**Section 225.APPENDIX B Continuous Emission Monitoring System for Mercury**

**Section 225.EXHIBIT A Specifications and Test Procedures**

1. Installation and Measurement Location

1.1 Gas and Mercury Monitors

Following the procedures in Section 8.1.1 of Performance Specification 2 in appendix B to 40 CFR 60, incorporated by reference in Section 225.140, install the pollutant concentration monitor or monitoring system at a location where the pollutant concentration and emission rate measurements are directly representative of the total emissions from the affected unit. Select a representative measurement point or path for the monitor probes (or for the path from the transmitter to the receiver) such that the CO2 or O2, concentration monitoring system, mercury concentration monitoring system, or sorbent trap monitoring system will pass the relative accuracy test (see Section 6 of this Exhibit).

It is recommended that monitor measurements be made at locations where the exhaust gas temperature is above the dew-point temperature. If the cause of failure to meet the relative accuracy tests is determined to be the measurement location, relocate the monitor probes.

1.1.1 Point Monitors

Locate the measurement point (1) within the centroidal area of the stack or duct cross-section, or (2) no less than 1.0 meter from the stack or duct wall.

1.2 Flow Monitors

Install the flow monitor in a location that provides representative volumetric flow over all operating conditions. Such a location is one that provides an average velocity of the flue gas flow over the stack or duct cross section and is representative of the pollutant concentration monitor location. Where the moisture content of the flue gas affects volumetric flow measurements, use the procedures in both Reference Methods 1 and 4 of appendix A to 40 CFR 60, incorporated by reference in Section 225.140, to establish a proper location for the flow monitor. The Illinois EPA recommends (but does not require) performing a flow profile study following the procedures in 40 CFR 60, appendix A, Method 1, Sections 11.5 or 11.4, incorporated by reference in Section 225.140, for each of the three operating or load levels indicated in Section 6.5.2.1 of this Exhibit to determine the acceptability of the potential flow monitor location and to determine the number and location of flow sampling points required to obtain a representative flow value. The procedure in 40 CFR 60, appendix A, Test Method 1, Section 11.5, incorporated by reference in Section 225.140, may be used even if the flow measurement location is greater than or equal to 2 equivalent stack or duct diameters downstream or greater than or equal to ½ duct diameter upstream from a flow disturbance. If a flow profile study shows that cyclonic (or swirling) or stratified flow conditions exist at the potential flow monitor location that are likely to prevent the monitor from meeting the performance specifications of this part, then the Agency recommends either (1) selecting another location where there is no cyclonic (or swirling) or stratified flow condition, or (2) eliminating the cyclonic (or swirling) or stratified flow condition by straightening the flow, e.g., by installing straightening vanes. The Agency also recommends selecting flow monitor locations to minimize the effects of condensation, coating, erosion, or other conditions that could adversely affect flow monitor performance.

1.2.1 Acceptability of Monitor Location

The installation of a flow monitor is acceptable if either (1) the location satisfies the minimum siting criteria of Method 1 in appendix A to 40 CFR 60, incorporated by reference in Section 225.140 (i.e., the location is greater than or equal to eight stack or duct diameters downstream and two diameters upstream from a flow disturbance; or, if necessary, two stack or duct diameters downstream and one-half stack or duct diameter upstream from a flow disturbance), or (2) the results of a flow profile study, if performed, are acceptable (i.e., there are no cyclonic (or swirling) or stratified flow conditions), and the flow monitor also satisfies the performance specifications of this part. If the flow monitor is installed in a location that does not satisfy these physical criteria, but nevertheless the monitor achieves the performance specifications of this part, then the location is acceptable, notwithstanding the requirements of this Section.

1.2.2 Alternative Monitoring Location

Whenever the owner or operator successfully demonstrates that modifications to the exhaust duct or stack (such as installation of straightening vanes, modifications of ductwork, and the like) are necessary for the flow monitor to meet the performance specifications, the Agency may approve an interim alternative flow monitoring methodology and an extension to the required certification date for the flow monitor.

Where no location exists that satisfies the physical siting criteria in Section 1.2.1, where the results of flow profile studies performed at two or more alternative flow monitor locations are unacceptable, or where installation of a flow monitor in either the stack or the ducts is demonstrated to be technically infeasible, the owner or operator may petition the Agency for an alternative method for monitoring flow.

2. Equipment Specifications

2.1 Instrument Span and Range

In implementing Sections 2.1.1 through 2.1.2 of this Exhibit, set the measurement range for each parameter (CO2, O2, or flow rate) high enough to prevent full-scale exceedances from occurring, yet low enough to ensure good measurement accuracy and to maintain a high signal-to-noise ratio. To meet these objectives, select the range such that the majority of the readings obtained during typical unit operation are kept, to the extent practicable, between 20.0 and 80.0 percent of the full-scale range of the instrument. These guidelines do not apply to mercury monitoring systems.

2.1.1 CO2 and O2 Monitors

For an O2 monitor (including O2 monitors used to measure CO2 emissions or percentage moisture), select a span value between 15.0 and 25.0 percent O2. For a CO2 monitor installed on a boiler, select a span value between 14.0 and 20.0 percent CO2. For a CO2 monitor installed on a combustion turbine, an alternative span value between 6.0 and 14.0 percent CO2 may be used. An alternative CO2 span value below 6.0 percent may be used if an appropriate technical justification is included in the hardcopy monitoring plan. An alternative O2 span value below 15.0 percent O2 may be used if an appropriate technical justification is included in the monitoring plan (e.g., O2 concentrations above a certain level create an unsafe operating condition). Select the full-scale range of the instrument to be consistent with Section 2.1 of this Exhibit and to be greater than or equal to the span value. Select the calibration gas concentrations for the daily calibration error tests and linearity checks in accordance with Section 5.1 of this Exhibit, as percentages of the span value. For O2 monitors with span values ≥ 21.0 percent O2, purified instrument air containing 20.9 percent O2 may be used as the high-level calibration material. If a dual-range or autoranging diluent analyzer is installed, the analyzer may be represented in the monitoring plan as a single component.

2.1.2 Flow Monitors

Select the full-scale range of the flow monitor so that it is consistent with Section 2.1 of this Exhibit and can accurately measure all potential volumetric flow rates at the flow monitor installation site.

2.1.2.1 Maximum Potential Velocity and Flow Rate

For this purpose, determine the span value of the flow monitor using the following procedure. Calculate the maximum potential velocity (MPV) using Equation A-3a or A-3b or determine the MPV (wet basis) from velocity traverse testing using Reference Method 2 (or its allowable alternatives) in appendix A to 40 CFR 60, incorporated by reference in Section 225.140. If using test values, use the highest average velocity (determined from the Method 2 traverses) measured at or near the maximum unit operating load. Express the MPV in units of wet standard feet per minute (fpm). For the purpose of providing substitute data during periods of missing flow rate data in accordance with 40 CFR 75.31 and 75.33 and as required elsewhere in this part, calculate the maximum potential stack gas flow rate (MPF) in units of standard cubic feet per hour (scfh), as the product of the MPV (in units of wet, standard fpm) times 60, times the cross-sectional area of the stack or duct (in ft**2**) at the flow monitor location.

 (Eq. A-3a)

or

 (Eq. A-3b)

Where:

|  |  |  |
| --- | --- | --- |
| MPV | = | maximum potential velocity (fpm, standard wet basis). |
| Fd | = | dry-basis F factor (dscf/mmBtu) from Table 1, Section 3.3.5 of Appendix F, 40 CFR 75. |
| Fc | = | carbon-based F factor (scf CO2/mmBtu) from Table 1, Section 3.3.5 of Appendix F, 40 CFR 75. |
| Hf | = | maximum heat input (mmBtu/minute) for all units, combined, exhausting to the stack or duct where the flow monitor is located. |
| A | = | inside cross sectional area (ft2) of the flue at the flow monitor location. |
| %O2d | = | maximum oxygen concentration, percent dry basis, under normal operating conditions. |
| %CO2d | = | minimum carbon dioxide concentration, percent dry basis, under normal operating conditions. |
| %H2O | = | maximum percent flue gas moisture content under normal operating conditions. |

2.1.2.2 Span Values and Range

Determine the span and range of the flow monitor as follows. Convert the MPV, as determined in Section 2.1.2.1 of this Exhibit, to the same measurement units of flow rate that are used for daily calibration error tests (e.g., scfh, kscfh, kacfm, or differential pressure (inches of water)). Next, determine the "calibration span value" by multiplying the MPV (converted to equivalent daily calibration error units) by a factor no less than 1.00 and no greater than 1.25, and rounding up the result to at least two significant figures. For calibration span values in inches of water, retain at least two decimal places. Select appropriate reference signals for the daily calibration error tests as percentages of the calibration span value, as specified in Section 2.2.2.1 of this Exhibit. Finally, calculate the "flow rate span value" (in scfh) as the product of the MPF, as determined in Section 2.1.2.1 of this Exhibit, times the same factor (between 1.00 and 1.25) that was used to calculate the calibration span value. Round off the flow rate span value to the nearest 1000 scfh. Select the full-scale range of the flow monitor so that it is greater than or equal to the span value and is consistent with Section 2.1 of this Exhibit. Include in the monitoring plan for the unit: calculations of the MPV, MPF, calibration span value, flow rate span value, and full-scale range (expressed both in scfh and, if different, in the measurement units of calibration).

2.1.2.3 Adjustment of Span and Range

For each affected unit or common stack, the owner or operator must make a periodic evaluation of the MPV, span, and range values for each flow rate monitor (at a minimum, an annual evaluation is required) and must make any necessary span and range adjustments with corresponding monitoring plan updates, as described in subsections (a) through (c) of this Section 2.1.2.3. Span and range adjustments may be required, for example, as a result of changes in the fuel supply, changes in the stack or ductwork configuration, changes in the manner of operation of the unit, or installation or removal of emission controls. In implementing the provisions in subsections (a) and (b) of this Section 2.1.2.3, note that flow rate data recorded during short-term, non-representative operating conditions (e.g., a trial burn of a different type of fuel) must be excluded from consideration. The owner or operator must keep the results of the most recent span and range evaluation on-site, in a format suitable for inspection. Make each required span or range adjustment no later than 45 days after the end of the quarter in which the need to adjust the span or range is identified.

a) If the fuel supply, stack or ductwork configuration, operating parameters, or other conditions change such that the maximum potential flow rate changes significantly, adjust the span and range to assure the continued accuracy of the flow monitor. A "significant" change in the MPV means that the guidelines of Section 2.1 of this Exhibit can no longer be met, as determined by either a periodic evaluation by the owner or operator or from the results of an audit by the Agency. The owner or operator should evaluate whether any planned changes in operation of the unit may affect the flow of the unit or stack and should plan any necessary span and range changes needed to account for these changes, so that they are made in as timely a manner as practicable to coordinate with the operational changes. Calculate the adjusted calibration span and flow rate span values using the procedures in Section 2.1.2.2 of this Exhibit.

b) Whenever the full-scale range is exceeded during a quarter, provided that the exceedance is not caused by a monitor out-of-control period, report 200.0 percent of the current full-scale range as the hourly flow rate for each hour of the full-scale exceedance. If the range is exceeded, make appropriate adjustments to the flow rate span and range to prevent future full-scale exceedances. Calculate the new calibration span value by converting the new flow rate span value from units of scfh to units of daily calibration. A calibration error test must be performed and passed to validate data on the new range.

c) Whenever changes are made to the MPV, full-scale range, or span value of the flow monitor, as described in subsections (a) and (b) of this Section, record and report (as applicable) the new full-scale range setting, calculations of the flow rate span value, calibration span value, and MPV in an updated monitoring plan for the unit. The monitoring plan update must be made in the quarter in which the changes become effective. Record and report the adjusted calibration span and reference values as parts of the records for the calibration error test required by Exhibit B to Appendix B. Whenever the calibration span value is adjusted, use reference values for the calibration error test that meet the requirements of Section 2.2.2.1 of this Exhibit, based on the most recent adjusted calibration span value. Perform a calibration error test according to Section 2.1.1 of Exhibit B to Appendix B whenever making a change to the flow monitor span or range, unless the range change also triggers a recertification under Section 1.4 of Appendix B.

2.1.3 Mercury Monitors

Determine the appropriate span and range values for each mercury pollutant concentration monitor, so that all expected mercury concentrations can be determined accurately.

2.1.3.1 Maximum Potential Concentration

The maximum potential concentration depends upon the type of coal combusted in the unit. For the initial MPC determination, there are three options:

1) 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

2) You may base the MPC on the results of site-specific emission testing using one of the mercury reference methods in Section 1.6 of this Appendix, if the unit does not have add-on mercury emission controls or a flue gas desulfurization system, or if you test upstream of these control devices. A minimum of 3 test runs are required at the normal operating load. Use the highest total mercury concentration obtained in any of the tests as the MPC; or

3) You may base the MPC on 720 or more hours of historical CEMS data or data from a sorbent trap monitoring system, if the unit does not have add-on mercury emission controls or a flue gas desulfurization system (or if the CEMS or sorbent trap system is located upstream of these control devices) and if the mercury CEMS or sorbent trap system has been tested for relative accuracy against one of the mercury reference methods in Section 1.6 of this Appendix and has met a relative accuracy specification of 20.0% or less.

2.1.3.2 Maximum Expected Concentration

For units with FGD systems that significantly reduce mercury emissions (including fluidized bed units that use limestone injection) and for units equipped with add-on mercury emission controls (e.g., carbon injection), determine the maximum expected mercury concentration (MEC) during normal, stable operation of the unit and emission controls. To calculate the MEC, substitute the MPC value from Section 2.1.3.1 of this Exhibit into Equation A-2 in Section 2.1.1.2 of appendix A to 40 CFR 75, incorporated by reference in Section 225.140. For units with add-on mercury emission controls, base the percent removal efficiency on design engineering calculations. For units with FGD systems, use the best available estimate of the mercury removal efficiency of the FGD system.

2.1.3.3 Span and Range Values

a) For each mercury monitor, determine a high span value, by rounding the MPC value from Section 2.1.3.1 of this Exhibit upward to the next highest multiple of 10 µg/scm.

b) For an affected unit equipped with an FGD system or a unit with add-on mercury emission controls, if the MEC value from Section 2.1.3.2 of this Exhibit is less than 20 percent of the high span value from subsection (a) of this Section, and if the high span value is 20 µg/scm or greater, define a second, low span value of 10 µg/scm.

c) If only a high span value is required, set the full-scale range of the mercury analyzer to be greater than or equal to the span value.

d) If two span values are required, you may either:

1) Use two separate (high and low) measurement scales, setting the range of each scale to be greater than or equal to the high or low span value, as appropriate; or

2) Quality-assure two segments of a single measurement scale.

2.1.3.4 Adjustment of Span and Range

For each affected unit or common stack, the owner or operator must make a periodic evaluation of the MPC, MEC, span, and range values for each mercury monitor (at a minimum, an annual evaluation is required) and must make any necessary span and range adjustments, with corresponding monitoring plan updates. Span and range adjustments may be required, for example, as a result of changes in the fuel supply, changes in the manner of operation of the unit, or installation or removal of emission controls. In implementing the provisions in subsections (a) and (b) of this Section, data recorded during short-term, non-representative process operating conditions (e.g., a trial burn of a different type of fuel) must be excluded from consideration. The owner or operator must keep the results of the most recent span and range evaluation on-site, in a format suitable for inspection. Make each required span or range adjustment no later than 45 days after the end of the quarter in which the need to adjust the span or range is identified, except that up to 90 days after the end of that quarter may be taken to implement a span adjustment if the calibration gas concentrations currently being used for calibration error tests, system integrity checks, and linearity checks are unsuitable for use with the new span value and new calibration materials must be ordered or additional Hg generator calibration points must be certified.

a) The guidelines of Section 2.1 of this Exhibit do not apply to mercury monitoring systems.

b) Whenever a full-scale range exceedance occurs during a quarter and is not caused by a monitor out-of-control period, proceed as follows:

1) For monitors with a single measurement scale, report that the system was out of range and invalid data was obtained until the readings come back on-scale and, if appropriate, make adjustments to the MPC, span, and range to prevent future full-scale exceedances; or

2) For units with two separate measurement scales, if the low range is exceeded, no further action is required, provided that the high range is available and is not out-of-control or out-of-service for any reason. 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, report that the system was out-of-control until the readings return to the low range or until the high range is able to provide quality assured data (unless the reason that the high-scale range is not able to provide quality assured data is because the high-scale range has been exceeded; if the high-scale range is exceeded follow the procedures in subsection (b)(1) of this Section).

c) Whenever changes are made to the MPC, MEC, full-scale range, or span value of the mercury monitor, record and report (as applicable) the new full-scale range setting, the new MPC or MEC and calculations of the adjusted span value in an updated monitoring plan. The monitoring plan update must be made in the quarter in which the changes become effective. In addition, record and report the adjusted span as part of the records for the daily calibration error test and linearity check specified by Exhibit B to Appendix B. Whenever the span value is adjusted, use calibration gas concentrations that meet the requirements of Section 5.1 of this Exhibit, based on the adjusted span value. When a span adjustment is so significant that the calibration gas concentrations currently being used for calibration error tests, system integrity checks and linearity checks are unsuitable for use with the new span value, then a diagnostic linearity or 3-level system integrity check using the new calibration gas concentrations must be performed and passed. Use the data validation procedures in Section 1.4(b)(3) of this Appendix, beginning with the hour in which the span is changed.

2.2 Design for Quality Control Testing

2.2.1 Pollutant Concentration and CO2 or O2 Monitors

a) Design and equip each pollutant concentration and CO2 or O2 monitor with a calibration gas injection port that allows a check of the entire measurement system when calibration gases are introduced. For extractive and dilution type monitors, all monitoring components exposed to the sample gas, (e.g., sample lines, filters, scrubbers, conditioners, and as much of the probe as practicable) are included in the measurement system. For in-situ type monitors, the calibration must check against the injected gas for the performance of all active electronic and optical components (e.g., transmitter, receiver, analyzer).

b) Design and equip each pollutant concentration or CO2 or O2 monitor to allow daily determinations of calibration error (positive or negative) at the zero- and mid- or high-level concentrations specified in Section 5.2 of this Exhibit.

2.2.2 Flow Monitors

Design all flow monitors to meet the applicable performance specifications.

2.2.2.1 Calibration Error Test

Design and equip each flow monitor to allow for a daily calibration error test consisting of at least two reference values: Zero to 20 percent of span or an equivalent reference value (e.g., pressure pulse or electronic signal) and 50 to 70 percent of span. Flow monitor response, both before and after any adjustment, must be capable of being recorded by the data acquisition and handling system. Design each flow monitor to allow a daily calibration error test of the entire flow monitoring system, from and including the probe tip (or equivalent) through and including the data acquisition and handling system, or the flow monitoring system from and including the transducer through and including the data acquisition and handling system.

2.2.2.2 Interference Check

a) Design and equip each flow monitor with a means to ensure that the moisture expected to occur at the monitoring location does not interfere with the proper functioning of the flow monitoring system. Design and equip each flow monitor with a means to detect, on at least a daily basis, pluggage of each sample line and sensing port, and malfunction of each resistance temperature detector (RTD), transceiver or equivalent.

b) Design and equip each differential pressure flow monitor to provide an automatic, periodic back purging (simultaneously on both sides of the probe) or equivalent method of sufficient force and frequency to keep the probe and lines sufficiently free of obstructions on at least a daily basis to prevent velocity sensing interference, and a means for detecting leaks in the system on at least a quarterly basis (manual check is acceptable).

c) Design and equip each thermal flow monitor with a means to ensure on at least a daily basis that the probe remains sufficiently clean to prevent velocity sensing interference.

d) Design and equip each ultrasonic flow monitor with a means to ensure on at least a daily basis that the transceivers remain sufficiently clean (e.g., back purging system) to prevent velocity sensing interference.

2.2.3 Mercury Monitors

Design and equip each mercury monitor to permit the introduction of known concentrations of elemental mercury and HgCl2 separately, at a point immediately preceding the sample extraction filtration system, such that the entire measurement system can be checked. If the mercury monitor does not have a converter, the HgCl2 injection capability is not required.

3. Performance Specifications

3.1 Calibration Error

a) The calibration error performance specifications in this Section apply only to 7-day calibration error tests under Sections 6.3.1 and 6.3.2 of this Exhibit and to the offline calibration demonstration described in Section 2.1.1.2 of Exhibit B to Appendix B. The calibration error limits for daily operation of the continuous monitoring systems required under this part are found in Section 2.1.4(a) of Exhibit B to Appendix B.

b) The calibration error of a mercury concentration monitor must not deviate from the reference value of either the zero or upscale calibration gas by more than 5.0 percent of the span value, as calculated using Equation A-5 of this Exhibit. Alternatively, if the span value is 10 µg/scm, the calibration error test results are also acceptable if the absolute value of the difference between the monitor response value and the reference value, R-A in Equation A-5 of this Exhibit, is ≤ 1.0 µg/scm.

 (Eq. A-5)

Where:

|  |  |  |
| --- | --- | --- |
| CE | = | Calibration error as a percentage of the span of the instrument. |
| R | = | Reference value of zero or upscale (high-level or mid-level, as applicable) calibration gas introduced into the monitoring system. |
| A | = | Actual monitoring system response to the calibration gas. |
| S | = | Span of the instrument, as specified in Section 2 of this Exhibit. |

3.2 Linearity and System Integrity Checks

For CO2 or O2 monitors (including O2 monitors used to measure CO2 emissions or percent moisture):

a) The error in linearity for each calibration gas concentration (low-, mid-, and high-levels) must not exceed or deviate from the reference value by more than 5.0 percent as calculated using Equation A-4 of this Exhibit; or

b) The absolute value of the difference between the average of the monitor response values and the average of the reference values, R-A in Equation A-4 of this Exhibit, must be less than or equal to 0.5 percent CO2 or O2, whichever is less restrictive.

For the linearity check and the 3-level system integrity check of a mercury monitor, which are required, respectively, under Section 1.4(c)(1)(B) and (c)(1)(E) of Appendix B, the measurement error must not exceed 10.0 percent of the reference value at any of the three gas levels. To calculate the measurement error at each level, take the absolute value of the difference between the reference value and mean CEM response, divide the result by the reference value, and then multiply by 100. Alternatively, the results at any gas level are acceptable if the absolute value of the difference between the average monitor response and the average reference value, i.e., R-A in Equation A-4 of this Exhibit, does not exceed 0.8 µg/m3. The principal and alternative performance specifications in this Section also apply to the single-level system integrity check described in Section 2.6 of Exhibit B to Appendix B.

 (Eq. A-4)

Where:

|  |  |  |
| --- | --- | --- |
| ME | = | Percentage measurement error, for a linearity check or system integrity check, based upon the reference value. |
| R | = | Reference value of low-, mid-, or high-level calibration gas introduced into the monitoring system. |
| A | = | Average of the monitoring system responses. |

3.3 Relative Accuracy

3.3.1 Relative Accuracy for CO2 and O2 Monitors

The relative accuracy for CO2 and O2 monitors must not exceed 10.0 percent. The relative accuracy test results are also acceptable if the difference between the mean value of the CO2 or O2 monitor measurements and the corresponding reference method measurement mean value, calculated using equation A-7 of this Exhibit, does not exceed ± 1.0 percent CO2 or O2.

 (Eq. A-7)

Where:

|  |  |  |
| --- | --- | --- |
| n | = | Number of data points. |
| di | = | The difference between a reference method value and the corresponding continuous emission monitoring system value (RMi- CEMi) at a given point in time i. |

3.3.2 Relative Accuracy for Flow Monitors

a) The relative accuracy of flow monitors must not exceed 10.0 percent at any load (or operating) level at which a RATA is performed (i.e., the low-, mid-, or high-level, as defined in Section 6.5.2.1 of this Exhibit).

b) For affected units where the average of the flow reference method measurements of gas velocity at a particular load (or operating) level of the relative accuracy test audit is less than or equal to 10.0 fps, the difference between the mean value of the flow monitor velocity measurements and the reference method mean value in fps at that level must not exceed ± 2.0 fps, wherever the 10.0 percent relative accuracy specification is not achieved.

3.3.3 Relative Accuracy for Moisture Monitoring Systems

The relative accuracy of a moisture monitoring system must not exceed 10.0 percent. The relative accuracy test results are also acceptable if the difference between the mean value of the reference method measurements (in percent H2O) and the corresponding mean value of the moisture monitoring system measurements (in percent H2O), calculated using Equation A-7 of this Exhibit does not exceed ± 1.5 percent H2O.

3.3.4 Relative Accuracy for Mercury Monitoring Systems

The relative accuracy of a mercury concentration monitoring system or a sorbent trap monitoring system must not exceed 20.0 percent. Alternatively, for affected units where the average of the reference method measurements of mercury concentration during the relative accuracy test audit is less than 5.0 µg/scm, the test results are acceptable if the difference between the mean value of the monitor measurements and the reference method mean value does not exceed 1.0 µg/scm, in cases where the relative accuracy specification of 20.0 percent is not achieved.

3.4 Cycle Time

The cycle time for mercury concentration monitors, oxygen monitors used to determine percent moisture, and any other monitoring component of a continuous emission monitoring system that is required to perform a cycle time test must not exceed 15 minutes.

4. Data Acquisition and Handling Systems

Automated data acquisition and handling systems must read and record the full range of pollutant concentrations and volumetric flow from zero through span and provide a continuous, permanent record of all measurements and required information as a computer data file capable of being reproduced in a readable hard copy format. These systems also must have the capability of interpreting and converting the individual output signals from a flow monitor, a CO2 monitor, an O2 monitor, a moisture monitoring system, a mercury concentration monitoring system, and a sorbent trap monitoring system, to produce a continuous readout of pollutant emission rates or pollutant mass emissions (as applicable) in the appropriate units (e.g., lb/hr, lb/mmBtu, ounces/hr, tons/hr). These systems also must have the capability of interpreting and converting the individual output signals from a flow monitor to produce a continuous readout of pollutant mass emission rates in the units of the standard. Where CO2 emissions are measured with a continuous emission monitoring system, the data acquisition and handling system must also produce a readout of CO2 mass emissions in tons.

Data acquisition and handling systems must also compute and record monitor calibration error, flow rate data, or mercury emission rate data.

5. Calibration Gas

5.1 Reference Gases

For the purposes of Appendix B, calibration gases include the following:

5.1.1 Standard Reference Materials (SRM)

These calibration gases may be obtained from the National Institute of Standards and Technology (NIST) at the following address: Quince Orchard and Cloppers Road, Gaithersburg MD 20899-0001.

5.1.2 SRM-Equivalent Compressed Gas Primary Reference Material (PRM)

Contact the Gas Metrology Team, Analytical Chemistry Division, Chemical Science and Technology Laboratory of NIST, at the address in Section 5.1.1, for a list of vendors and cylinder gases.

5.1.3 NIST Traceable Reference Materials

Contact the Gas Metrology Team, Analytical Chemistry Division, Chemical Science and Technology Laboratory of NIST, at the address in Section 5.1.1, for a list of vendors and cylinder gases that meet the definition for a NIST Traceable Reference Material (NTRM) provided in 40 CFR 72.2, incorporated by reference in Section 225.140.

5.1.4 EPA Protocol Gases

a) An EPA Protocol Gas is a calibration gas mixture prepared and analyzed according to Section 2 of the "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards", September 1997, EPA-600/R-97/121 or such revised procedure as approved by the Administrator (EPA Traceability Protocol).

b) An EPA Protocol Gas must have a specialty gas producer-certified uncertainty (95 percent confidence interval) that must not be greater than 2.0 percent of the certified concentration (tag value) of the gas mixture. The uncertainty must be calculated using the statistical procedures (or equivalent statistical techniques) that are listed in Section 2.1.8 of the EPA Traceability Protocol.

c) A copy of EPA-600/R-97/121 is available from the National Technical Information Service, 5285 Port Royal Road, Springfield VA, 703-605-6585 or http://www.ntis.gov, and from http://www.epa.gov/ttn/emc/news.html or http:// www.epa.gov/appcdwww/tsb/index.html.

5.1.5 Research Gas Mixtures

Research gas mixtures must be vendor-certified to be within 2.0 percent of the concentration specified on the cylinder label (tag value), using the uncertainty calculation procedure in Section 2.1.8 of the "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards", September 1997, EPA-600/R-97/121. Inquiries about the RGM program should be directed to: National Institute of Standards and Technology, Analytical Chemistry Division, Chemical Science and Technology Laboratory, B-324 Chemistry, Gaithersburg MD 20899.

5.1.6 Zero Air Material

Zero air material is defined in 40 CFR 72.2, incorporated by reference in Section 225.140.

5.1.7 NIST/EPA-Approved Certified Reference Materials

Existing certified reference materials (CRMs) that are still within their certification period may be used as calibration gas.

5.1.8 Gas Manufacturer's Intermediate Standards

Gas manufacturer's intermediate standards is defined in 40 CFR 72.2, incorporated by reference in Section 225.140.

5.1.9 Mercury Standards

For 7-day calibration error tests of mercury concentration monitors and for daily calibration error tests of mercury monitors, either NIST-traceable elemental mercury standards (as defined in Section 225.130) or a NIST-traceable source of oxidized mercury (as defined in Section 225.130) may be used. For linearity checks, NIST-traceable elemental mercury standards must be used. For 3-level and single-point system integrity checks under Section 1.4(c)(1)(E) of Appendix B, Sections 6.2(g) and 6.3.1 of this Exhibit, and Sections 2.1.1, 2.2.1 and 2.6 of Exhibit B to Appendix B, a NIST-traceable source of oxidized mercury must be used. Alternatively, other NIST-traceable standards may be used for the required checks, subject to the approval of the Agency. Notwithstanding these requirements, mercury calibration standards that are not NIST-traceable may be used for the tests described in this Section until December 31, 2009. However, on and after January 1, 2010, only NIST-traceable calibration standards must be used for these tests.

5.2 Concentrations

Four concentration levels are required as follows.

5.2.1 Zero-level Concentration

0.0 to 20.0 percent of span, including span for high-scale or both low- and high-scale for Hg, CO2 and O2 monitors, as appropriate.

5.2.2 Low-level Concentration

20.0 to 30.0 percent of span, including span for high-scale or both low- and high-scale for Hg, CO2 and O2 monitors, as appropriate.

5.2.3 Mid-level Concentration

50.0 to 60.0 percent of span, including span for high-scale or both low- and high-scale for Hg, CO2 and O2 monitors, as appropriate.

5.2.4 High-level Concentration

80.0 to 100.0 percent of span, including span for high-scale or both low-and high-scale for Hg, CO2 and O2 monitors, as appropriate.

6. Certification Tests and Procedures

6.1 General Requirements

6.1.1 Pretest Preparation

Install the components of the continuous emission monitoring system (i.e., pollutant concentration monitors, CO2 or O2 monitor, and flow monitor) as specified in Sections 1, [2](http://www.westlaw.com/Find/Default.wl?rs=dfa1.0&vr=2.0&DB=1000546&DocName=40USCAS2&FindType=L), and [3](http://www.westlaw.com/Find/Default.wl?rs=dfa1.0&vr=2.0&DB=1000546&DocName=40USCAS3&FindType=L) of this Exhibit, and prepare each system component and the combined system for operation in accordance with the manufacturer's written instructions. Operate the units during each period when measurements are made. Units may be tested on non-consecutive days. To the extent practicable, test the DAHS software prior to testing the monitoring hardware.

6.1.2 Requirements for Air Emission Testing Bodies

a) On and after January 1, 2009, any Air Emission Testing Body (AETB) conducting relative accuracy test audits of CEMS and sorbent trap monitoring systems under Part 225, Subpart B, must conform to the requirements of ASTM D7036-04 pursuant to 40 CFR 75, appendix A, section 6.1.2 (incorporated by reference in Section 225.140). This Section is not applicable to daily operation, daily calibration error checks, daily flow interference checks, quarterly linearity checks or routine maintenance of CEMS.

b) The AETB must provide to the affected sources certification that the AETB operates in conformance with, and that data submitted to the Agency has been collected in accordance with, the requirements of ASTM D7036-04 pursuant to 40 CFR 75, appendix A, section 6.1.2 (incorporated by reference in Section 225.140). This certification may be provided in the form of:

1) A certificate of accreditation of relevant scope issued by a recognized, national accreditation body; or

2) A letter of certification signed by a member of the senior management staff of the AETB.

c) The AETB must either provide a Qualified Individual on-site to conduct or must oversee all relative accuracy testing carried out by the AETB as required in ASTM D7036-04 pursuant to 40 CFR 75, appendix A, section 6.1.2 (incorporated by reference in Section 225.140). The Qualified Individual must provide the affected sources with copies of the qualification credentials relevant to the scope of the testing conducted.

6.2 Linearity Check (General Procedures)

Check the linearity of each CO2, Hg, and O2 monitor while the unit, or group of units for a common stack, is combusting fuel at conditions of typical stack temperature and pressure; it is not necessary for the unit to be generating electricity during this test. For units with two measurement ranges (high and low) for a particular parameter, perform a linearity check on both the low scale and the high scale. For on-going quality assurance of the CEMS, perform linearity checks, using the procedures in this Section, on the ranges and at the frequency specified in Section 2.2.1 of Exhibit B to Appendix B. Challenge each monitor with calibration gas, as defined in Section 5.1 of this Exhibit, at the low-, mid-, and high-range concentrations specified in Section 5.2 of this Exhibit. Introduce the calibration gas at the gas injection port, as specified in Section 2.2.1 of this Exhibit. Operate each monitor at its normal operating temperature and conditions. For extractive and dilution type monitors, pass the calibration gas through all filters, scrubbers, conditioners, and other monitor components used during normal sampling and through as much of the sampling probe as is practical. For in-situ type monitors, perform calibration checking all active electronic and optical components, including the transmitter, receiver, and analyzer. Challenge the monitor three times with each reference gas (see example data sheet in Figure 1). Do not use the same gas twice in succession. To the extent practicable, the duration of each linearity test, from the hour of the first injection to the hour of the last injection, must not exceed 24 unit operating hours. Record the monitor response from the data acquisition and handling system. For each concentration, use the average of the responses to determine the error in linearity using Equation A-4 in this Exhibit. Linearity checks are acceptable for monitor or monitoring system certification, recertification, or quality assurance if none of the test results exceed the applicable performance specifications in Section 3.2 of this Exhibit. The status of emission data from a CEMS prior to and during a linearity test period must be determined as follows:

a) For the initial certification of a CEMS, data from the monitoring system are considered invalid until all certification tests, including the linearity test, have been successfully completed, unless the conditional data validation procedures in Section 1.4(b)(3) of Appendix B are used. When the procedures in Section 1.4(b)(3) of Appendix B are followed, the words "initial certification" apply instead of "recertification", and complete all of the initial certification tests by January 1, 2009, rather than within the time periods specified in Section 1.4(b)(3)(D) of Appendix B for the individual tests.

b) For the routine quality assurance linearity checks required by Section 2.2.1 of Exhibit B to Appendix B, use the data validation procedures in Section 2.2.3 of Exhibit B to Appendix B.

c) When a linearity test is required as a diagnostic test or for recertification, use the data validation procedures in Section 1.4 (b)(3) of Appendix B.

d) For linearity tests of non-redundant backup monitoring systems, use the data validation procedures in Section 1.4(d)(2)(C) of Appendix B.

e) For linearity tests performed during a grace period and after the expiration of a grace period, use the data validation procedures in Sections 2.2.3 and 2.2.4, respectively, of Exhibit B to Appendix B.

f) For all other linearity checks, use the data validation procedures in Section 2.2.3 of Exhibit B to Appendix B.

g) For mercury monitors, follow the guidelines in Section 2.2.3 of this Exhibit in addition to the applicable procedures in Section 6.2 when performing the system integrity checks described in Section 1.4(c)(1)(E) and in Sections 2.1.1, 2.2.1, and 2.6 of Exhibit B to Appendix B.

h) For mercury concentration monitors, if moisture and/or chlorine is added to the calibration gas during the required linearity checks or system integrity checks, the dilution effect of the moisture and/or chlorine addition on the calibration gas concentration must be accounted for in an appropriate manner.

6.3 7-Day Calibration Error Test

6.3.1 Gas Monitor 7-day Calibration Error Test

Measure the calibration error of each mercury concentration monitor and each CO2 or O2 monitor while the unit is combusting fuel (but not necessarily generating electricity) once each day for 7 consecutive operating days according to the following procedures. For mercury monitors, you may perform this test using either elemental mercury standards or a NIST-traceable source of oxidized mercury. Also for mercury monitors, if moisture and/or chlorine is added to the calibration gas, the dilution effect of the added moisture and/or chlorine on the calibration gas concentration must be accounted for in an appropriate manner. (In the event that unit outages occur after the commencement of the test, the 7 consecutive unit operating days need not be 7 consecutive calendar days.) Units using dual span monitors must perform the calibration error test on both high- and low-scales of the pollutant concentration monitor. The calibration error test procedures in this Section and in Section 6.3.2 of this Exhibit must also be used to perform the daily assessments and additional calibration error tests required under Sections 2.1.1 and 2.1.3 of Exhibit B to Appendix B. Do not make manual or automatic adjustments to the monitor settings until after taking measurements at both zero and high concentration levels for that day during the 7-day test. If automatic adjustments are made following both injections, conduct the calibration error test such that the magnitude of the adjustments can be determined and recorded. Record and report test results for each day using the unadjusted concentration measured in the calibration error test prior to making any manual or automatic adjustments (i.e., resetting the calibration). The calibration error tests should be approximately 24 hours apart, (unless the 7-day test is performed over non-consecutive days). Perform calibration error tests at both the zero-level concentration and high-level concentration, as specified in Section 5.2 of this Exhibit. Alternatively, a mid-level concentration gas (50.0 to 60.0 percent of the span value) may be used in lieu of the high-level gas, provided that the mid-level gas is more representative of the actual stack gas concentrations. Use only calibration gas, as specified in Section 5.1 of this Exhibit. Introduce the calibration gas at the gas injection port, as specified in Section 2.2.1 of this Exhibit. Operate each monitor in its normal sampling mode. For extractive and dilution type monitors, pass the calibration gas through all filters, scrubbers, conditioners, and other monitor components used during normal sampling and through as much of the sampling probe as is practical. For in-situ type monitors, perform calibration, checking all active electronic and optical components, including the transmitter, receiver, and analyzer. Challenge the pollutant concentration monitors and CO2 or O2 monitors once with each calibration gas. Record the monitor response from the data acquisition and handling system. Using Equation A-5 of this Exhibit, determine the calibration error at each concentration once each day (at approximately 24-hour intervals) for 7 consecutive days according to the procedures given in this Section. The results of a 7-day calibration error test are acceptable for monitor or monitoring system certification, recertification or diagnostic testing if none of these daily calibration error test results exceed the applicable performance specifications in Section 3.1 of this Exhibit. The status of emission data from a gas monitor prior to and during a 7-day calibration error test period must be determined as follows:

a) For initial certification, data from the monitor are considered invalid until all certification tests, including the 7-day calibration error test, have been successfully completed, unless the conditional data validation procedures in Section 1.4(b)(3) of Appendix B are used. When the procedures in Section 1.4(b)(3) of Appendix B are followed, the words "initial certification" apply instead of "recertification", and complete all of the initial certification tests by July 1, 2009, rather than within the time periods specified in Section 1.4(b)(3)(D) of Appendix B for the individual tests.

b) When a 7-day calibration error test is required as a diagnostic test or for recertification, use the data validation procedures in Section 1.4(b)(3) of Appendix B.

6.3.2 Flow Monitor 7-day Calibration Error Test

Flow monitors installed on peaking units (as defined in 40 CFR 72.2, incorporated by reference in Section 225.140) are exempted from the 7-day calibration error test requirements of this part. In all other cases, perform the 7-day calibration error test of a flow monitor, when required for certification, recertification or diagnostic testing, according to the following procedures. Introduce the reference signal corresponding to the values specified in Section 2.2.2.1 of this Exhibit to the probe tip (or equivalent), or to the transducer. During the 7-day certification test period, conduct the calibration error test while the unit is operating once each unit operating day (as close to 24-hour intervals as practicable). In the event that unit outages occur after the commencement of the test, the 7 consecutive operating days need not be 7 consecutive calendar days. Record the flow monitor responses by means of the data acquisition and handling system. Calculate the calibration error using Equation A-6 of this Exhibit. Do not perform any corrective maintenance, repair, or replacement upon the flow monitor during the 7-day test period other than that required in the quality assurance/quality control plan required by Exhibit B to Appendix B. Do not make adjustments between the zero and high reference level measurements on any day during the 7-day test. If the flow monitor operates within the calibration error performance specification (i.e., less than or equal to 3.0 percent error each day and requiring no corrective maintenance, repair, or replacement during the 7-day test period), the flow monitor passes the calibration error test. Record all maintenance activities and the magnitude of any adjustments. Record output readings from the data acquisition and handling system before and after all adjustments. Record and report all calibration error test results using the unadjusted flow rate measured in the calibration error test prior to resetting the calibration. Record all adjustments made during the 7-day period at the time the adjustment is made, and report them in the certification or recertification application. The status of emissions data from a flow monitor prior to and during a 7-day calibration error test period must be determined as follows:

a) For initial certification, data from the monitor are considered invalid until all certification tests, including the 7-day calibration error test, have been successfully completed, unless the conditional data validation procedures in Section 1.4(b)(3) of Appendix B are used. When the procedures in Section 1.4(b)(3) of Appendix B are followed, the words "initial certification" apply instead of "recertification", and complete all of the initial certification tests by July 1, 2009, rather than within the time periods specified in Section 1.4(b)(3)(D) of Appendix B for the individual tests.

b) When a 7-day calibration error test is required as a diagnostic test or for recertification, use the data validation procedures in Section 1.4(b)(3).

 (Eq. A-6)

Where:

|  |  |  |
| --- | --- | --- |
| CE | = | Calibration error as a percentage of span. |
| R | = | Low or high level reference value specified in Section 2.2.2.1 of this Exhibit. |
| A | = | Actual flow monitor response to the reference value. |
| S | = | Flow monitor calibration span value as determined under Section 2.1.2.2 of this Exhibit. |

6.3.3

For gas or flow monitors installed on peaking units, the exemption from performing the 7-day calibration error test applies as long as the unit continues to meet the definition of a peaking unit in 40 CFR 72.2, incorporated by reference in Section 225.140. However, if at the end of a particular calendar year or ozone season, it is determined that peaking unit status has been lost, the owner or operator must perform a diagnostic 7-day calibration error test of each monitor installed on the unit, by no later than December 31 of the following calendar year.

6.4 Cycle Time Test

Perform cycle time tests for each pollutant concentration monitor and continuous emission monitoring system while the unit is operating, according to the following procedures. Use a zero-level and a high-level calibration gas (as defined in Section 5.2 of this Exhibit) alternately. For mercury monitors, the calibration gas used for this test may either be the elemental or oxidized form of mercury. To determine the downscale cycle time, measure the concentration of the flue gas emissions until the response stabilizes. Record the stable emissions value. Inject a zero-level concentration calibration gas into the probe tip (or injection port leading to the calibration cell, for in-situ systems with no probe). Record the time of the zero gas injection, using the data acquisition and handling system (DAHS). Next, allow the monitor to measure the concentration of the zero gas until the response stabilizes. Record the stable ending calibration gas reading. Determine the downscale cycle time as the time it takes for 95.0 percent of the step change to be achieved between the stable stack emissions value and the stable ending zero gas reading. Then repeat the procedure, starting with stable stack emissions and injecting the high-level gas, to determine the upscale cycle time, which is the time it takes for 95.0 percent of the step change to be achieved between the stable stack emissions value and the stable ending high-level gas reading. Use the following criteria to assess when a stable reading of stack emissions or calibration gas concentration has been attained. A stable value is equivalent to a reading with a change of less than 2.0 percent of the span value for 2 minutes, or a reading with a change of less than 6.0 percent from the measured average concentration over 6 minutes. Alternatively, the reading is considered stable if it changes by no more than 0.5 ppm, 0.5 µg/m3 (for mercury) for two minutes. (Owners or operators of systems that do not record data in 1-minute or 3-minute intervals may petition the Agency for alternative stabilization criteria.) For monitors or monitoring systems that perform a series of operations (such as purge, sample, and analyze), time the injections of the calibration gases so they will produce the longest possible cycle time. Refer to Figures 6a and 6b in this Exhibit for example calculations of upscale and downscale cycle times. Report the slower of the two cycle times (upscale or downscale) as the cycle time for the analyzer. On and after July 1, 2009, record the cycle time for each component analyzer separately. For time-shared systems, perform the cycle time tests at each of the probe locations that will be polled within the same 15-minute period during monitoring system operations. To determine the cycle time for time-shared systems, at each monitoring location, report the sum of the cycle time observed at that monitoring location plus the sum of the time required for all purge cycles (as determined by the continuous emission monitoring system manufacturer) at each of the probe locations of the time-shared systems. For monitors with dual ranges, report the test results for each range separately. Cycle time test results are acceptable for monitor or monitoring system certification, recertification or diagnostic testing if none of the cycle times exceed 15 minutes. The status of emissions data from a monitor prior to and during a cycle time test period must be determined as follows:

a) For initial certification, data from the monitor are considered invalid until all certification tests, including the cycle time test, have been successfully completed, unless the conditional data validation procedures in Section 1.4(b)(3) of Appendix B are used. When the procedures in Section 1.4(b)(3) of Appendix B are followed, the words "initial certification" apply instead of "recertification", and complete all of the initial certification tests by July 1, 2009, rather than within the time periods specified in Section 1.4(b)(3)(D) of Appendix B for the individual tests.

b) When a cycle time test is required as a diagnostic test or for recertification, use the data validation procedures in Section 1.4(b)(3) of Appendix B.

6.5 Relative Accuracy (General Procedures)

Perform the required relative accuracy test audits (RATAs) as follows for each flow monitor, each O2 or CO2 diluent monitor used to calculate heat input, each mercury concentration monitoring system, each sorbent trap monitoring system, and each moisture monitoring system.

a) Except as otherwise provided in this subsection, perform each RATA while the unit (or units, if more than one unit exhausts into the flue) is combusting the fuel that is a normal primary or backup fuel for that unit (for some units, more than one type of fuel may be considered normal, e.g., a unit that combusts gas or oil on a seasonal basis). For units that co-fire fuels as the predominant mode of operation, perform the RATAs while co-firing. For mercury monitoring systems, perform the RATAs while the unit is combusting coal. When relative accuracy test audits are performed on CEMS installed on bypass stacks/ducts, use the fuel normally combusted by the unit (or units, if more than one unit exhausts into the flue) when emissions exhaust through the bypass stack/ducts.

b) Perform each RATA at the load (or operating) levels specified in Section 6.5.1 or 6.5.2 of this Exhibit or in Section 2.3.1.3 of Exhibit B to Appendix B, as applicable.

c) For monitoring systems with dual ranges, perform the relative accuracy test on the range normally used for measuring emissions. For units with add-on mercury controls that operate continuously rather than seasonally, or for units that need a dual range to record high concentration "spikes" during startup conditions, the low range is considered normal. However, for some dual span units (e.g., for units that use fuel switching or for which the emission controls are operated seasonally), provided that both monitor ranges are connected to a common probe and sample interface, either of the two measurement ranges may be considered normal; in such cases, perform the RATA on the range that is in use at the time of the scheduled test. If the low and high measurement ranges are connected to separate sample probes and interfaces, RATA testing on both ranges is required.

d) Record monitor or monitoring system output from the data acquisition and handling system.

e) Complete each single-load relative accuracy test audit within a period of 168 consecutive unit operating hours, as defined in 40 CFR 72.2, incorporated by reference in Section 225.140 (or, for CEMS installed on common stacks or bypass stacks, 168 consecutive stack operating hours, as defined in 40 CFR 72.2, incorporated by reference in Section 225.140). Notwithstanding this requirement, up to 336 consecutive unit or stack operating hours may be taken to complete the RATA of a mercury monitoring system, when ASTM 6784-02 (incorporated by reference in Section 225.140) or Method 29 in appendix A-8 to 40 CFR 60, incorporated by reference in Section 225.140, is used as the reference method. For 2-level and 3-level flow monitor RATAs, complete all of the RATAs at all levels, to the extent practicable, within a period of 168 consecutive unit (or stack) operating hours; however, if this is not possible, up to 720 consecutive unit (or stack) operating hours may be taken to complete a multiple-load flow RATA.

f) The status of emission data from the CEMS prior to and during the RATA test period must be determined as follows:

1) For the initial certification of a CEMS, data from the monitoring system are considered invalid until all certification tests, including the RATA, have been successfully completed, unless the conditional data validation procedures in Section 1.4(b)(3) of Appendix B are used. When the procedures in Section 1.4(b)(3) of Appendix B are followed, the words "initial certification" apply instead of "recertification", and complete all of the initial certification tests by January 1, 2009, rather than within the time periods specified in Section 1.4(b)(3)(D) of Appendix B for the individual tests.

2) For the routine quality assurance RATAs required by Section 2.3.1 of Exhibit B to Appendix B, use the data validation procedures in Section 2.3.2 of Exhibit B to Appendix B.

3) For recertification RATAs, use the data validation procedures in Section 1.4(b)(3).

4) For quality assurance RATAs of non-redundant backup monitoring systems, use the data validation procedures in Section 1.4(d)(2)(D) and (E) of Appendix B.

5) For RATAs performed during and after the expiration of a grace period, use the data validation procedures in Sections 2.3.2 and 2.3.3, respectively, of Exhibit B to Appendix B.

6) For all other RATAs, use the data validation procedures in Section 2.3.2 of Exhibit B to Appendix B.

g) For each flow monitor, each CO2 or O2 diluent monitor used to determine heat input, each moisture monitoring system, each mercury concentration monitoring system, and each sorbent trap monitoring system, calculate the relative accuracy, in accordance with Section 7.3 of this Exhibit, as applicable.

6.5.1 Gas and Mercury Monitoring System RATAs (Special Considerations)

a) Perform the required relative accuracy test audits for each CO2 or O2 diluent monitor used to determine heat input, each mercury concentration monitoring system, and each sorbent trap monitoring system at the normal load level or normal operating level for the unit (or combined units, if common stack), as defined in Section 6.5.2.1 of this Exhibit. If two load levels or operating levels have been designated as normal, the RATAs may be done at either load level.

b) For the initial certification of a gas or mercury monitoring system and for recertifications in which, in addition to a RATA, one or more other tests are required (i.e., a linearity test, cycle time test, or 7-day calibration error test), the Agency recommends that the RATA not be commenced until the other required tests of the CEMS have been passed.

6.5.2 Flow Monitor RATAs (Special Considerations)

a) Except as otherwise provided in subsection (b) of this Section, perform relative accuracy test audits for the initial certification of each flow monitor at three different exhaust gas velocities (low, mid, and high), corresponding to three different load levels within the range of operation, as defined in Section 6.5.2.1 of this Exhibit. For a common stack/duct, the three different exhaust gas velocities may be obtained from frequently used unit/load or operating level combinations for the units exhausting to the common stack. Select the three exhaust gas velocities such that the audit points at adjacent load or operating levels (i.e., low and mid or mid and high), in megawatts (or in thousands of lb/hr of steam production or in ft/sec, as applicable), are separated by no less than 25.0 percent of the range of operation, as defined in Section 6.5.2.1 of this Exhibit.

b) For flow monitors on bypass stacks/ducts and peaking units, the flow monitor relative accuracy test audits for initial certification and recertification must be single-load tests, performed at the normal load, as defined in Section 6.5.2.1(d) of this Exhibit.

c) Flow monitor recertification RATAs must be done at three load levels, unless otherwise specified in subsection (b) or (e) of this Section or unless otherwise specified or approved by the Agency.

d) The semiannual and annual quality assurance flow monitor RATAs required under Exhibit B to Appendix B must be done at the load levels specified in Section 2.3.1.3 of Exhibit B to Appendix B.

6.5.2.1 Range of Operation and Normal Load Levels

a) The owner or operator must determine the upper and lower boundaries of the "range of operation" as follows for each unit (or combination of units, for common stack configurations): The lower boundary of the range of operation of a unit must be the minimum safe, stable loads for any of the units discharging through the stack. Alternatively, for a group of frequently-operated units that serve a common stack, the sum of the minimum safe, stable loads for the individual units may be used as the lower boundary of the range of operation. The upper boundary of the range of operation of a unit must be the maximum sustainable load. The "maximum sustainable load" is the higher of either: the nameplate or rated capacity of the unit, less any physical or regulatory limitations or other deratings; or the highest sustainable load, based on at least four quarters of representative historical operating data. For common stacks, the maximum sustainable load is the sum of all of the maximum sustainable loads of the individual units discharging through the stack, unless this load is unattainable in practice, in which case use the highest sustainable combined load for the units that discharge through the stack, based on at least four quarters of representative historical operating data. The load values for the units must be expressed either in units of megawatts of thousands of lb/hr of steam load or mmBtu/hr of thermal output.

b) The load levels for relative accuracy test audits will, except for peaking units, be defined as follows: the "low" load level will be the first 30.0 percent of the range of operation; the "mid" load level will be the middle portion (>30.0 percent, but

≤ 60.0 percent) of the range of operation; and the "high" load level will be the upper end (>60.0 percent) of the range of operation. For example, if the upper and lower boundaries of the range of operation are 100 and 1100 megawatts, respectively, then the low, mid, and high load levels would be 100 to 400 megawatts, 400 to 700 megawatts, and 700 to 1100 megawatts, respectively.

c) The owner or operator must identify, for each affected unit or common stack, the "normal" load level or levels (low, mid or high), based on the operating history of the units. To identify the normal load levels, the owner or operator must, at a minimum, determine the relative number of operating hours at each of the three load levels, low, mid, and high over the past four representative operating quarters. The owner or operator must determine, to the nearest 0.1 percent, the percentage of the time that each load level (low, mid, high) has been used during that time period. A summary of the data used for this determination and the calculated results must be kept on-site in a format suitable for inspection. For new units or newly-affected units, the data analysis in this subsection may be based on fewer than four quarters of data if fewer than four representative quarters of historical load data are available. Or, if no historical load data are available, the owner or operator may designate the normal load based on the expected or projected manner of operating the unit. However, in either case, once four quarters of representative data become available, the historical load analysis must be repeated.

d) Determination of Normal Load. Based on the analysis of the historical load data described in subsection (c) of this Section, the owner or operator must designate the most frequently used load level as the normal load level for the unit (or combination of units, for common stacks). The owner or operator may also designate the second most frequently used load level as an additional normal load level for the unit or stack. If the manner of operation of the unit changes significantly, such that the designated normal loads or the two most frequently used load levels change, the owner or operator must repeat the historical load analysis and must redesignate the normal loads and the two most frequently used load levels, as appropriate. A minimum of two representative quarters of historical load data are required to document that a change in the manner of unit operation has occurred. Update the electronic monitoring plan whenever the normal load levels and the two most frequently-used load levels are redesignated.

e) The owner or operator must report the upper and lower boundaries of the range of operation for each unit (or combination of units, for common stacks), in units of megawatts or thousands of lb/hr or mmBtu/hr of steam production (as applicable), in the electronic monitoring plan required under Section 1.10 of Appendix B.

6.5.2.2 Multi-Load Flow RATA Results

For each multi-load flow RATA, calculate the flow monitor relative accuracy at each load level. If a flow monitor relative accuracy test is failed or aborted due to a problem with the monitor on any load level of a 2-load (or 3-load) relative accuracy test audit, the RATA must be repeated at that load level. However, the entire 2-load (or 3-load) relative accuracy test audit does not have to be repeated unless the flow monitor polynomial coefficients or K-factors are changed, in which case a 3-load RATA is required.

6.5.3 Calculations

Using the data from the relative accuracy test audits, calculate relative accuracy in accordance with the procedures and equations specified in Section 7 of this Exhibit.

6.5.4 Reference Method Measurement Location

Select a location for reference method measurements that is (1) accessible; (2) in the same proximity as the monitor or monitoring system location; and (3) meets the requirements of Performance Specification 3 in appendix B of 40 CFR 60, incorporated by reference in Section 225.140, for CO2 or O2 monitors, or Method 1 (or 1A) in appendix A of 40 CFR 60, incorporated by reference in Section 225.140, for volumetric flow, except as otherwise indicated in this Section or as approved by the Agency.

6.5.5 Reference Method Traverse Point Selection

Select traverse points that ensure acquisition of representative samples of pollutant and diluent concentrations, moisture content, temperature, and flue gas flow rate over the flue cross Section. To achieve this, the reference method traverse points must meet the requirements of Section 8.1.3 of Performance Specification 2 ("PS No. 2") in appendix B to 40 CFR 60, incorporated by reference in Section 225.140 (for moisture monitoring system RATAs), Performance Specification 3 in appendix B to 40 CFR 60, incorporated by reference in Section 225.140 (for O2 and CO2 monitor RATAs), Method 1 (or 1A) (for volumetric flow rate monitor RATAs), Method 3 (for molecular weight), and Method 4 (for moisture determination) in appendix A to 40 CFR 60, incorporated by reference in Section 225.140. The following alternative reference method traverse point locations are permitted for moisture and gas monitor RATAs:

a) For moisture determinations where the moisture data are used only to determine stack gas molecular weight, a single reference method point, located at least 1.0 meter from the stack wall, may be used. For moisture monitoring system RATAs and for gas monitor RATAs in which moisture data are used to correct pollutant or diluent concentrations from a dry basis to a wet basis (or vice-versa), single-point moisture sampling may only be used if the 12-point stratification test described in Section 6.5.5.1 of this Exhibit is performed prior to the RATA for at least one pollutant or diluent gas, and if the test is passed according to the acceptance criteria in Section 6.5.5.3(b) of this Exhibit.

b) For gas monitoring system RATAs, the owner or operator may use any of the following options:

1) At any location (including locations where stratification is expected), use a minimum of six traverse points along a diameter, in the direction of any expected stratification. The points must be located in accordance with Method 1 in appendix A to 40 CFR 60, incorporated by reference in Section 225.140.

2) At locations where Section 8.1.3 of PS No. 2 allows the use of a short reference method measurement line (with three points located at 0.4, 1.2, and 2.0 meters from the stack wall), the owner or operator may use an alternative 3-point measurement line, locating the three points at 4.4, 14.6, and 29.6 percent of the way across the stack, in accordance with Method 1 in appendix A to 40 CFR 60, incorporated by reference in Section 225.140.

3) At locations where stratification is likely to occur (e.g., following a wet scrubber or when dissimilar gas streams are combined), the short measurement line from Section 8.1.3 of PS No. 2 (or the alternative line described in subsection (b)(2) of this Section) may be used in lieu of the prescribed "long" measurement line in Section 8.1.3 of PS No. 2, provided that the 12-point stratification test described in Section 6.5.5.1 of this Exhibit is performed and passed one time at the location (according to the acceptance criteria of Section 6.5.5.3(a) of this Exhibit) and provided that either the 12-point stratification test or the alternative (abbreviated) stratification test in Section 6.5.5.2 of this Exhibit is performed and passed prior to each subsequent RATA at the location (according to the acceptance criteria of Section 6.5.5.3(a) of this Exhibit).

4) A single reference method measurement point, located no less than 1.0 meter from the stack wall and situated along one of the measurement lines used for the stratification test, may be used at any sampling location if the 12-point stratification test described in Section 6.5.5.1 of this Exhibit is performed and passed prior to each RATA at the location (according to the acceptance criteria of Section 6.5.5.3(b) of this Exhibit).

c) For mercury monitoring systems, use the same basic approach for traverse point selection that is used for the other gas monitoring system RATAs, except that the stratification test provisions in Sections 8.1.3 through 8.1.3.5 of Method 30A must apply, rather than the provisions of Sections 6.5.5.1 through 6.5.5.3 of this Exhibit.

6.5.5.1 Stratification Test

a) With the units operating under steady-state conditions at the normal load level (or normal operating level), as defined in Section 6.5.2.1 of this Exhibit, use a traversing gas sampling probe to measure diluent (CO2 or O2) concentrations at a minimum of 12 points, located according to Method 1 in appendix A to 40 CFR 60, incorporated by reference in Section 225.140.

b) Use Method 3A in appendix A to 40 CFR 60, incorporated by reference in Section 225.140, to make the measurements. Data from the reference method analyzers must be quality assured by performing analyzer calibration error and system bias checks before the series of measurements and by conducting system bias and calibration drift checks after the measurements, in accordance with the procedures of Method 3A.

c) Measure for a minimum of 2 minutes at each traverse point. To the extent practicable, complete the traverse within a 2-hour period.

d) If the load has remained constant (± 3.0 percent) during the traverse and if the reference method analyzers have passed all of the required quality assurance checks, proceed with the data analysis.

e) Calculate the average CO2 or O2 concentrations at each of the individual traverse points. Then, calculate the arithmetic average CO2 or O2 concentrations for all traverse points.

6.5.5.2 Alternative (Abbreviated) Stratification Test

a) With the units operating under steady-state conditions at the normal load level (or normal operating level), as defined in Section 6.5.2.1 of this Exhibit, use a traversing gas sampling probe to measure the diluent (CO2 or O2) concentrations at three points. The points must be located according to the specifications for the long measurement line in Section 8.1.3 of PS No. 2 (i.e., locate the points 16.7 percent, 50.0 percent, and 83.3 percent of the way across the stack). Alternatively, the concentration measurements may be made at six traverse points along a diameter. The six points must be located in accordance with Method 1 in appendix A to 40 CFR 60, incorporated by reference in Section 225.140.

b) Use Method 3A in appendix A to 40 CFR 60, incorporated by reference in Section 225.140, to make the measurements. Data from the reference method analyzers must be quality assured by performing analyzer calibration error and system bias checks before the series of measurements and by conducting system bias and calibration drift checks after the measurements, in accordance with the procedures of Method 3A.

c) Measure for a minimum of 2 minutes at each traverse point. To the extent practicable, complete the traverse within a 1-hour period.

d) If the load has remained constant (± 3.0 percent) during the traverse and if the reference method analyzers have passed all of the required quality assurance checks, proceed with the data analysis.

e) Calculate the average CO2 or O2 concentrations at each of the individual traverse points. Then, calculate the arithmetic average CO2 or O2 concentrations for all traverse points.

6.5.5.3 Stratification Test Results and Acceptance Criteria

a) For each diluent gas RATA, the short reference method measurement line described in Section 8.1.3 of PS No. 2 may be used in lieu of the long measurement line prescribed in Section 8.1.3 of PS No. 2 if the results of a stratification test, conducted in accordance with Section 6.5.5.1 or 6.5.5.2 of this Exhibit (as appropriate; see Section 6.5.5(b)(3) of this Exhibit), show that the concentration at each individual traverse point differs by no more than ± 10.0 percent from the arithmetic average concentration for all traverse points. The results are also acceptable if the concentration at each individual traverse point differs by no more than ± 0.5 percent CO2 or O2 from the arithmetic average concentration for all traverse points.

b) For each diluent gas RATA, a single reference method measurement point, located at least 1.0 meter from the stack wall and situated along one of the measurement lines used for the stratification test, may be used for that diluent gas if the results of a stratification test, conducted in accordance with Section 6.5.5.1 of this Exhibit, show that the concentration at each individual traverse point differs by no more than ± 5.0 percent from the arithmetic average concentration for all traverse points. The results are also acceptable if the concentration at each individual traverse point differs by no more than ± 0.3 percent CO2 or O2 from the arithmetic average concentration for all traverse points.

c) The owner or operator must keep the results of all stratification tests on-site, in a format suitable for inspection, as part of the supplementary RATA records required under Section 1.13(a)(7) of Appendix B.

6.5.6 Sampling Strategy

a) Conduct the reference method tests so they will yield results representative of the pollutant concentration, emission rate, moisture, temperature, and flue gas flow rate from the unit and can be correlated with mercury monitor, CO2 or O2, moisture, flow monitoring system, and mercury CEMS (or excepted monitoring system) measurements (as applicable). The minimum acceptable time for a gas monitoring system RATA run or for a moisture monitoring system RATA run is 21 minutes. For each run of a gas monitoring system RATA, all necessary pollutant concentration measurements, diluent concentration measurements, and moisture measurements (if applicable) must, to the extent practicable, be made within a 60-minute period. For flow monitor RATAs, the minimum time per run must be 5 minutes. Flow rate reference method measurements may be made either sequentially from port to port or simultaneously at two or more sample ports. The velocity measurement probe may be moved from traverse point to traverse point either manually or automatically. If, during a flow RATA, significant pulsations in the reference method readings are observed, be sure to allow enough measurement time at each traverse point to obtain an accurate average reading when a manual readout method is used (e.g., a "sight-weighted" average from a manometer). Also, allow sufficient measurement time to ensure that stable temperature readings are obtained at each traverse point, particularly at the first measurement point at each sample port, when a probe is moved sequentially from port-to-port. A minimum of one set of auxiliary measurements for stack gas molecular weight determination (i.e., diluent gas data and moisture data) is required for every clock hour of a flow RATA or for every three test runs (whichever is less restrictive). Alternatively, moisture measurements for molecular weight determination may be performed before and after a series of flow RATA runs at a particular load level (low, mid, or high), provided that the time interval between the two moisture measurements does not exceed three hours. If this option is selected, the results of the two moisture determinations must be averaged arithmetically and applied to all RATA runs in the series. Successive flow RATA runs may be performed without waiting in-between runs. If an O2-diluent monitor is used as a CO2 continuous emission monitoring system, perform a CO2 system RATA (i.e., measure CO2, rather than O2, with the reference method). For moisture monitoring systems, an appropriate coefficient, K-factor or other suitable mathematical algorithm may be developed prior to the RATA, to adjust the monitoring system readings with respect to the reference method. If such a coefficient, K-factor or algorithm is developed, it must be applied to the CEMS readings during the RATA and (if the RATA is passed), to the subsequent CEMS data, by means of the automated data acquisition and handling system. The owner or operator must keep records of the current coefficient, K-factor or algorithm, as specified in Section 1.13(a)(5)(F) of Appendix B. Whenever the coefficient, K-factor or algorithm is changed, a RATA of the moisture monitoring system is required. For the RATA of a mercury CEMS using the Ontario Hydro Method, or for the RATA of a sorbent trap system (irrespective of the reference method used), the time per run must be long enough to collect a sufficient mass of mercury to analyze. For the RATA of a sorbent trap monitoring system, the type of sorbent material used by the traps must be the same as for daily operation of the monitoring system; however, the size of the traps used for the RATA may be smaller than the traps used for daily operation of the system. Spike the third section of each sorbent trap with elemental mercury, as described in Section 7.1.2 of Exhibit D to Appendix B. Install a new pair of sorbent traps prior to each test run. For each run, the sorbent trap data must be validated according to the quality assurance criteria in Section 8 of Exhibit D to Appendix B.

b) To properly correlate the mercury, volumetric flow rate, moisture, CO2 or O2 monitoring system data with the reference method data, annotate the beginning and end of each reference method test run (including the exact time of day) on the individual chart recorders or other permanent recording devices.

6.5.7 Correlation of Reference Method and Continuous Emission Monitoring System

Confirm that the monitoring system and reference method test results are on consistent moisture, pressure, temperature, and diluent concentration basis (e.g., since the flow monitor measures flow rate on a wet basis, Method 2 test results must also be on a wet basis). Compare flow-monitor and reference method results on a scfh basis. Also, consider the response times of the pollutant concentration monitor, the continuous emission monitoring system, and the flow monitoring system to ensure comparison of simultaneous measurements.

For each relative accuracy test audit run, compare the measurements obtained from the continuous emission monitoring system (in µg/m3, % CO2, % O2, or % H2O, as applicable) against the corresponding reference method values. Tabulate the paired data in a table such as the one shown in Figure 2.

6.5.8 Number of Reference Method Tests

Perform a minimum of nine sets of paired monitor (or monitoring system) and reference method test data for every required (i.e., certification, recertification, diagnostic, semiannual, or annual) relative accuracy test audit. For 2-load and 3-load relative accuracy test audits of flow monitors, perform a minimum of nine sets at each of the load levels.

6.5.9 Reference Methods

The following methods are from appendix A to 40 CFR 60, incorporated by reference in Section 225.140, or have been published by ASTM, and are the reference methods for performing relative accuracy test audits under this Part: Method 1 or 1A in appendix A-1 to 40 CFR 60 for siting; Method 2 or its allowable alternatives in appendices A-1 and A-2 to 40 CFR 60 (except for Methods 2B and 2E) for stack gas velocity and volumetric flow rate; Method 3, 3A or 3B in appendix A-2 to 40 CFR 60 for O2 and CO2; Method 4 in appendix A-3 to 40 CFR 60 for moisture; and for mercury, either ASTM D6784-02 (the Ontario Hydro Method, incorporated by reference under Section 225.140), or Method 29, Method 30A, or Method 30B in appendix A-8 to 40 CFR 60.

7. Calculations

7.1 Linearity and System Integrity Checks

Analyze the linearity check data for Hg, CO2, and O2 monitors and the system integrity check data for Hg CEMS as follows. Calculate the percentage measurement error based upon the reference value at the low-level, mid-level, and high-level concentrations specified in Section 6.2 of this Exhibit. Perform this calculation once during the certification test. Use the following equation to calculate the measurement error for each reference value.

 (Eq. A-4)

Where:

|  |  |  |
| --- | --- | --- |
| ME | = | Percentage measurement error, based upon the reference value. |
| R | = | Reference value of low-, mid-, or high-level calibration gas introduced into the monitoring system. |
| A | = | Average of the monitoring system responses. |

7.2 Calibration Error

7.2.1 Pollutant Concentration and Diluent Monitors

For each reference value, calculate the percentage calibration error based upon instrument span for daily calibration error tests using the following equation:

 (Eq. A-5)

Where:

|  |  |  |
| --- | --- | --- |
| CE | = | Calibration error as a percentage of the span of the instrument. |
| R | = | Reference value of zero or upscale (high-level or mid-level, as applicable) calibration gas introduced into the monitoring system. |
| A | = | Actual monitoring system response to the calibration gas. |
| S | = | Span of the instrument, as specified in Section 2 of this Exhibit. |

7.2.2 Flow Monitor Calibration Error

For each reference value, calculate the percentage calibration error based upon span using the following equation:

 (Eq. A-6)

Where:

|  |  |  |
| --- | --- | --- |
| CE | = | Calibration error as a percentage of span. |
| R | = | Low or high level reference value specified in Section 2.2.2.1 of this Exhibit. |
| A | = | Actual flow monitor response to the reference value. |
| S | = | Flow monitor calibration span value as determined under Section 2.1.2.2 of this Exhibit. |

7.3 Relative Accuracy for O2 Monitors, Mercury Monitoring Systems, and Flow Monitors

Analyze the relative accuracy test audit data from the reference method tests for CO2 or O2 monitors used only for heat input rate determination, mercury monitoring systems used to determine mercury mass emissions under Sections 1.14 through 1.18 of Appendix B, and flow monitors using the following procedures. Summarize the results on a data sheet. An example is shown in Figure 2. Calculate the mean of the monitor or monitoring system measurement values. Calculate the mean of the reference method values. Using data from the automated data acquisition and handling system, calculate the arithmetic differences between the reference method and monitor measurement data sets. Then calculate the arithmetic mean of the difference, the standard deviation, the confidence coefficient, and the monitor or monitoring system relative accuracy using the following procedures and equations.

7.3.1 Arithmetic Mean

Calculate the arithmetic mean of the differences, d, of a data set as follows.

 (Eq. A-7)

Where:

|  |  |  |
| --- | --- | --- |
| n | = | Number of data points. |
| di | = | The difference between a reference method value and the corresponding continuous emission monitoring system value (RMi- CEMi) at a given point in time i. |

7.3.2 Standard Deviation

Calculate the standard deviation, Sd, of a data set as follows:

 (Eq. A-8)

Where:

|  |  |  |
| --- | --- | --- |
| n | = | Number of data points. |
| di | = | The difference between a reference method value and the corresponding continuous emission monitoring system value (RMi- CEMi) at a given point in time i. |

7.3.3 Confidence Coefficient

Calculate the confidence coefficient (one-tailed), cc, of a data set as follows:

 (Eq. A-9)

Where:

|  |  |  |
| --- | --- | --- |
| t0.025 | = | t value (see Table 7-1). |

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Table 7-1 t-Values | | | | | |
| n-1 | t0.025 | n-1 | t0.025 | n-1 | t0.025 |
| 1 | 12.706 | 12 | 2.179 | 23 | 2.069 |
| 2 | 4.303 | 13 | 2.160 | 24 | 2.064 |
| 3 | 3.182 | 14 | 2.145 | 25 | 2.060 |
| 4 | 2.776 | 15 | 2.131 | 26 | 2.056 |
| 5 | 2.571 | 16 | 2.120 | 27 | 2.052 |
| 6 | 2.447 | 17 | 2.110 | 28 | 2.048 |
| 7 | 2.365 | 18 | 2.101 | 29 | 2.045 |
| 8 | 2.306 | 19 | 2.093 | 30 | 2.042 |
| 9 | 2.262 | 20 | 2.086 | 40 | 2.021 |
| 10 | 2.228 | 21 | 2.080 | 60 | 2.000 |
| 11 | 2.201 | 22 | 2.074 | >60 | 1.960 |

7.3.4 Relative Accuracy

Calculate the relative accuracy of a data set using the following equation.

 (Eq. A-10)

Where:

|  |  |  |
| --- | --- | --- |
|  | = | Arithmetic mean of the reference method values. |
|  | = | The absolute value of the mean difference between the reference method values and the corresponding continuous emission monitoring system values. |
|  | = | The absolute value of the confidence coefficient. |

7.5 Reference Flow-to-Load Ratio or Gross Heat Rate

a) Except as provided in Section 7.6 of this Exhibit, the owner or operator must determine Rref, the reference value of the ratio of flow rate to unit load, each time that a passing flow RATA is performed at a load level designated as normal in Section 6.5.2.1 of this Exhibit. The owner or operator must report the current value of Rref in the electronic quarterly report required under 40 CFR 75.64, incorporated by reference in Section 225.140, and must also report the completion date of the associated RATA. If two load levels have been designated as normal under Section 6.5.2.1 of this Exhibit, the owner or operator must determine a separate Rrefvalue for each of the normal load levels. The reference flow-to-load ratio must be calculated as follows:

 (Eq. A-13)

Where:

|  |  |  |
| --- | --- | --- |
| Rref | = | Reference value of the flow-to-load ratio, from the most recent normal-load flow RATA, scfh/megawatts, scfh/1000 lb/hr of steam, or scfh/ (mmBtu/hr of steam output). |
| Qref | = | Average stack gas volumetric flow rate measured by the reference method during the normal-load RATA, scfh. |
| Lavg | = | Average unit load during the normal-load flow RATA, megawatts, 1000 lb/hr of steam, or mmBtu/hr of thermal output. |

b) In Equation A-13, for a common stack, determine Lavg by summing, for each RATA run, the operating loads of all units discharging through the common stack, and then taking the arithmetic average of the summed loads. For a unit that discharges its emissions through multiple stacks, either determine a single value of Qref for the unit or a separate value of Qref for each stack. In the former case, calculate Qref by summing, for each RATA run, the volumetric flow rates through the individual stacks and then taking the arithmetic average of the summed RATA run flow rates. In the latter case, calculate the value of Qref for each stack by taking the arithmetic average, for all RATA runs, of the flow rates through the stack. For a unit with a multiple stack discharge configuration consisting of a main stack and a bypass stack (e.g., a unit with a wet SO2 scrubber), determine Qref separately for each stack at the time of the normal load flow RATA. Round off the value of Rref to two decimal places.

c) In addition to determining Rrefor as an alternative to determine Rref, a reference value of the gross heat rate (GHR) may be determined. In order to use this option, quality assured diluent gas (CO2 or O2) must be available for each hour of the most recent normal-load flow RATA. The reference value of the GHR must be determined as follows:

 (Eq. A-13a)

Where:

|  |  |  |
| --- | --- | --- |
| (GHR)ref | = | Reference value of the gross heat rate at the time of the most recent normal-load flow RATA, Btu/kwh, Btu/lb steam load, or Btu heat input/mmBtu steam output. |
| (HeatInput)avg | = | Average hourly heat input during the normal-load flow RATA, as determined using the applicable equation in Exhibit C to this Appendix, mmBtu/hr. For multiple stack configurations, if the reference GHR value is determined separately for each stack, use the hourly heat input measured at each stack. If the reference GHR is determined at the unit level, sum the hourly heat inputs measured at the individual stacks. |
| Lavg | = | Average unit load during the normal-load flow RATA, megawatts, 1000 lb/hr of steam, or mmBtu/hr thermal output. |

d) In the calculation of (HeatInput)avg, use Qref, the average volumetric flow rate measured by the reference method during the RATA, and use the average diluent gas concentration measured during the flow RATA (i.e., the arithmetic average of the diluent gas concentrations for all clock hours in which a RATA run was performed).

7.6 Flow-to-Load Test Exemptions

For complex stack configurations (e.g., when the effluent from a unit is divided and discharges through multiple stacks in such a manner that the flow rate in the individual stacks cannot be correlated with unit load), the owner or operator may petition the USEPA under 40 CFR 75.66, incorporated by reference in Section 225.140, for an exemption from the requirements of Section 7.7 to appendix A to 40 CFR 75 and Section 2.2.5 of Exhibit B to Appendix B. The petition must include sufficient information and data to demonstrate that a flow-to-load or gross heat rate evaluation is infeasible for the complex stack configuration.

Figure 1. Linearity Error Determination

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Day |  | Date and time |  | Reference value |  | Monitor value |  | Difference |  | Percent of reference value |
| Low-level: |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |  |  |  |  |
| Mid-level: |  |  |  |  |  |  |  |  |  |  |
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Figure 2. Relative Accuracy Determination (Pollutant Concentration Monitors)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | | SO2 (ppm [FNc]) | | | | | | | | |  | | CO2 (Pollutant) (ppm [FNc]) | | | | | | |
| Run No. |  | | Date and time |  | RM [FNa] |  | M [FNb] |  | Diff |  | | Date and time | |  | RM [FNa] |  | M [FNb] |  | Diff | |
| 1 |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
|  |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
| 2 |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
|  |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
| 3 |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
|  |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
| 4 |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
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| 5 |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
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| 8 |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
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| 9 |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
|  |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
| 10 |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
|  |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
| 11 |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
|  |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
| 12 |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |
|  |  | |  |  |  |  |  |  |  |  | |  | |  |  |  |  |  |  | |

Arithmetic Mean Difference (Eq. A-7).

Confidence Coefficient (Eq. A-9).

Relative Accuracy (Eq. A-10).

[FNa] RM means "reference method data".

[FNb] M means "monitor data".

[FNc] Make sure the RM and M data are on a consistent basis, either wet or dry.

Figure 3. Relative Accuracy Determination (Flow Monitors)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Flow rate (Low) | | | |  | Flow rate (Normal) | | | |  | Flow rate (High) | | | |
|  | (scf/hr) [FNa] | | | |  | (scf/hr) [FNa] | | | |  | (scf/hr) [FNa] | | | |
| Run time | Date and time | RM | M | Diff |  | Date and time | RM | M | Diff |  | Date and time | RM | M | Diff |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 8 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 9 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 10 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 11 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |
| 12 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |  | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ | \_\_\_\_ |

Arithmetic Mean Difference (Eq. A-7).

Confidence Coefficient (Eq. A-9).

Relative Accuracy (Eq. A-10).

[FNa] Make sure the RM and M data are on a consistent basis, either wet or dry.

Figure 4. Relative Accuracy Determination (NOx/Dilent Combined System)

Reference method data NOx system (lb/mmBtu)

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Run No. |  | Date and time |  | NOx ( ) |  | [FNa] |  | O2/ CO2% |  | RM |  | M |  | Difference |
| 1 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 7 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 8 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 10 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 11 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 12 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Arithmetic Mean Difference (Eq. A-7).

Confidence Coefficient (Eq. A-9).

Relative Accuracy (Eq. A-10).

[FNa] Specify units: ppm, lb/dscf, mg/dscm.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Figure 5. Cycle Time | | | | | | | | | | | |
| Date of test |  | | | | | | | | | | |
| Component/system ID#: | | | | | | |  | | | | |
| Analyzer type | |  | | | | | | | | | |
| Serial Number | | |  | | | | | | | | |
| High level gas concentration: | | | | | | | |  | | | ppm/% (circle one) |
| Zero level gas concentration: | | | | | | | |  | | | ppm/% (circle one) |
| Analyzer span setting: | | | | | |  | | | | | ppm/% (circle one) |
| Upscale: | | | | | | | | | | | |
| Stable starting monitor value: | | | | | | | | |  | | ppm/% (circle one) |
| Stable ending monitor reading: | | | | | | | | | |  | ppm/% (circle one) |
| Elapsed time: | | | |  | | | | | | | Seconds |
| Downscale: | | | | | | | | | | | |
| Stable starting monitor value: | | | | | | | | |  | | ppm/% (circle one) |
| Stable ending monitor reading: | | | | | | | | | |  | ppm/% (circle one) |
| Elapsed time: | | | |  | | | | | | | seconds |
| Component cycle time = | | | | | | |  | | | | seconds |
| System cycle time = | | | | |  | | | | | | seconds |

A. To determine the upscale cycle time (Figure 6a), measure the flue gas emissions until the response stabilizes. Record the stabilized value (see Section 6.4 of this Exhibit for the stability criteria).

B. Inject a high-level calibration gas into the port leading to the calibration cell or thimble (Point B). Allow the analyzer to stabilize. Record the stabilized value.

C. Determine the step change. The step change is equal to the difference between the final stable calibration gas value (Point D) and the stabilized stack emissions value (Point A).

D. Take 95% of the step change value and add the result to the stabilized stack emissions value (Point A). Determine the time at which 95% of the step change occurred (Point C).

E. Calculate the upscale cycle time by subtracting the time at which the calibration gas was injected (Point B) from the time at which 95% of the step change occurred (Point C). In this example, upscale cycle time = (11-5) = 6 minutes.

F. To determine the downscale cycle time (Figure 6b) repeat the procedures above, except that a zero gas is injected when the flue gas emissions have stabilized, and 95% of the step change in concentration is subtracted from the stabilized stack emissions value.

G. Compare the upscale and downscale cycle time values. The longer of these two times is the cycle time for the analyzer.

(Source: Added at 33 Ill. Reg. 10427, effective June 26, 2009)