PROCEDURE 5. QUALITY ASSURANCE REQUIREMENTS FOR VAPOR PHASE MERCURY CONTINUOUS EMISSIONS MONITORING SYSTEMS AND SORBENT TRAP MONITORING SYSTEMS USED FOR COMPLIANCE DETERMINATION AT STATIONARY SOURCES

1.0 Applicability and Principle

1.1 Applicability. The purpose of Procedure 5 is to establish the minimum requirements for evaluating the effectiveness of quality control (QC) and quality assurance (QA) procedures as well as the quality of data produced by vapor phase mercury (Hg) continuous emissions monitoring systems (CEMS) and sorbent trap monitoring systems. Procedure 5 applies to Hg CEMS and sorbent trap monitoring systems used for continuously determining compliance with emission standards or operating permit limits as specified in an applicable regulation or permit. Other QA/QC procedures may apply to other auxiliary monitoring equipment that may be needed to determine Hg emissions in the units of measure specified in an applicable permit or regulation.

Procedure 5 covers the measurement of Hg emissions as defined in Performance Specification 12A (PS 12A) and Performance Specification 12B (PS 12B) in appendix B to this part, *i.e.*, total vapor phase Hg representing the sum of the elemental (Hg°, CAS Number 7439-97-6) and oxidized (Hg^{+2}) forms of gaseous Hg.

Procedure 5 specifies the minimum requirements for controlling and assessing the quality of Hg CEMS and sorbent trap monitoring system data submitted to EPA or a delegated permitting authority. You must meet these minimum requirements if you are responsible for one or more Hg CEMS or sorbent trap monitoring systems used for compliance monitoring. We encourage you to develop and implement a more extensive QA program or to continue such programs where they already exist.

You must comply with the basic requirements of Procedure 5 immediately following successful completion of the initial performance test described in PS 12A or PS 12B in appendix B to this part (as applicable).

1.2 Principle. The QA procedures consist of two distinct and equally important functions. One function is the assessment of the quality of the Hg CEMS or sorbent trap monitoring system data by estimating accuracy. The other function is the control and improvement of the quality of the CEMS or sorbent trap monitoring system data by implementing QC policies and corrective actions. These two functions form a control loop: When the assessment function indicates that the data quality is inadequate, the quality control effort must be increased until the data quality is acceptable. In order to provide uniformity in the assessment and reporting of data quality, this procedure explicitly specifies assessment methods for calibration drift, system integrity, and accuracy. Several of the procedures are based on those of PS 12A and PS 12B in appendix B to

this part. Because the control and corrective action function encompasses a variety of policies, specifications, standards, and corrective measures, this procedure treats QC requirements in general terms to allow each source owner or operator to develop a QC system that is most effective and efficient for the circumstances.

2.0 Definitions

2.1 *Mercury Continuous Emission Monitoring System (Hg CEMS)* means the equipment required for the determination of the total vapor phase Hg concentration in the stack effluent. The Hg CEMS consists of the following major subsystems:

2.1.1 *Sample Interface* means that portion of the CEMS used for one or more of the following: sample acquisition, sample transport, sample conditioning, and protection of the monitor from the effects of the stack effluent.

2.1.2 *Hg Analyzer* means that portion of the Hg CEMS that measures the total vapor phase Hg concentration and generates a proportional output.

2.1.3 *Data Recorder* means that portion of the CEMS that provides a permanent electronic record of the analyzer output. The data recorder may provide automatic data reduction and CEMS control capabilities.

2.2 *Sorbent Trap Monitoring System* means the total equipment required for the collection of gaseous Hg samples using paired three-partition sorbent traps as described in PS 12B in appendix B to this part.

2.3 *Span Value* means the measurement range as specified for the affected source category in the applicable regulation and/or monitoring performance specification.

2.4 *Zero, Mid-Level, and High Level Values* means the reference gas concentrations used for calibration drift assessments and system integrity checks on a Hg CEMS, expressed as percentages of the span value (*see* section 7.1 of PS 12A in appendix B to this part).

2.5 *Calibration Drift (CD)* means the absolute value of the difference between the CEMS output response and either the upscale Hg reference gas or the zero-level Hg reference gas, expressed as a percentage of the span value, when the entire CEMS, including the sampling interface, is challenged after a stated period of operation during which no unscheduled maintenance, repair, or adjustment took place.

2.6 *System Integrity (SI) Check* means a test procedure assessing transport and measurement of oxidized Hg by a Hg CEMS. In particular, system integrity is expressed as the absolute value of the difference between the CEMS output response and the reference value of either a mid- or high-level mercuric chloride ($HgCl_2$) reference gas, as a percentage of span, when the entire CEMS, including the sampling interface, is challenged.

2.7 *Relative Accuracy (RA)* means the absolute mean difference between the pollutant concentrations determined by a continuous monitoring system (e.g., Hg CEMS or sorbent trap monitoring system) and the values determined by a reference method (RM) plus the 2.5 percent error confidence coefficient of a series of tests divided by the mean of the RM tests. Alternatively, for sources with an average RM concentration less than 5.0 micrograms per standard cubic meter (µg/scm), the RA may be expressed as the absolute value of the difference between the mean CEMS and RM values.

2.8 *Relative Accuracy Test Audit (RATA)* means an audit test procedure consisting of at least nine runs, in which the accuracy of the total vapor phase Hg concentrations measured by a CEMS or sorbent trap monitoring system is evaluated by comparison against concurrent measurements made with a reference test method.

2.9 *Quarterly Gas Audit (QGA)* means an audit procedure in which the accuracy of the total vapor phase Hg concentrations measured by a CEMS is evaluated by challenging the CEMS with a zero and two upscale reference gases.

3.0 QC Requirements

3.1 Each source owner or operator must develop and implement a QC program. At a minimum, each QC program must include written procedures which should describe in detail, complete, step-by-step procedures and operations for each of the following activities (as applicable):

(a) Calibration drift (CD) checks of Hg CEMS.

(b) CD determination and adjustment of Hg CEMS.

(c) Weekly system integrity check procedures for Hg CEMS.

(d) Routine operation, maintenance, and QA/QC procedures for sorbent trap monitoring systems.

(e) Routine and preventive maintenance procedures for Hg CEMS (including spare parts inventory).

(f) Data recording, calculations, and reporting.

(g) Accuracy audit procedures for Hg CEMS and sorbent trap monitoring systems including sampling and analysis methods.

(h) Program of corrective action for malfunctioning Hg CEMS and sorbent trap monitoring systems.

These written procedures must be kept on record and available for inspection by the responsible enforcement agency. Also, as noted in section 5.2.4, below, whenever excessive inaccuracies of a Hg CEMS occur for two consecutive quarters, the source owner or operator must revise the

current written procedures or modify or replace the CEMS or sorbent trap monitoring system to correct the deficiency causing the excessive inaccuracies.

4.0 Calibration Drift (CD) Assessment

4.1 CD Requirement. As described in 40 CFR 60.13(d) and 63.8(c), source owners and operators of Hg CEMS must check, record, and quantify the CD at two concentration values at least once daily (approximately 24 hours) in accordance with the method prescribed by the manufacturer. The Hg CEMS calibration must, as minimum, be adjusted whenever the daily zero (or low-level) CD or the daily high-level CD exceeds two times the limits of the applicable PS in appendix B of this part.

4.2 Recording Requirement for Automatic CD Adjusting CEMS. CEMS that automatically adjust the data to the corrected calibration values (e.g., microprocessor control) must either be programmed to record the unadjusted concentration measured in the CD prior to resetting the calibration, if performed, or to record the amount of adjustment.

4.3 Criteria for Excessive CD. If either the zero (or low-level) or high-level CD result exceeds twice the applicable drift specification in section 13.2 of PS 12A in appendix B to this part for five, consecutive, daily periods, the CEMS is out-of-control. If either the zero (or low-level) or high-level CD result exceeds four times the applicable drift specification in PS 12A during any CD check, the CEMS is out-of-control. If the CEMS is out-of-control, take necessary corrective action. Following corrective action, repeat the CD checks.

4.3.1 Out-Of-Control Period Definition. The beginning of the out-of-control period is the time corresponding to the completion of the fifth, consecutive, daily CD check with a CD in excess of two times the allowable limit, or the time corresponding to the completion of the daily CD check preceding the daily CD check that results in a CD in excess of four times the allowable limit. The end of the out-of-control period is the time corresponding to the completion of the CD check following corrective action that results in the CD's at both the zero (or low-level) and high-level measurement points being within the corresponding allowable CD limit (*i.e.*, either two times or four times the allowable limit in the applicable PS in appendix B).

4.3.2 CEMS Data Status During Out-of-Control Period. During the period the CEMS is out-of-control, the CEMS data may not be used either to determine compliance with an emission limit or to meet a minimum data availability requirement specified in an applicable regulation or permit.

5.0 Data Accuracy Assessment

5.1 Hg CEMS Audit Requirements. For each Hg CEMS, an accuracy audit must be performed at least once each calendar quarter. Successive quarterly audits must, to the extent practicable, be performed no less than 2 months apart. The audits must be conducted as follows:

5.1.1 Relative Accuracy Test Audit (RATA). A RATA of the Hg CEMS must be conducted at least once every four calendar quarters, except as otherwise noted in section 5.1.4 of this

appendix. Perform the RATA as described in section 8.5 of PS 12A in appendix B to this part. Calculate the results according to section 12.4 of PS 12A.

5.1.2 Quarterly Gas Audit. A quarterly gas audit (QGA) may be conducted in three of four calendar quarters, but in no more than three quarters in succession. To perform a QGA, challenge the CEMS with a zero-level and two upscale level audit gases of known concentrations, first of elemental Hg and then of oxidized Hg, within the following ranges:

Audit point	**Audit range**
1	20 to 30% of span value.
2	50 to 60% of span value.

Sequentially inject each of the three audit gases (zero and two upscale), three times each for a total of nine injections. Inject the gases in such a manner that the entire CEMS is challenged. Do not inject the same gas concentration twice in succession.

Use elemental Hg and oxidized Hg (mercuric chloride, $HgCl_2$) audit gases that are National Institute of Standards and Technology (NIST)-certified or NIST-traceable following an EPA Traceability Protocol. If audit gas cylinders are used, do not dilute gas when challenging the Hg CEMS. For each reference gas concentration, determine the average of the three CEMS responses and subtract the average response from the reference gas value. Calculate the measurement error at each gas level using Equation 12A-1 in section 8.2 of PS 12A.

5.1.3 Relative Accuracy Audit (RAA). As an alternative to the QGA, a RAA may be conducted in three of four calendar quarters, but in no more than three quarters in succession. To conduct a RAA, follow the RATA test procedures in section 8.5 of PS 12A in appendix B to this part, except that only three test runs are required.

5.1.4 Alternative Quarterly Audits. Alternative quarterly audit procedures may be used as approved by the Administrator for three of four calendar quarters. One RATA is required at least every four calendar quarters, except in the case where the affected facility is off-line (does not operate) in the fourth calendar quarter since the quarter of the previous RATA. In that case, the RATA must be performed in the quarter in which the unit recommences operation. Also, quarterly gas audits (or RAAs, if applicable) are not required for calendar quarters in which the affected facility does not operate.

5.2 Sorbent Trap Monitoring System Audit Requirements. For each sorbent trap monitoring system, a RATA must be conducted at least once every four calendar quarters, except as otherwise noted in section 5.1.4 of this appendix. Perform the RATA as described in section 8.3 of PS 12B in appendix B to this part. Calculate the results according to section 12.4 of PS 12A.

5.3 Excessive Audit Inaccuracy. If the results of a RATA, QGA, or RAA exceed the applicable criteria in section 5.3.3, the Hg CEMS or sorbent trap monitoring system is out-of-control. If the Hg CEMS or sorbent trap monitoring system is out-of-control, take necessary corrective action to eliminate the problem. Following corrective action, the source owner or operator must audit

the CEMS or sorbent trap monitoring system using the same type of test that failed to meet the accuracy criterion. For instance, a RATA must always be performed following an out-of-control period resulting from a failed RATA. Whenever audit results show the Hg CEMS or sorbent trap monitoring system to be out-of-control, the owner or operator must report both the results of the failed test and the results of the retest following corrective action showing the CEMS to be operating within specifications.

5.3.1 Out-Of-Control Period Definition. The beginning of the out-of-control period is the hour immediately following the completion of a RATA, RAA, QGA or system integrity check that fails to meet the applicable performance criteria in section 5.3.3, below. The end of the out-of-control period is the time corresponding to the completion of a subsequent successful test of the same type.

5.3.2 Monitoring Data Status During Out-Of-Control Period. During the period the monitor is out-of-control, the monitoring data may not be used to determine compliance with an applicable emission limit or to meet a minimum data availability requirement in an applicable regulation or permit.

5.3.3 Criteria for Excessive Audit Inaccuracy. Unless specified otherwise in an applicable regulation or permit, the criteria for excessive inaccuracy are:

(a) For the RATA, the allowable RA in the applicable PS in appendix B (e.g., PS 12A or PS 12B).

(b) For the QGA, ±15 percent of the average audit value or ±0.5 $\mu g/m^3$, whichever is greater.

(c) For the RAA, ±20 percent of the three run average or ±10 percent of the applicable standard, whichever is greater.

5.3.4 Criteria for Acceptable QC Procedures. Repeated excessive inaccuracies (*i.e.,* out-of-control conditions resulting from the quarterly audits) indicates the QC procedures are inadequate or that the CEMS or sorbent trap monitoring system is incapable of providing quality data. Therefore, whenever excessive inaccuracies occur for two consecutive quarters, the source owner or operator must revise the QC procedures (*see* section 3) or modify, repair, or replace the CEMS or sorbent trap monitoring system.

6.0 Reporting Requirements

6.1 Data Assessment Report. At the reporting interval specified in the applicable regulation or permit, report for each Hg CEMS and/or sorbent trap monitoring system the accuracy assessment results from section 5, above. For Hg CEMS, also report the CD assessment results from section 4, above. Report this information as a Data Assessment Report (DAR), and include the appropriate DAR(s) with the emissions report required under the applicable regulation or permit.

6.2 Contents of the DAR. At a minimum, the DAR must contain the following information:

6.2.1 Facility name and address including identification of source owner/operator.

6.2.2 Identification and location of each Hg CEMS and/or sorbent trap monitoring system.

6.2.3 Manufacturer, model, and serial number of each Hg CEMS and/or sorbent trap monitoring system.

6.2.4 CD Assessment for each Hg CEMS, including the identification of out-of-control periods.

6.2.5 System integrity check data for each Hg CEMS.

6.2.6 Accuracy assessment for each Hg CEMS and/or sorbent trap monitoring system, including the identification of out-of-control periods. The results of all required RATAs, QGAs, RAAs, and audits of auxiliary equipment must be reported. If an accuracy audit shows a CEMS or sorbent trap monitoring system to be out-of-control, report both the audit results that caused the out-of-control period and the results of the retest following corrective action, showing the monitoring system to be operating within specifications.

6.2.7 Summary of all corrective actions taken when the Hg CEMS and/or sorbent trap monitoring system was determined to be out-of-control.

6.3 Data Retention. As required in 40 CFR 60.7(d) and 63.10(b), all measurements from CEMS and sorbent trap monitoring systems, including the quality assurance data required by this procedure, must be retained by the source owner for at least 5 years.

7.0 Bibliography

7.1 Calculation and Interpretation of Accuracy for Continuous Emission Monitoring Systems (CEMS). section 3.0.7 of the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods. EPA-600/4-77-027b. August 1977. U.S. Environmental Protection Agency. Office of Research and Development Publications, 26 West St. Clair Street, Cincinnati, OH 45268.