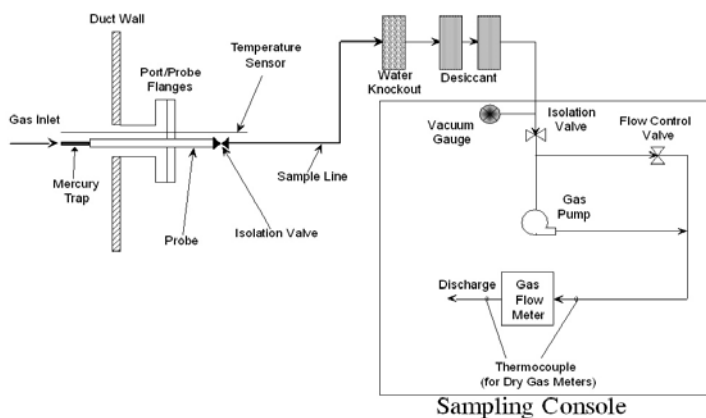


Figure 2. Typical Sorbent Trap Monitoring System

### D.5.1 Sorbent Trap Monitoring System

A typical sorbent trap monitoring system is shown in Figure 2. The monitoring system shall include the following components:

#### D.5.1.1 Sorbent Traps

The sorbent media used to collect Hg must be configured in a trap with three distinct and identical segments or sections, connected in series, that are amenable to separate analyses. Section 1 is designated for primary capture of gaseous Hg. Section 2 is designated as a backup section for determination of vapor-phase Hg breakthrough. Section 3 is designated for QA/QC purposes where this section shall be spiked with an known amount of gaseous Hg<sup>0</sup> prior to sampling and later analyzed to determine recovery efficiency. The sorbent media may be any collection material (e.g., carbon, chemically-treated filter, etc.) capable of quantitatively capturing and recovering for subsequent analysis, all gaseous forms of Hg for the intended application. Selection of the sorbent media shall be based on the material's ability to achieve the performance criteria contained in D.8 as well as the sorbent's vapor phase Hg capture efficiency for the emissions matrix and the expected sampling duration at the test site. The sorbent media must be obtained from a source that can demonstrate the quality assurance and control necessary to ensure consistent reliability. The paired sorbent traps are supported on a probe (or probes) and inserted directly into the flue gas stream.

#### D.5.1.2 Sampling Probe Assembly

Each probe assembly shall have a leak-free attachment to the sorbent trap(s). Each sorbent trap must be mounted at the entrance of or within the probe such that the gas sampled enters the trap directly. Each probe/sorbent trap assembly must be heated to a temperature sufficient to prevent liquid condensation in the sorbent trap(s). Auxiliary heating is required only where the stack temperature is too low to prevent condensation. Use a calibrated thermocouple to monitor the stack temperature. A single probe capable of operating the paired sorbent traps may be used. Alternatively, individual probe/sorbent trap assemblies may be used, provided that the individual sorbent traps are co-located to ensure representative Hg monitoring and are sufficiently separated to prevent aerodynamic interference.

#### D.5.1.3 Moisture Removal Device

A robust moisture removal device or system, suitable for continuous duty (such as a Peltier cooler), shall be used to remove water vapor from the gas stream prior to entering the gas flow meter.

#### D.5.1.4 Vacuum Pump

Use a leak-tight vacuum pump capable of operating within the system's flow range.

#### D.5.1.5 Gas Flow Meter

A gas flow meter (such as a dry gas meter, thermal mass flow meter, or other suitable measurement device) shall be used to determine the total sample volume on a dry basis, in units of standard cubic meters. The meter must be sufficiently accurate to measure the total sample volume to within 2 percent and must be calibrated at selected flow rates across the range of sample flow rates at which the sorbent trap monitoring system typically operates. The gas flow meter shall be equipped with any necessary auxiliary measurement devices (e.g., temperature sensors, pressure measurement devices) needed to correct the sample volume to standard conditions.

#### D.5.1.6 Sample Flow Rate Meter and Controller

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Use a flow rate indicator and controller for maintaining necessary sampling flow rates.

#### D.5.1.7 Temperature Sensor

Same as section 6.1.1.7 of Method 5 in appendix A-3 to 40 CFR Part 60.

#### D.5.1.8 Barometer

Same as section 6.1.2 of Method 5 in appendix A-3 to 40 CFR Part 60.

#### D.5.1.9 Data Logger (Optional)

Device for recording associated and necessary ancillary information (e.g., temperatures, pressures, flow, time, etc.).

#### D.5.2 Gaseous Hg<sup>0</sup> Sorbent Trap Spiking System

A known mass of gaseous Hg<sup>0</sup> must be spiked onto section 3 of each sorbent trap prior to sampling. Any approach capable of quantitatively delivering known masses of Hg<sup>0</sup> onto sorbent traps is acceptable. Several technologies or devices are available to meet this objective. Their practicality is a function of Hg mass spike levels. For low levels, gas generators or tanks that are certified by the National Institute of Standards and Technology (NIST) or traceable to NIST may be suitable, if such materials are commercially available, but will likely require long preparation times.

A more practical, alternative system, capable of delivering almost any mass required, makes use of NIST-certified or NIST-traceable Hg salt solutions (e.g., Hg(NO<sub>3</sub>)<sub>2</sub>). With this system, an aliquot of known volume and concentration is added to a reaction vessel containing a reducing agent (e.g., stannous chloride); the Hg salt solution is reduced to Hg<sup>0</sup> and purged onto section 3 of the sorbent trap using an impinger sparging system.

#### D.5.3 Sample Analysis Equipment

Any analytical system capable of quantitatively recovering and quantifying total Hg from sorbent media is acceptable provided that the analysis can meet the performance criteria in Table D.1 in D.8. Candidate recovery techniques include leaching, digestion, and thermal desorption. Candidate analytical techniques include ultraviolet atomic fluorescence (UV AF); ultraviolet atomic absorption (UV AA), with and without gold trapping; and in situ X-ray fluorescence (XRF) analysis.

#### D.6 Reagents and Standards

Only NIST-certified or NIST-traceable calibration gas standards and reagents shall be used for the tests and procedures required under D. (see D.9.1).

#### D.7 Sample Collection and Transport

##### D.7.1 Pre-Test Procedures

##### D.7.1.1 Installation and Measurement Location

##### D.7.1.1.1 Sorbent Trap Monitoring System.

Select a monitoring location that is representative of the Hg emissions from the source, where the sorbent trap monitoring system is likely to pass the relative accuracy test audit (RATA) e.g., a location that: (a) conforms to the guidelines in section 8.1.1 of Performance Specification 2 in appendix B to 40 CFR Part 60; and/or (b) is shown to be free of stratification or minimally stratified through measurement traverses for Hg or other gases such as SO<sub>2</sub> and

NO<sub>x</sub>. If the monitoring system is unable to pass the RATA and the measurement location is determined to be the cause, relocate the probe.

#### D.7.1.1.2 Auxiliary Monitors

For auxiliary monitors that are needed for flow-proportional sampling or to convert Hg concentrations to the desired units of measure (i.e., flow monitors, CO<sub>2</sub> or O<sub>2</sub> monitors, and/or moisture monitors, as applicable), follow the installation and measurement location guidelines in section 1 of appendix A to 40 CFR Part 75.

#### D.7.1.2 Estimate of Hg Concentration in the Flue Gas

An estimate of the expected stack Hg concentration is required to establish a target sample flow rate, total gas sample volume, and the mass of Hg<sup>0</sup> to be spiked onto section 3 of each sorbent trap.

#### D.7.1.3 Pre-sampling Spiking of Sorbent Traps

Based on the estimated Hg concentration in the stack, the target sample rate and the target sampling duration, calculate the expected mass loading for section 1 of each sorbent trap (for an example calculation, see D.11.1). The pre-sampling spike to be added to section 3 of each sorbent trap shall be within ± 50 percent of the expected section 1 mass loading. Spike section 3 of each sorbent trap at this level, as described in D.5.2. For each sorbent trap, keep an official record of the mass of Hg<sup>0</sup> added to section 3. This record shall include, at a minimum, the ID number of the trap, the date and time of the spike, the name of the analyst performing the procedure, the mass of Hg<sup>0</sup> added to section 3 of the trap (µg), and the supporting calculations. This record shall be maintained in a format suitable for inspection and audit and shall be made available to the Department upon request.

#### D.7.1.4 Pre-test Leak Check

Perform a leak check with the sorbent traps in place. Draw a vacuum in each sample train. Adjust the vacuum in the sample train to ~15" Hg. Using the gas flow meter, determine leak rate. The leakage rate must not exceed 4 percent of the target sampling rate. Once the leak check passes this criterion, carefully release the vacuum in the sample train then seal the sorbent trap inlet until the probe is ready for insertion into the stack or duct.

#### D.7.1.5 Determination of Flue Gas Characteristics

Determine or measure the flue gas measurement environment characteristics (gas temperature, static pressure, gas velocity, stack moisture, etc.) in order to determine ancillary requirements such as probe heating requirements (if any), initial sample rate, proportional sampling conditions, moisture management, etc.

#### D.7.2 Sample Collection

D.7.2.1 Remove the plug from the end of each sorbent trap and store each plug in a clean sorbent trap storage container. Remove the stack or duct port cap and insert the probe(s). Secure the probe(s) and ensure that no leakage occurs between the port and the environment.

D.7.2.2 Record initial data including the sorbent trap ID, start time, starting gas flow meter readings, initial temperatures, set points, and any other appropriate information.

#### D.7.2.3 Flow Rate Control

Set the initial sample flow rate at the target value from D.7.1.2. Record the initial gas flow meter reading, stack temperature (if needed to convert to standard conditions), meter temperatures (if needed), etc. Then, for every

operating hour during the sampling period, record the date and time, the sample flow rate, the gas flow meter reading, the stack temperature (if needed), the flow meter temperatures (if needed), temperatures of heated equipment such as the vacuum lines and the probes (if heated), and the sampling system vacuum readings. Also, record the stack gas flow rate, as measured by the certified flow monitor, and the ratio of the stack gas flow rate to the sample flow rate. Adjust the sampling flow rate to maintain proportional sampling, i.e., keep the ratio of the stack gas flow rate to sample flow rate within  $\pm 25$  percent of the reference ratio from the first hour of the data collection period (see D.11.2). The sample flow rate through a sorbent trap monitoring system during any hour (or portion of an hour) in which the unit is not operating shall be zero.

#### D.7.2.4 Stack Gas Moisture Determination

If data from the sorbent trap monitoring system will be used to calculate Hg mass emissions, determine the stack gas moisture content using a continuous moisture monitoring system that is certified according to 40 CFR Part 75. Alternatively, use the appropriate fuel-specific moisture default value provided in 40 CFR 75.11(b).

#### D.7.2.5 Essential Operating Data

Obtain and record any essential operating data for the unit during the test period, e.g., the barometric pressure for correcting the sample volume measured by a dry gas meter to standard conditions. At the end of the data collection period, record the final gas flow meter reading and the final values of all other essential parameters.

#### D.7.2.6 Post Test Leak Check

When sampling is completed, turn off the sample pump, remove the probe/sorbent trap from the port and carefully re-plug the end of each sorbent trap. Perform a leak check with the sorbent traps in place, at the maximum vacuum reached during the sampling period. Use the same general approach described in D.7.1.4. Record the leakage rate and vacuum. The leakage rate must not exceed 4 percent of the average sampling rate for the data collection period. Following the leak check, carefully release the vacuum in the sample train.

#### D.7.2.7 Sample Recovery

Recover each sampled sorbent trap by removing it from the probe, sealing both ends. Wipe any deposited material from the outside of the sorbent trap. Place the sorbent trap into an appropriate sample storage container and store/preserve in an appropriate manner.

#### D.7.2.8 Sample Preservation, Storage, and Transport

While the performance criteria of this approach provide for verification of appropriate sample handling, it is still important that the user consider, determine, and plan for suitable sample preservation, storage, transport, and holding times for these measurements. Therefore, procedures in ASTM D6911-03 "Standard Guide for Packaging and Shipping Environmental Samples for Laboratory Analysis" shall be followed for all samples.

#### D.7.2.9 Sample Custody

Proper procedures and documentation for sample chain of custody are critical to ensuring data integrity. The chain of custody procedures in ASTM D4840-99 (reapproved 2004) "Standard Guide for Sample Chain-of-Custody Procedures" shall be followed for all samples (including field samples and blanks).

### D.8 Quality Assurance and Quality Control (QA/QC)

Table D.1 summarizes the QA/QC performance criteria that are used to validate the Hg emissions data from sorbent

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trap monitoring systems. Failure to achieve these performance criteria will result in invalidation of Hg emissions data, except where otherwise noted. D.8.1 provides specific instructions pertaining to the relative accuracy test audit (RATA) requirements for sorbent trap monitoring systems. D.8.2 provides general QA/QC instructions for auxiliary monitoring systems that are needed to convert Hg concentration data from a sorbent trap system to various units of measure. D.8.3 describes the QA/QC program that must be developed and implemented for the monitoring systems.

**Table D.1: QA/QC Criteria For Sorbent Trap Monitoring Systems**

<b>QA/QC Test or Specification</b>	<b>Acceptance Criteria</b>	<b>Frequency</b>	<b>Consequences if Not Met</b>
Pre-test leak check	≤ 4% of target sampling rate	Prior to sampling	Sampling shall not commence until the leak check is passed
Post-test leak check	≤ 4% of average sampling rate	After sampling	Invalidate the data from the paired traps or, if certain conditions are met, report adjusted data from a single trap (see D.11.7.1.3)
Ratio of stack gas flow rate to sample flow rate	No more than 5% of the hourly ratios or 5 hourly ratios (whichever is less restrictive) may deviate from the reference ratio by more than ± 25%.	Every hour throughout data collection period	Invalidate the data from the paired traps or, if certain conditions are met, report adjusted data from a single trap (see D.11.7.1.3)
Sorbent trap section 2 breakthrough	≤ 5% of section 1 Hg mass	Every sample	Invalidate the data from the paired traps or, if certain conditions are met, report adjusted data from a single trap (see D.11.7.1.3)
Paired sorbent trap agreement	≤ 10% Relative Deviation (RD) if the average concentration is > 1.0 micrograms per cubic meter (µg/m <sup>3</sup> ) ≤ 20% RD if the average concentration is ≤ 1.0 µg/m <sup>3</sup> .  Results also acceptable if absolute difference between concentrations from paired traps is < 0.03 µg/m <sup>3</sup>	Every sample	Either invalidate the data from the paired traps or, if certain conditions are met, report the results from the trap with the higher Hg concentration (see D.11.7.1.3)
Spike Recovery Study	Average recovery between 85% and 115% for each of the 3 spike concentration levels.	Prior to analyzing field samples and prior to use of new sorbent media.	Field samples shall not be analyzed until the percent recovery criterion has been met.
Multipoint analyzer calibration	Each analyzer reading within ± 10% of true value and r <sup>2</sup> ≥ 0.99.	On the day of analysis, before analyzing any samples.	Recalibrate until successful.
Analysis of independent calibration standard	Within ± 10% of true value	Following daily calibration, prior to analyzing field samples	Recalibrate and repeat independent standard analysis until successful.
Spike recovery from section 3 of sorbent trap	75-125% of spike amount	Every sample	Invalidate the data from the paired traps or, if certain conditions are met, report adjusted data from a single trap (see D.11.7.1.3)
RATA	RA ≤ 20.0% or Mean difference ≤ 1.0 µg/scm, when the mean RM value is < 5.0 µg/scm	For initial certification and annually thereafter.	Data from the system are invalidated until a RATA is passed.
Gas flow meter calibration	Calibration factor (Y) within ± 5% of average value from the most recent 3-point calibration.	At three settings prior to initial use and at least quarterly at one setting thereafter. For mass flow meters, initial calibration with stack gas is required.	Recalibrate the meter at three orifice settings to determine a new value of Y.
Temperature sensor calibration	Absolute temperature measured by sensor within ± 1.5% of a reference sensor.	Prior to initial use and at least quarterly thereafter.	Recalibrate. Sensor may not be used until specification is met.
Barometer calibration	Absolute pressure measured by instrument within ± 10 mm Hg of reading with a Hg barometer.	Prior to initial use and at least quarterly thereafter.	Recalibrate. Instrument may not be used until specification is met.

**D.8.1 Sorbent Trap System RATAs**

For the initial certification of a sorbent trap monitoring system, a RATA is required. For on-going QA purposes, the ~~2-27-09~~

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RATA must be repeated annually. “Annually” means once every four QA operating quarters. A “QA operating quarter” is a calendar quarter with at least 168 unit or stack operating hours (see 40 CFR 72.2). The RATA grace period provisions in section 2.3.3 of appendix B to 40 CFR Part 75 apply to the sorbent trap monitoring system. Perform each RATA according to the general procedures for gas monitoring system RATAs described in sections 6.5 through 6.5.8 of appendix A to 40 CFR Part 75, supplemented by the special instructions in D.8.1.1 through D.8.1.4.

#### D.8.1.1 Reference Methods

Acceptable Hg reference methods for the RATA of a sorbent trap system include ASTM D6784-02(2008) (the Ontario Hydro Method), Method 30A in appendix A-8 to 40 CFR Part 60, and Method 30B in appendix A-8 to 40 CFR Part 60.

D.8.1.1.1 When Method 30A is used, calibration standards not traceable to NIST may be used until the later of: (1) the date on which traceability protocols cited in C.3.5 and C.3.6 are published; or (2) January 1, 2010. The time per run must be long enough to collect a sufficient mass of Hg to analyze on the sorbent trap monitoring system sorbent traps, but no less than 21 minutes if Method 30A is used.

D.8.1.1.2 When Method 30B is used, the sorbent material used in the reference method traps does not have to be the same type of sorbent that is used in the sorbent trap monitoring system. The size of both the sorbent trap monitoring system and 30B reference method traps used for the RATA may be smaller than the traps used for daily operation of the system. For both the sorbent trap monitoring system and 30B reference method, install a new pair of sorbent traps prior to each test run. The time per run must be long enough to collect a sufficient mass of Hg to analyze on both the sorbent trap monitoring system and 30B reference method traps.

D.8.1.1.3 When ASTM D6784-02(2008) is used, paired sampling trains are required. The time per run must be long enough to collect a sufficient mass of Hg to analyze on both the sorbent trap monitoring system traps and the ASTM D6784-02(2008) sampling trains. To validate an ASTM D6784-02(2008) test run, the relative deviation (RD), calculated using Equation D.6 in D.11.6, must not exceed 10 percent, when the average concentration is greater than 1.0 µg/dscm. If the average concentration is ≤ 1.0 µg/dscm, the RD must not exceed 20 percent. When using Equation D.6 in D.11.6 for paired ASTM D6784-02(2008) samples, “RD” is the relative deviation between samples “a” and “b,” and “C<sub>a</sub>” and “C<sub>b</sub>” are the Hg concentrations of samples “a” and “b.” The RD results are also acceptable if the absolute difference between the Hg concentrations measured by the paired trains does not exceed 0.03 µg/dscm. If the RD criterion is met, the run is valid. For each valid run, average the total Hg (vapor phase plus particulate-bound) concentrations measured by the two trains, for use in calculating RA and BAF as specified in D.8.1.3 and D.8.1.4.

#### D.8.1.2 Special Considerations

The RATA must be done at normal load (as defined in section 6.5.2.1 of appendix A to 40 CFR Part 75), while combusting solid fossil fuel or ash. Locate the reference method (RM) sampling points according to section 6.5.6(b) in appendix A to 40 CFR Part 75. If stratification testing is deemed necessary to justify using fewer RM sample points or alternative RM point locations, follow the applicable procedures in sections 8.1.3 through 8.1.3.5 of Method 30A in appendix A-8 to 40 CFR Part 60. A minimum of 9 valid runs are required for each RATA, directly comparing the sorbent trap monitoring system measurements to the reference method. If more than 9 runs are performed, a maximum of three runs may be discarded. Complete the RATA within 168 unit operating hours, except when ASTM D6784-02(2008) is used, in which case up to 336 operating hours may be taken to finish the test. Install a new pair of sorbent traps in the sorbent trap monitoring system prior to each test run. The type of sorbent material used by the sorbent trap monitoring system during the RATA must be the same as for daily operation of the sorbent trap monitoring system. The size of the sorbent traps used in the sorbent trap monitoring system for the RATA may be smaller than the traps used for daily operation of the sorbent trap monitoring system.

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Spike the third section of each sorbent trap in the sorbent trap monitoring system with elemental Hg, as described in D.7.1.3. For each run, the sorbent trap data for the sorbent trap monitoring system shall be validated according to the quality assurance criteria in Table D.1.

#### D.8.1.3 Calculation of Relative Accuracy

Calculate the relative accuracy (RA) of the monitoring system, on a  $\mu\text{g}/\text{scm}$  basis, according to section 7.3 in appendix A to 40 CFR Part 75. For a unit that qualifies as a low emitter of Hg (i.e., the mean reference method (RM) concentration during the RATA is  $< 5 \mu\text{g}/\text{scm}$ ), if the calculated RA exceeds 20.0%, the results of the RATA are still acceptable if the absolute difference between the mean RM and monitoring system concentrations does not exceed  $1.0 \mu\text{g}/\text{scm}$ . All comparisons of RM and monitoring system data must be made on a consistent moisture basis (dry or wet).

#### D.8.1.4 Bias Adjustment

##### D.8.1.4.1 Sorbent Trap Monitoring System

To ensure that Hg concentration is not under-reported, the bias test described in section 7.6.4 of appendix A to 40 CFR Part 75 shall be performed each time that a RATA of the sorbent trap monitoring system is done. If the bias test is failed, a bias adjustment factor (BAF) must be calculated in accordance with section 7.6.5(a) of appendix A to 40 CFR Part 75, and applied to the hourly data from the sorbent trap monitoring system, beginning with the hour after the RATA is completed. For low emitting sources (mean RM concentration during the RATA  $< 5 \mu\text{g}/\text{scm}$ ), if the calculated BAF exceeds 1.250, a BAF of 1.250 may be used for reporting purposes.

##### D.8.1.4.2 Auxiliary Monitoring Systems

For a flow monitor that is certified and quality-assured according to 40 CFR Part 75, bias adjustment is mandatory, in accordance with sections 7.6.4 and 7.6.5 of appendix A to 40 CFR Part 75. Bias adjustment is not required for diluent gas monitors or moisture monitoring systems.

#### D.8.2 Certification and QA of Auxiliary and Backup Monitors

##### D.8.2.1 Auxiliary Monitoring Systems

Auxiliary monitoring systems that are used to measure stack gas volumetric flow rate and/or diluent gas concentration and/or moisture must be certified. Periodic QA testing of these monitoring systems is also required. The certification test procedures and performance specifications for these systems are found in 40 CFR 75.20(c), and in sections 3 and 6 of appendix A to 40 CFR Part 75. The QA test requirements, acceptance criteria, and data validation provisions are found in appendix B to 40 CFR Part 75.

##### D.8.2.2 Backup Monitoring Systems and Analyzers

If any redundant backup monitoring systems, non-redundant backup monitoring systems, or temporary like-kind replacement analyzers are used, these monitoring systems and analyzers shall be installed, certified, maintained, operated, and quality-assured according to the applicable provisions in C.8.1.3.

#### D.8.3 QA/QC Program for Sorbent Trap & Auxiliary Monitoring Systems

A quality assurance/quality control (QA/QC) program shall be developed and implemented for the sorbent trap monitoring system and (if applicable) for the auxiliary monitoring systems used to convert Hg concentration data from the sorbent trap system to the appropriate units of measure. At a minimum, include in the QA/QC program a

written plan that describes in detail (or that refers to separate documents containing) complete, step-by-step procedures and operations for the following activities. Electronic storage of the QA/QC plan is permissible, provided that the information can be made available in hard copy to auditors and inspectors.

#### D.8.3.1 Requirements for All Monitoring Systems

##### D.8.3.1.1 Preventive Maintenance

Keep a written record of procedures needed to maintain the monitoring system in proper operating condition and a schedule for those procedures. This shall, at a minimum, include procedures specified by the manufacturers of the equipment and, if applicable, additional or alternate procedures developed for the equipment.

##### D.8.3.1.2 Record Keeping and Reporting

Keep a written record describing procedures that will be used to implement the recordkeeping and reporting requirements of 310 CMR 7.29 and 310 CMR 7.02(3)(o).

##### D.8.3.1.3 Maintenance Records

Keep a record of all testing, maintenance, or repair activities performed on any sorbent trap and any auxiliary monitoring systems (if used) in a location and format suitable for inspection. A maintenance log may be used for this purpose. The following records shall be maintained: date, time, and description of any testing, adjustment, repair, replacement, or preventive maintenance action performed and records of any corrective actions associated with a monitor outage period. Additionally, any adjustment that recharacterizes a system's ability to record and report emissions data must be recorded (e.g., changing of flow monitor or moisture monitoring system polynomial coefficients, K factors or mathematical algorithms, changing of temperature and pressure coefficients and dilution ratio settings), and a written explanation of the procedures used to make the adjustment(s) shall be kept.

#### D.8.3.2 Specific Requirements for Sorbent Trap Monitoring Systems

##### D.8.3.2.1 Sorbent Trap Identification and Tracking

Include procedures for inscribing or otherwise permanently marking a unique identification number on each sorbent trap, for tracking purposes. Keep records of the ID of the monitoring system in which each sorbent trap is used, and the dates and hours of each Hg collection period.

##### D.8.3.2.2 Monitoring System Integrity and Data Quality

Explain the procedures used to perform the leak checks when a sorbent trap is placed in service and removed from service. Also explain the other QA procedures used to ensure system integrity and data quality, including, but not limited to, gas flow meter calibrations, verification of moisture removal, and ensuring air-tight pump operation. In addition, the QA plan must include the data acceptance and quality control criteria in D.8. All reference meters used to calibrate the gas flow meters (e.g., wet test meters) shall be periodically recalibrated. Annual, or more frequent, recalibration is recommended. If a NIST-traceable calibration device is used as a reference flow meter, the QA plan must include a section for on-going maintenance and periodic recalibration to maintain the accuracy and NIST-traceability of the calibrator.

##### D.8.3.2.3 Hg Analysis

Explain the chain of custody employed in packing, transporting, and analyzing the sorbent traps (see D.7.2.8 and D.7.2.9). Keep records of all Hg analyses. The analyses shall be performed in accordance with the procedures

described in D.10.

#### D.8.3.2.4 Laboratory Certification

It is recommended that any laboratory performing analyses of carbon sorbent traps be certified by the International Organization for Standardization (ISO) to have a proficiency that meets the requirements of ISO 17025. However, if the laboratory performs the spike recovery study described in D.10.3 and repeats that procedure annually, ISO certification is not necessary.

#### D.8.3.2.5 Data Collection Period

State, and provide the rationale for, the minimum acceptable data collection period (e.g., one day, one week, etc.) for the size of sorbent trap selected for the monitoring. Include in the discussion such factors as the Hg concentration in the stack gas, the capacity of the sorbent trap, and the minimum mass of Hg required for the analysis.

#### D.8.3.2.6 Relative Accuracy Test Audit Procedures

Keep records of the procedures and details peculiar to the sorbent trap monitoring systems that are to be followed for relative accuracy test audits, such as trap size, reference methods used, sampling and analysis methods used, etc.

#### D.8.3.3 Specific Requirements for Auxiliary Monitoring Systems

##### D.8.3.3.1 Daily Calibrations and Linearity Checks

Keep a written record of the procedures used for daily calibrations of all auxiliary monitoring systems. If a CO<sub>2</sub> or O<sub>2</sub> monitor is used, also keep records of the procedures used to perform linearity checks. Explain how the test results are calculated and evaluated.

##### D.8.3.3.2 Monitoring System Adjustments

Explain how each component of the continuous emission monitoring system will be adjusted to provide correct responses to calibration gases or reference signals after routine maintenance, repairs, or corrective actions.

##### D.8.3.3.3 Relative Accuracy Test Audits

Keep a written record of procedures used for RATAs of the monitoring systems. Indicate the reference methods used and explain how the test results are calculated and evaluated.

##### D.8.3.3.4 Verification of Emission Controls Performance

For units and common stack configurations that have flue gas desulfurization (FGD) systems or add-on Hg emission controls, if parametric data are used to verify proper control device operation during missing data periods (see D.11.8.5), the QA plan shall identify the parameters that are monitored and the acceptable range of values for each parameter. If data from a certified SO<sub>2</sub> CEMS are used to verify proper FGD operation, the SO<sub>2</sub> monitoring system must be included in the QA plan.

#### D.8.4 Recertification

Whenever a replacement, modification, or change in a certified sorbent trap monitoring system or auxiliary monitoring system is made that may significantly affect the ability of the system to accurately measure or record the

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Hg concentration, stack gas volumetric flow rate, CO<sub>2</sub> concentration, O<sub>2</sub> concentration, or percent moisture, the monitoring system shall be recertified. Furthermore, whenever a replacement, modification, or change to the flue gas handling system or the unit operation is made that may significantly change the flow or concentration profile, the monitoring system shall be recertified. The same tests performed for the initial certification of the monitoring system shall be repeated for recertification, unless otherwise specified in the applicable regulation. The conditional data validation provisions in 40 CFR 75.20(b)(3) may be used for recertification events. Examples of changes that require recertification include: (a) replacement of a gas analyzer; (b) change in the type of sorbent material used in the sorbent traps; and (c) change in location or orientation of the sampling probe.

#### D.9 Calibration and Standardization

D.9.1 Only NIST-certified or NIST-traceable calibration standards (i.e., calibration gases, solutions, etc.) shall be used for the spiking and analytical procedures in D. NIST-traceable Hg salt solutions suitable for spiking the third section of the sorbent traps are commercially available. Cylinder gases or generators used for section 3 spiking must meet the requirements of the traceability protocol cited in C.3.5.

#### D.9.2 Gas Flow Meter Calibration

##### D.9.2.1 Preliminaries

The manufacturer or supplier of the gas flow meter should perform all necessary set-up, testing, programming, etc., and should provide the end user with any necessary instructions, to ensure that the meter will give an accurate readout of dry gas volume in standard cubic meters for the particular field application.

##### D.9.2.2 Initial Calibration

Prior to its initial use, a calibration of the flow meter shall be performed. The initial calibration may be done by the manufacturer, by the equipment supplier, or by the end user. If the flow meter is volumetric in nature (e.g., a dry gas meter), the manufacturer, equipment supplier, or end user may perform a direct volumetric calibration using any gas. For a mass flow meter, the manufacturer, equipment supplier, or end user may calibrate the meter using a bottled gas mixture containing  $12 \pm 0.5\%$  CO<sub>2</sub>,  $7 \pm 0.5\%$  O<sub>2</sub>, and balance N<sub>2</sub>, or these same gases in proportions more representative of the expected stack gas composition. Mass flow meters may also be initially calibrated on-site, using actual stack gas.

##### D.9.2.2.1 Initial Calibration Procedures

Determine an average calibration factor (Y) for the gas flow meter, by calibrating it at three sample flow rate settings covering the range of sample flow rates at which the sorbent trap monitoring system typically operates. Either the procedures in section 10.3.1 of Method 5 in appendix A-3 to 40 CFR Part 60 or the procedures in section 16 of Method 5 in appendix A-3 to 40 CFR Part 60 may be followed. If a dry gas meter is being calibrated, use at least five revolutions of the meter at each flow rate.

##### D.9.2.2.2 Alternative Initial Calibration Procedures

Alternatively, the initial calibration of the gas flow meter may be performed using a reference gas flow meter (RGFM). The RGFM may either be: (a) A wet test meter calibrated according to section 10.3.1 of Method 5 in appendix A-3 to 40 CFR Part 60; (b) a gas flow metering device calibrated at multiple flow rates using the procedures in section 16 of Method 5 in appendix A-3 to 40 CFR Part 60; or (c) a NIST-traceable calibration device capable of measuring volumetric flow to an accuracy of 1 percent. To calibrate the gas flow meter using the RGFM, proceed as follows: While the sorbent trap monitoring system is sampling the actual stack gas or a compressed gas mixture that simulates the stack gas composition (as applicable), connect the RGFM to the discharge of the system.

Care must be taken to minimize the dead volume between the sample flow meter being tested and the RGFM. Concurrently measure dry gas volume with the RGFM and the flow meter being calibrated for a minimum of 10 minutes at each of three flow rates covering the typical range of operation of the sorbent trap monitoring system. For each 10-minute (or longer) data collection period, record the total sample volume, in units of dry standard cubic meters (dscm), measured by the RGFM and the gas flow meter being tested.

#### D.9.2.2.3 Initial Calibration Factor

Calculate an individual calibration factor  $Y_i$  at each tested flow rate from D.9.2.2.1 or D.9.2.2.2 (as applicable), by taking the ratio of the reference sample volume to the sample volume recorded by the gas flow meter. Average the three  $Y_i$  values, to determine  $Y$ , the calibration factor for the flow meter. Each of the three individual values of  $Y_i$  must be within  $\pm 0.02$  of  $Y$ . Except as otherwise provided in D.9.2.2.4 and D.9.2.2.5, use the average  $Y$  value from the three level calibration to adjust all subsequent gas volume measurements made with the gas flow meter.

#### D.9.2.2.4 Initial On-Site Calibration Check

For a mass flow meter that was initially calibrated using a compressed gas mixture, an on-site calibration check shall be performed before using the flow meter to provide data for reporting purposes. While sampling stack gas, check the calibration of the flow meter at one intermediate flow rate typical of normal operation of the monitoring system. Follow the basic procedures in D.9.2.2.1 or D.9.2.2.2. If the onsite calibration check shows that the value of  $Y_i$ , the calibration factor at the tested flow rate, differs by more than 5 percent from the value of  $Y$  obtained in the initial calibration of the meter, repeat the full 3-level calibration of the meter using stack gas to determine a new value of  $Y$ , and apply the new  $Y$  value to all subsequent gas volume measurements made with the gas flow meter.

#### D.9.2.2.5 Ongoing Quality Assurance

Recalibrate the gas flow meter quarterly at one intermediate flow rate setting representative of normal operation of the monitoring system. Follow the basic procedures in D.9.2.2.1 or D.9.2.2.2. If a quarterly recalibration shows that the value of  $Y_i$ , the calibration factor at the tested flow rate, differs from the current value of  $Y$  by more than 5 percent, repeat the full 3-level calibration of the meter to determine a new value of  $Y$ , and apply the new  $Y$  value to all subsequent gas volume measurements made with the gas flow meter.

#### D.9.3 Thermocouples and Other Temperature Sensors

Use the procedures and criteria in section 10.3 of Method 2 in appendix A-1 to 40 CFR Part 60 to calibrate in-stack temperature sensors and thermocouples. Dial thermometers shall be calibrated against NIST-traceable thermometers. Calibrations must be performed prior to initial use and at least quarterly thereafter. At each calibration point, the absolute temperature measured by the temperature sensor must agree to within  $\pm 1.5$  percent of the temperature measured with the reference sensor, otherwise the sensor may not continue to be used.

#### D.9.4 Barometer

Calibrate against a NIST-traceable barometer. Calibration must be performed prior to initial use and at least quarterly thereafter. At each calibration point, the absolute pressure measured by the barometer must agree to within  $\pm 10$  mm Hg of the pressure measured by the NIST-traceable barometer, otherwise the barometer may not continue to be used.

#### D.9.5 Other Sensors and Gauges

Calibrate all other sensors and gauges according to the procedures specified by the instrument manufacturer(s).

#### D.9.6 Analytical System Calibration

See D.10.1.

#### D.10 Analytical Procedures

The analysis of the Hg samples may be conducted using any instrument or technology capable of quantifying total Hg from the sorbent media and meeting the performance criteria in D.8.

##### D.10.1 Analyzer System Calibration

Perform a multipoint calibration of the analyzer at three or more upscale points over the desired quantitative range (multiple calibration ranges shall be calibrated, if necessary). The field samples analyzed must fall within a calibrated, quantitative range and meet the necessary performance criteria. For samples that are suitable for aliquotting, a series of dilutions may be needed to ensure that the samples fall within a calibrated range. However, for sorbent media samples that are consumed during analysis (e.g., thermal desorption techniques), extra care must be taken to ensure that the analytical system is appropriately calibrated prior to sample analysis. The calibration curve range(s) must be determined based on the anticipated level of Hg mass on the sorbent media. Knowledge of estimated stack Hg concentrations and total sample volume may be required prior to analysis. The calibration curve for use with the various analytical techniques (e.g., UV AA, UV AF, and XRF) can be generated by directly introducing standard solutions into the analyzer or by spiking the standards onto the sorbent media and then introducing into the analyzer after preparing the sorbent/standard according to the particular analytical technique. For each calibration curve, the value of the square of the linear correlation coefficient, i.e.,  $r^2$ , must be  $\geq 0.99$ , and the analyzer response must be within  $\pm 10$  percent of reference value at each upscale calibration point. Calibrations must be performed on the day of the analysis, before analyzing any of the samples. Following calibration, an independently prepared standard (not from same calibration stock solution) shall be analyzed. The measured value of the independently prepared standard must be within  $\pm 10$  percent of the expected value.

##### D.10.2 Sample Preparation

Carefully separate the three sections of each sorbent trap. Combine for analysis all materials associated with each section, i.e., any supporting substrate that the sample gas passes through prior to entering a media section (e.g., glass wool, polyurethane foam, etc.) must be analyzed with that segment.

##### D.10.3 Spike Recovery Study

Before analyzing any field samples, the laboratory must demonstrate the ability to recover and quantify Hg from the sorbent media by performing the following spike recovery study for sorbent media traps spiked with elemental Hg. Using the procedures described in D.5.2 and D.11.1, spike the third section of nine sorbent traps with gaseous Hg<sup>0</sup>, i.e., three traps at each of three different mass loadings, representing the range of masses anticipated in the field samples. This will yield a 3 x 3 sample matrix. Prepare and analyze the third section of each spiked trap, using the techniques that will be used to prepare and analyze the field samples. The average recovery for each spike concentration must be between 85 and 115 percent. If multiple types of sorbent media are to be analyzed, a separate spike recovery study is required for each sorbent material. If multiple ranges are calibrated, a separate spike recovery study is required for each range.

##### D.10.4 Field Sample Analyses

Analyze the sorbent trap samples following the same procedures that were used for conducting the spike recovery study. The three sections of each sorbent trap must be analyzed separately (i.e., section 1, then section 2, then section 3). Quantify the total mass of Hg for each section based on analytical system response and the calibration

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curve from D.10.1. Determine the spike recovery from sorbent trap section 3. The spike recovery must be no less than 75 percent and no greater than 125 percent. To report the final Hg mass for each trap, add together the Hg masses collected in trap sections 1 and 2.

#### D.11 Calculations, Data Reduction, and Data Analysis

##### D.11.1 Calculation of Pre-Sampling Spiking Level

Determine sorbent trap section 3 spiking level using estimates of the stack Hg concentration, the target sample flow rate, and the expected sample duration. First, calculate the expected Hg mass that will be collected in section 1 of the trap. The pre-sampling spike must be within ±50 percent of this mass.

Example calculation: For an estimated stack Hg concentration of 5 µg/m<sup>3</sup>, a target sample rate of 0.30 liters per minute (L/min), and a sample duration of 5 days:

$$(0.30 \text{ L/min}) (1440 \text{ minutes/day}) (5 \text{ days}) (10^{-3} \text{ cubic meters/liter}) (5 \mu\text{g/m}^3) = 10.8 \mu\text{g}$$

A pre-sampling spike of 10.8 µg ±50 percent is, therefore, appropriate.

##### D.11.2 Calculations for Flow-Proportional Sampling

For the first hour of the data collection period, determine the reference ratio of the stack gas volumetric flow rate to the sample flow rate, as follows:

$$R_{ref} = \frac{KQ_{ref}}{F_{ref}} \quad \text{(Equation D.1)}$$

Where:

R<sub>ref</sub> = Reference ratio of hourly stack gas flow rate to hourly sample flow rate

Q<sub>ref</sub> = Average stack gas volumetric flow rate for first hour of collection period, increased for bias, if necessary (scfh)

F<sub>ref</sub> = Average sample flow rate for first hour of the collection period, in appropriate units (e.g., liters/minute, cubic centimeters/minute, dscm/minute)

K = Power of ten multiplier, to keep the value of R<sub>ref</sub> between 1 and 100. The appropriate K value will depend on the selected units of measure for the sample flow rate.

Then, for each subsequent hour of the data collection period, calculate ratio of the stack gas flow rate to the sample flow rate using Equation D.2:

$$R_h = \frac{KQ_h}{F_h} \quad \text{(Equation D.2)}$$

Where:

R<sub>h</sub> = Ratio of hourly stack gas flow rate to hourly sample flow rate

Q<sub>h</sub> = Average stack gas volumetric flow rate for the hour, increased for bias, if necessary (scfh)

F<sub>h</sub> = Average sample flow rate for the hour, in appropriate units (e.g., liters/minute, cubic centimeters/minute, dscm/minute)

K = Power of ten multiplier, to keep the value of R<sub>h</sub> between 1 and 100. The appropriate K value will depend on the selected units of measure for the sample flow rate and the range of expected stack gas flow rates.

Maintain the value of  $R_h$  within  $\pm 25$  percent of  $R_{ref}$  throughout the data collection period.

### D.11.3 Calculation of Spike Recovery

Calculate the percent recovery of each section 3 spike, as follows:

$$\%R = \frac{M_3}{M_s} \times 100 \text{ (Equation D.3)}$$

Where:

$\%R$  = Percentage recovery of the pre-sampling spike

$M_3$  = Mass of Hg recovered from section 3 of the sorbent trap, ( $\mu\text{g}$ )

$M_s$  = Calculated Hg mass of the pre-sampling spike, from D.7.1.3, ( $\mu\text{g}$ )

### D.11.4 Calculation of Breakthrough

Calculate the percent breakthrough to the second section of the sorbent trap, as follows:

$$\%B = \frac{M_2}{M_1} \times 100 \text{ (Equation D.4)}$$

Where:

$\%B$  = Percent breakthrough

$M_2$  = Mass of Hg recovered from section 2 of the sorbent trap, ( $\mu\text{g}$ )

$M_1$  = Mass of Hg recovered from section 1 of the sorbent trap, ( $\mu\text{g}$ )

### D.11.5 Calculation of Hg Concentration

Calculate the Hg concentration for each sorbent trap, using the following equation:

$$C = \frac{M^*}{V_t} \text{ (Equation D.5)}$$

Where:

$C$  = Concentration of Hg for the collection period ( $\mu\text{g}/\text{dscm}$ )

$M^*$  = Total mass of Hg recovered from sections 1 and 2 of the sorbent trap, micrograms ( $\mu\text{g}$ )

$V_t$  = Total volume of dry gas metered during the collection period, dry standard cubic meters (dscm).

(Note: For the purposes of 310 CMR 7.00: Appendix D, standard temperature and pressure are defined as 20°C and 760 mm Hg, respectively).

### D.11.6 Calculation of Paired Trap Agreement

Calculate the relative deviation (RD) between the Hg concentrations measured with the paired sorbent traps:

$$RD = \frac{|C_a - C_b|}{C_a + C_b} \times 100 \text{ (Equation D.6)}$$

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Where:

RD = Relative deviation between the Hg concentrations from traps "a" and "b" (percent)

C<sub>a</sub> = Concentration of Hg for the collection period, for sorbent trap "a" (µg/dscm)

C<sub>b</sub> = Concentration of Hg for the collection period, for sorbent trap "b" (µg/dscm)

#### D.11.7 Data Reduction

##### D.11.7.1 Sorbent Trap Monitoring Systems

Typical data collection periods for normal, day-to-day operation of a sorbent trap monitoring system range from about 24 hours to 168 hours. For the required RATAs of the system, smaller sorbent traps are often used, and the data collection time per run is considerably shorter (e.g., 1 hour or less). Generally speaking, the acceptance criteria for the following five QA specifications in Table D.1 must be met to validate a data collection period: (a) the post-test leak check; (b) the ratio of stack gas flow rate to sample flow rate; (c) section 2 breakthrough; (d) paired trap agreement; and (e) section 3 spike recovery.

D.11.7.1.1 When both traps meet the acceptance criteria for all five QA specifications, the two measured Hg concentrations shall be averaged arithmetically and the average value shall be applied to each hour of the data collection period.

D.11.7.1.2 To validate a RATA run, both traps must meet the acceptance criteria for all five QA specifications. However, as discussed in D.11.7.1.3, for normal day-to-day operation of the monitoring system, a data collection period may, in certain instances, be validated based on the results from one trap.

D.11.7.1.3 For the routine, day-to-day operation of the monitoring system, when one of the traps either: (a) fails the post-test leak check; or (b) has excessive section 2 breakthrough; or (c) fails to maintain the proper stack flow-to-sample flow ratio; or (d) fails to achieve the required section 3 spike recovery, provided that the other trap meets the acceptance criteria for all four of these QA specifications, the Hg concentration measured by the valid trap may multiplied by a factor of 1.111 and used for reporting purposes. Further, if both traps meet the acceptance criteria for all four of these QA specifications, but the acceptance (RD) criterion for paired trap agreement is not met, the higher of the two Hg concentrations measured by the traps may be reported, in lieu of invalidating the data from the paired traps.

D.11.7.1.4 Whenever the data from a pair of sorbent traps must be invalidated and no quality-assured data from a certified backup Hg monitoring system or Hg reference method are available to cover the hours in the data collection period, use missing data substitution, according to D.11.8.2.

##### D.11.7.2 Auxiliary Monitoring Systems

Reduce the data from the auxiliary monitoring systems to hourly averages, in accordance with 40 CFR 75.10(d).

#### D.11.8 Calculation of Hg Mass Emissions, Emission Rates and Removal Efficiency

For determining compliance with 310 CMR 7.29(5)(a)3. and 310 CMR 7.02(3)(o), use the calculation methods in D.11.8.1.1 through D.11.8.1.7. To ensure that the methods in D.11.8.1.1 through D.11.8.1.7 are applied correctly, the missing data substitution provisions of D.11.8.2 must be taken into account.

##### D.11.8.1 Hg Mass Emissions

D.11.8.1.1 Calculate the Hg mass emissions for each unit for each hour, using Equation D.7:

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$$M_h = K C_h Q_h t_h (1 - B_{ws}) \quad \text{(Equation D.7)}$$

Where:

$M_h$  = Hg mass emissions for the hour, pounds (lb)

$K$  = Units conversion constant,  $6.236 \times 10^{-11}$ , pound-standard cubic meter per microgram-standard cubic foot (lb-scm/ $\mu$ g-scf)

$C_h$  = Flow-proportional hourly average Hg concentration, dry basis, as measured by paired sorbent traps, increased for bias, if necessary ( $\mu$ g/dscm).  $C_h$  may be the Hg concentration measured by a single trap in some instances (see D.11.7.1).

$Q_h$  = Hourly average stack gas volumetric flow rate, increased for bias, if necessary, standard cubic feet per hour (scfh)

$t_h$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

$B_{ws}$  = Moisture fraction of the stack gas, expressed as a decimal (equal to % H<sub>2</sub>O/100)

When using Equation D.7, calculate the hourly Hg mass emissions on a clock hour basis. For non-operating hours, the Hg mass emissions will, of course, be zero. Use the appropriate substitute data values for  $C_h$  and/or  $Q_h$  and/or  $B_{ws}$  for operating hours in which a quality-assured value of any of these parameters is unavailable.

D.11.8.1.2 Use Equation D.8 to calculate Hg mass emissions over each month and 12-month period for each unit, as required by 310 CMR 7.29(7)(b)1. **or over each year as required by 310 CMR 7.02(3)(o)**, and to demonstrate compliance with 310 CMR 7.29(5)(a)3.c.i. **or 310 CMR 7.02(3)(o)** at facilities with a single solid fossil fuel- or ash-fired unit:

$$M_u = \sum_{h=1}^n M_h \quad \text{(Equation D.8)}$$

Where:

$M_u$  = Hg mass emissions for the unit and time period, i.e., month or 12-month period (lb)

$M_h$  = Hg mass emissions for hour "h" in the specified time period, from Equation D.7 (lb)

$n$  = Number of hours in the month or 12-month period

D.11.8.1.3 For facilities with more than one solid fossil fuel- or ash-fired unit, use Equation D.9 to calculate Hg mass emissions over each month and 12-month period for the facility, as required by 310 CMR 7.29(7)(b)1. **or over each year as required by 310 CMR 7.02(3)(o)**, and to demonstrate **annual** compliance with 310 CMR 7.29(5)(a)3.c.i. **or 310 CMR 7.02(3)(o)**:

$$M_f = \sum_{u=1}^v M_u \quad \text{(Equation D.9)}$$

Where:

$M_f$  = Hg mass emissions for the facility and time period, i.e., month or 12-month period (lb)

$M_u$  = Hg mass emissions for a particular unit "u" and time period, i.e., month or 12-month period (lb)

$v$  = Number of solid fossil fuel- or ash-fired units at the facility

D.11.8.1.4 Use Equation D.10 to calculate the output-based Hg emission rate over each month and 12-month period for each unit, as required by 310 CMR 7.29(7)(b)3., and to demonstrate compliance with 310 CMR 7.29(5)(a)3.e.ii. and f.ii. over each 12-month period, at facilities with a single solid fossil fuel- or ash-fired unit:

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$$E_u = \frac{M_u}{GWh_u} \text{ (Equation D.10)}$$

Where:

$E_u$  = Hg emission rate for the unit and time period, i.e., month or 12-month period, pounds per gigawatt-hour (lb/GWh)

$M_u$  = Hg mass emissions for the unit and time period, i.e., month or 12-month period (lb)

$GWh_u$  = Net electrical output for the unit and time period, i.e., month or 12-month period (GWh)

D.11.8.1.5 For facilities with more than one solid fossil fuel- or ash-fired unit, use Equation D.11 to calculate the output-based Hg emission rate over each month and 12-month period for the facility, as required by 310 CMR 7.29(7)(b)3., and to demonstrate compliance with 310 CMR 7.29(5)(a)3.e.ii. and f.ii. over each 12-month period:

$$E_f = \frac{\sum_{u=1}^v M_u}{\sum_{u=1}^v GWh_u} \text{ (Equation D.11)}$$

Where:

$E_f$  = Hg emission rate for the facility and time period, i.e., month or 12-month period (lb/GWh)

$M_u$  = Hg mass emissions for a particular unit "u" and time period, i.e., month or 12-month period (lb)

$GWh_u$  = Net electrical output for a particular unit "u" and time period, i.e., month or 12-month period (GWh)

v = Number of solid fossil fuel- or ash-fired units at the facility

D.11.8.1.6 When choosing to comply with the removal efficiency standards of 310 CMR 7.29(5)(a)3.e.i. or f.i., use Equation D.12.A or D.12.B to calculate the average total Hg removal efficiency over each month and 12-month period for each unit, as required by 310 CMR 7.29(7)(b)5., and to demonstrate compliance with 310 CMR 7.29(5)(a)3.e.i. and f.i. over each 12-month period at facilities with a single solid fossil fuel- or ash-fired unit:

$$RE_u = \frac{C_u - \frac{\sum_{h=1}^i C_h t_h}{\sum_{h=1}^i t_h}}{C_u} \times 100 \text{ (Equation D.12.A)}$$

Where:

$RE_u$  = Hg removal efficiency for the unit and time period (%)

$C_u$  = Historic total Hg inlet concentration, listed in Table D.2 for each unit, dry basis ( $\mu\text{g}/\text{dscm}$ )

$C_h$  = Flow-proportional hourly average total Hg concentration, dry basis, as measured by paired sorbent traps, increased for bias, if necessary, for each unit ( $\mu\text{g}/\text{dscm}$ ).  $C_h$  may be the Hg concentration measured by a single trap in some instances (see D.11.7.1).

$t_h$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

i = Number of operating hours for the unit in the month or 12-month period

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$$RE_u = \frac{E_u - \sum_{h=1}^i M_h}{E_u} \times 100 \quad \text{(Equation D.12.B)}$$

Where:

$RE_u$  = Hg removal efficiency for the unit and time period (%)

$E_u$  = Historic total Hg inlet emission rate, listed in Table D.2 for each unit, pounds per million British thermal units (lb/mmBtu)

$M_h$  = Hg mass emissions for operating hour “h” in the specified time period, from Equation D.7 (lb)

$HI_h$  = Hourly heat input rate, for operating hour “h” in the specified time period, calculated from measurements of stack gas flow rate, diluent gas concentration, and moisture (if needed), or appropriate substitute data values for these parameters, together with a fuel-specific F-factor and an appropriate equation from section 5.2 of appendix F to 40 CFR Part 75, million British thermal units per hour (mmBtu/hr)

$t_h$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

$i$  = Number of operating hours for the unit in the month or 12-month period

D.11.8.1.7 When choosing to comply with the removal efficiency standards of 310 CMR 7.29(5)(a)3.e.i. or f.i. for a facility with more than one solid fossil fuel- or ash-fired unit, use Equation D.13.A or D.13.B to calculate the average total Hg removal efficiency over each month and 12-month period for each facility, as required by 310 CMR 7.29(7)(b)5., and to demonstrate compliance with 310 CMR 7.29(5)(a)3.e.i. and f.i. over each 12-month period:

$$RE_f = \frac{C_f - \frac{\sum_{h=1, u=1}^{i, v} C_{h,u} t_{h,u}}{\sum_{h=1, u=1}^{i, v} t_{h,u}}}{C_f} \times 100 \quad \text{(Equation D.13.A)}$$

Where:

$RE_f$  = Hg removal efficiency for the facility and time period (%)

$C_f$  = Average historic total Hg inlet concentration for the facility, i.e., average of the unit-level concentration ( $C_u$ ) values listed in Table D.2, dry basis ( $\mu\text{g/dscm}$ )

$C_{h,u}$  = Flow-proportional hourly average total Hg concentration, for operating hour “h” in the specified time period, for a particular unit “u,” as measured by paired sorbent traps, increased for bias, if necessary, dry basis ( $\mu\text{g/dscm}$ ).

$C_h$  may be the Hg concentration measured by a single trap in some instances (see D.11.7.1).

$t_{h,u}$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

$i$  = Number of operating hours for a particular unit “u” in the month or 12-month period

$v$  = Number of solid fossil fuel- or ash-fired units at the facility

or

$$RE_f = \frac{E_f - \sum_{h=1, u=1}^{i, v} \frac{M_{h,u}}{HI_{h,u} t_{h,u}}}{E_f} \times 100 \quad \text{(Equation D.13.B)}$$

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Where:

$RE_f$  = Hg removal efficiency for the facility and time period (%)

$E_f$  = Average historic total Hg inlet emission rate for the facility, i.e., average of the unit-level emission rate ( $E_u$ ) values listed in Table D.2, pounds per million British thermal units (lb/mmBtu)

$M_{h,u}$  = Hg mass emissions for operating hour "h" in the specified time period, for a particular unit "u," from Equation D.7 (lb)

$HI_{h,u}$  = Hourly heat input rate, for operating hour "h" in the specified time period, for a particular unit "u," calculated from measurements of stack gas flow rate, diluent gas concentration, and moisture (if needed), or appropriate substitute data values for these parameters, together with a fuel-specific F-factor and an appropriate equation from section 5.2 of appendix F to 40 CFR Part 75, million British thermal units per hour (mmBtu/hr)

$t_{h,u}$  = Unit or stack operating time, as defined in 40 CFR 72.2, fraction of the hour, expressed as a decimal (e.g., 1.00 for a full operating hour, 0.5 for 30 minutes of operation, 0.00 for a non-operating hour, etc.)

i = Number of operating hours for a particular unit "u" in the month or 12-month period

v = Number of solid fossil fuel- or ash-fired units at the facility

**Table D.2 Historic Total Hg Inlet Concentrations and Emission Rates**

Unit	$C_u$ ( $\mu\text{g/dscm}$ )	$E_u$ (lb/mmBtu)
Brayton Point unit 1	4.35	$3.76 \times 10^{-6}$
Brayton Point unit 2	4.67	$4.34 \times 10^{-6}$
Brayton Point unit 3	4.98	$5.42 \times 10^{-6}$
Salem Harbor unit 1	4.80	$4.97 \times 10^{-6}$
Salem Harbor unit 2	4.66	$4.84 \times 10^{-6}$
Salem Harbor unit 3	4.82	$5.46 \times 10^{-6}$
Mt. Tom	2.29	$3.11 \times 10^{-6}$
NRG Somerset	4.87	$4.20 \times 10^{-6}$

#### D.11.8.2 Missing Data Provisions

Missing data substitution is required whenever a measured value of a parameter needed to calculate the hourly Hg mass emissions or removal efficiency is not available. Use the following procedures to provide substitute data values when essential data from sorbent trap monitoring systems, auxiliary monitoring systems, certified backup monitoring systems or reference methods (as applicable) are unavailable.

##### D.11.8.2.1 Sorbent Trap Monitoring Systems

###### D.11.8.2.1.1 Definition of Missing Data Periods

For a certified sorbent trap monitoring system, a missing data period occurs in the following circumstances, unless quality-assured Hg concentration data from a certified backup Hg monitoring system or Hg reference method are available: (a) whenever a gas sample is not extracted from the stack during unit operation (e.g., during a monitoring system malfunction or when the system undergoes maintenance); and (b) when the results of the Hg analysis for a pair of sorbent traps are missing or invalid, as described in Table D.1. When the analytical results from a pair of sorbent traps are missing or invalid, the missing data period begins with the first hour in which those traps were brought into service and ends at the first hour in which valid Hg concentration data are obtained with another pair of sorbent traps (i.e., the hour at which this pair of traps is placed in service).

###### D.11.8.2.1.2 Initial Missing Data Procedures

Immediately following the initial certification of a sorbent trap monitoring system, apply the initial missing  $\text{SO}_2$

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concentration, CO<sub>2</sub> concentration, and moisture data algorithms in 40 CFR 75.31(b) to Hg concentration, until 720 hours of quality-assured Hg concentration data have been collected. Calculate, and update hourly, the percent monitor data availability (PMA) for Hg concentration, in accordance with 40 CFR 75.32.

#### D.11.8.2.1.3 Standard Missing Data Procedures

Once 720 quality-assured hours of Hg concentration data have been obtained following initial certification, provide substitute data for Hg concentration in accordance with the standard missing data procedures in 40 CFR 75.33(b)(1) through (b)(4), except that the term “Hg concentration” shall apply rather than “SO<sub>2</sub> concentration,” the term “sorbent trap monitoring system” shall apply rather than “SO<sub>2</sub> pollutant concentration monitor,” the term “maximum potential Hg concentration” shall apply rather than “maximum potential SO<sub>2</sub> concentration,” and the 95.0, 90.0 and 80.0 percent monitor data availability trigger conditions prescribed in 40 CFR 75.33(b)(1) through (b)(4) shall be replaced, respectively, with 90.0, 80.0 and 70.0 percent (see Table D.3).

**Table D.3: Standard Missing Data Procedures for Hg Concentration**

Trigger Conditions		Calculation Routines	
Percent Monitor Data Availability (PMA)	Duration (N) of Monitor Outage (Hours)	Method	Lookback Period
90 or more	N ≤ 24	Average of HB and HA	None
	N > 24	The greater of: • Average of HB and HA; or • 90th percentile value	None 720 hours*
80 or more, but below 90	N ≤ 8	Average of HB and HA	None
	N > 8	The greater of: • Average of HB and HA; or • 95th percentile value	None 720 hours*
70 or more, but below 80	N > 0	Maximum value	720 hours*
Below 70	N > 0	Maximum potential concentration	None

<sup>1</sup> HB and HA = Quality-assured Hg concentrations in the hour before and hour after the monitor outage.

\* Quality-assured monitor operating hours, during unit operation

#### D.11.8.2.1.4 Special Considerations for Units With Emission Controls

For a unit equipped with a flue gas desulfurization (FGD) system that significantly reduces the concentration of Hg emitted to the atmosphere (including circulating fluidized bed units that use limestone injection), or for a unit equipped with add-on Hg emission controls (e.g., carbon injection), the standard missing data procedures in D.11.8.2.1.3 may only be used for hours in which the SO<sub>2</sub> or Hg emission controls are documented to be operating properly, based on parametric data recorded during the missing data period. Hourly SO<sub>2</sub> concentration data from a certified CEMS may be used to demonstrate that a FGD system is working properly. For any hour(s) in the missing data period for which this documentation is unavailable, report the maximum potential Hg concentration (MPC), as defined in D.11.8.2.1.5.

However, when the PMA is less than 80.0 percent, but greater than or equal to 70.0 percent, and a missing data period occurs, the maximum controlled Hg concentration in the previous 720 hours of quality-assured data may be reported, in lieu of reporting the maximum value in the 720-hour lookback, for each missing data hour in which the FGD or Hg emission controls are documented to be operating properly. Further, when the PMA is less than 70.0 percent and a missing data period occurs, the greater of: (a) the maximum expected Hg concentration (MEC); or (b) 1.25 times the maximum controlled Hg concentration recorded in the previous 720 quality-assured hours of data

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may be reported, for each missing data hour in which the FGD or Hg emission controls are documented to be operating properly. The MEC shall be determined in accordance with D.11.8.2.1.6.

#### D.11.8.2.1.5 Maximum Potential Concentration

There are two options for determining the maximum potential Hg concentration (MPC): (a) use one of the following default values: 9 µg/scm for bituminous coal; 10 µg/scm for sub-bituminous coal; 16 µg/scm for lignite, and 1 µg/scm for waste coal, i.e., anthracite culm or bituminous gob. If different coals are blended, use the highest MPC for any fuel in the blend; or (b) base the MPC on the results of site-specific emission testing using one of the Hg reference methods in D.8.1.1. Option (b) may only be used if the unit does not have add-on Hg emission controls or a flue gas desulfurization (FGD) system, or if testing is performed upstream of all emission control devices. At least 3 test runs are required, at the normal operating load, and the highest Hg concentration obtained in any of the tests shall be the MPC.

#### D.11.8.2.1.6 Maximum Expected Concentration

For units with flue gas desulfurization (FGD) systems that significantly reduce Hg emissions (including fluidized bed units that use limestone injection) and for units equipped with add-on Hg emission controls (e.g., carbon injection), determine the maximum expected Hg concentration (MEC) during normal, stable operation of the unit and emission controls. To calculate the MEC, substitute the MPC value from D.11.8.2.1.5 into Equation A-2 in section 2.1.1.2 of appendix A to 40 CFR Part 75. For units with add-on Hg emission controls, base the percent removal efficiency on design engineering calculations. For units with FGD systems, use the best available estimate of the Hg removal efficiency of the FGD system.

#### D.11.8.2.2 Auxiliary Monitoring Systems

For the auxiliary monitoring systems (flow rate, diluent gas, and moisture), follow the applicable missing data procedures in Subpart D of 40 CFR Part 75.

### D.12 Reporting

Quarterly electronic reporting of data from the certified sorbent trap monitoring systems and, if applicable, auxiliary monitoring systems is required. At a minimum, the following data elements must be reported electronically:

#### D.12.1 Unit Information

Report unit information, including, but not limited to, the unit ID number, the maximum rated heat input capacity, the operating range (in terms of load), the normal operating load(s), the type(s) of fuel combusted, and the type(s) of emission controls.

#### D.12.2 Stack Information

For units that share a monitored common stack or for units with monitored multiple stack exhaust configurations, report the stack ID number(s) and show the unit/stack relationships.

#### D.12.3 Monitoring System Information

Report information for each monitoring system, including, but not limited to, system location, parameter monitored, system and component ID numbers, and component data (e.g., component type, manufacturer, model, serial number, installation date, etc.).

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#### D.12.4 Span and Range Information

If auxiliary monitoring systems are used, report span and range information for these systems.

#### D.12.5 Formulas

Report the mathematical formulas that are used to calculate hourly Hg mass emissions.

#### D.12.6 Operating Data

Report hourly unit operating data including, but not limited to, date and hour, unit (or stack) operating time, unit load, and the type of fuel combusted.

#### D.12.7 Emissions Data

##### D.12.7.1 Hourly Data

Report hourly Hg concentration data from the sorbent trap monitoring system and (if applicable) hourly data from the auxiliary monitoring systems that are used to calculate Hg mass emissions. For the sorbent trap system, a single Hg concentration value (derived from the analysis of the paired traps) is reported for each operating hour in each data collection period. Where bias adjustment is required, report both the unadjusted and bias-adjusted values. Report the hour-by-hour percent monitor data availability (PMA) for all monitored parameters. Indicate which hourly values of each monitored parameter are quality-assured and which are substitute data values. Also report the calculated hourly Hg mass emissions.

##### D.12.7.2 Cumulative and Average Values

Report the cumulative monthly, quarterly and year-to-date Hg mass emissions.

#### D.12.8 Supplementary Information

For each data collection period of the sorbent trap monitoring system, report supplementary data, including: starting and ending dates and times; ID numbers for the monitoring system, sorbent trap, and gas flow meter; sorbent trap serial numbers; Hg catch in sections 1 and 2 of each trap; mass of Hg in each third section spike and the mass of Hg recovered; total sample volume; gas flow meter readings; sampling rates; ratio of stack flow rate to sample flow rate; leak check results; and use of single trap adjustment factor (if applicable).

#### D.12.9 QA Test Data and Results

Report, as applicable, detailed quality assurance test data and summarized results, for the following QA tests: (a) calibration error tests, linearity checks, and RATAs of the auxiliary monitoring systems; and (b) gas flow meter calibrations, for the sorbent trap monitoring system.