4. Appendix B to part 60 is amended by adding Performance Specification 17 in numerical order to read as follows:

Appendix B to Part 60—Performance Specifications

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Performance Specification 17—Specifications and Test Procedures for Continuous Parameter Monitoring Systems at Stationary Sources

1.0 *What is the purpose of Performance Specification 17?*

The purpose of Performance Specification 17 (PS–17) is to establish the initial installation and performance procedures that are required for evaluating the acceptability of a continuous parameter monitoring system (CPMS). This performance specification applies instead of the requirements for applicable CPMS specified in any applicable subpart to 40 CFR part 60, 61, or 63, unless otherwise specified in the applicable subpart. This performance specification does not establish procedures or criteria for evaluating the ongoing performance of an installed CPMS over an extended period of time. Procedures for evaluating the ongoing performance of a CPMS are described in Procedure 4 of appendix F to 40 CFR part 40, Quality Assurance Procedures.

1.1 Under what circumstances does PS–17 apply to my CPMS? This performance specification applies to your CPMS if your CPMS meets the conditions specified in section 1.2 of this specification and you meet either conditions (1) or (2) of this section:

(1) You are required by any applicable subpart of 40 CFR parts 60 or 61 to install and operate the CPMS, or

(2) You are required by any applicable subpart of 40 CFR part 63 to install and operate the CPMS, and § 63.8(a)(2) of the General Provisions applies to the applicable subpart.

1.2 To what types of devices does PS–17 apply? This performance specification applies if your total equipment meets the conditions of (1) and (2) of this section:

(1) You are required by an applicable subpart to install and operate the total equipment on a continuous basis, and

(2) You, as owner or operator, use the total equipment to monitor the parameters (currently temperature, pressure, liquid flow rate, gas flow rate, mass flow rate, pH, and conductivity) associated with the operation of an emission control device or process unit.

1.3 When must I comply with PS–17? You must comply with PS–17 when any of conditions (1) through (5) of this section occur:

(1) At the time you install and place into operation a CPMS that is required by the applicable subpart after 90 days following the date of publication of the final rule in the **Federal Register**, or

(2) At the time you replace or relocate the sensor of an affected CPMS after 90 days following the date of publication of the final rule in the **Federal Register**, or

(3) At the time you replace the electronic signal modifier or conditioner, transmitter, external power supply, data acquisition system, data recording system, or any other mechanical or electrical component of your CPMS that affects the accuracy, range, or resolution of your CPMS after 90 days following the date of publication of the final rule in the **Federal Register**, or

(4) For CPMS located at facilities that are required to obtain a title V permit, at the time of your title V permit renewal.

(i) Prior to submitting your title V permit renewal, you must comply with the basic requirements of this performance specification.

(5) For CPMS located at area source facilities that are exempt from obtaining a title V permit, 5 years after the date of publication of the final rule in the **Federal Register**.

2.0 *What are the basic requirements of PS–17?*

This performance specification requires you, as an owner or operator of an applicable CPMS, to perform and record initial installation and calibration procedures to confirm the acceptability of the CPMS when it is installed and placed into operation.

2.1 How does PS–17 address the installation and equipment requirements for my CPMS? This specification stipulates basic installation, location, and equipment requirements for CPMS and identifies applicable voluntary consensus standards that provide additional guidance on the selection and installation of specific types of sensors associated with CPMS. This specification also identifies the types of equipment needed to check the accuracy of your CPMS. General equipment requirements are identified in section 6 of this specification. Location and installation requirements are addressed in sections 8.1 and 8.2 of this specification.

2.2 What types of procedures must I perform to demonstrate compliance with PS–17? This specification requires you, as owner or operator of a CPMS, to demonstrate that your CPMS satisfies minimum requirements for accuracy. For each of the monitoring parameters addressed (currently temperature, pressure, liquid flow rate, gas flow rate, mass flow rate, pH, and conductivity), this specification offers you the choice of two or more methods that you can use to demonstrate that your CPMS meets the specified accuracy requirements. For accuracy demonstrations that involve measurement of gas or liquid pressures, this specification also requires you to perform a leak test on any pressure connections. Accuracy demonstration methods are described in sections 8.4 through 8.8 of this specification; section 8.9 addresses alternative procedures for demonstrating compliance with this specification; and leak test procedures are described in section 8.10 of this specification.

2.3 What does PS–17 require me to do if my CPMS does not meet the specified accuracy requirements? If your CPMS does not meet the accuracy requirements, section 8 of this specification requires you to take corrective action until you can demonstrate that your CPMS meets the accuracy requirement.

2.4 What types of recordkeeping and reporting activities does PS–17 require? This specification does not have any reporting requirements but does require you to record and maintain data that identify your CPMS and show the results of any performance demonstrations of your CPMS. Recordkeeping requirements are described in section 14 of this specification.

3.0 *What special definitions apply to PS–17?*

3.1 Accuracy. A measure of the closeness of a measurement to the true or actual value.

3.2 Accuracy hierarchy. The ratio of the accuracy of a measurement instrument to the accuracy of a calibrated instrument or standard that is used to measure the accuracy of the measurement instrument. For example, if the accuracy of a calibrated temperature measurement device is 0.2 percent, and the accuracy of a thermocouple is 1.0 percent, the accuracy hierarchy is 5.0 (1.0 ÷ 0.2 = 5.0).

3.3 Conductivity CPMS. The total equipment that is used to measure and record the conductivity of a liquid on a continuous basis.

3.4 Continuous Parameter Monitoring System (CPMS). The total equipment that is used to measure and record a parameter (currently temperature, pressure, liquid flow rate, gas flow rate, mass flow rate, pH, and conductivity) on a continuous basis in one or more locations.

3.5 Cryogenic Application. An application of a temperature CPMS in which the sensor is subjected to a temperature of zero degrees Celsius (32 degrees Fahrenheit) or less.

3.6 Differential pressure tube. A device, such as a pitot tube, that consists of one or more pairs of tubes that are oriented to measure the velocity pressure and static pressure at one or more fixed points within a duct for the purpose of determining gas velocity.

3.7 Electronic Components. The electronic signal modifier or conditioner, transmitter, and power supply associated with a CPMS.

3.8 Flow CPMS. The total equipment that is used to measure and record liquid flow rate, gas flow rate, or mass flow rate on a continuous basis.

3.9 Integrator. The equipment that is used to calculate the material feed rate using two inputs: weight of the load on the material transfer system (e.g. belt conveyor) and the speed of the system.

3.10 Mass flow rate. The measurement of solid, liquid, or gas flow in units of mass per time, such as kilograms per minute or tons per hour.

3.11 Mechanical Component. Any component of a CPMS that consists of or includes moving parts or that is used to apply or transfer force to another component or part of the CPMS.

3.12 pH CPMS. The total equipment that is used to measure and record the pH of a liquid on a continuous basis.

3.13 Pressure CPMS. The total equipment that is used to measure and record the pressure of a liquid or gas at any location, or the differential pressure of a liquid or gas between any two locations, on a continuous basis.

3.14 Resolution. The smallest detectable or legible increment of measurement.

3.15 Sensor. The component or set of components of a CPMS that reacts to changes in the magnitude of the parameter that is measured by the CPMS (currently temperature, pressure, liquid flow rate, gas flow rate, mass flow rate, pH, or conductivity) and generates an output signal. Table 1 identifies the sensor components of some commonly used CPMS.

3.16 Solid mass flow rate. The measurement of the rate at which a solid material is processed or transferred (in units of mass per time). Examples of solid mass flow rate are the rate at which ore is fed to a material dryer or the rate at which powdered lime is injected into an exhaust duct.

3.17 Temperature CPMS. The total equipment that is used to measure and record the temperature of a liquid or gas at any location, or the differential temperature of a liquid or gas between any two locations, on a continuous basis.

3.18 Total Equipment. The sensor, mechanical components, electronic components, data acquisition system, data recording system, electrical wiring, and other components of a CPMS.

4.0 *Interferences* [Reserved]

5.0 *What do I need to know to ensure the safety of persons who perform the procedures specified in PS–17?*

The procedures required under this specification may involve hazardous materials, operations, site conditions, and equipment. This performance specification does not purport to address all of the safety issues associated with these procedures. It is the responsibility of the user to establish appropriate safety and health practices and determine the applicable regulatory limitations prior to performing these procedures.

6.0 *What equipment and supplies do I need?*

The types of equipment that you need to comply with this specification depend upon the parameter that is measured by your CPMS and upon site-specific conditions. You must select the appropriate equipment based on manufacturer's recommendations, your site-specific conditions, the parameter that your CPMS measures, and the method that you choose for demonstrating compliance with this specification. For most CPMS, you will need the two types of equipment described in paragraphs (1) and (2) of this section.

(1) The total equipment that is used to monitor and record the appropriate parameter, as defined in section 3.17 of this specification, and

(2) The equipment needed to perform the initial validation check of your CPMS, as specified in sections 8.4 through 8.8 of this specification.

6.1 What design criteria must my CPMS satisfy? You must select a CPMS that meets the design specifications in paragraphs (1) through (5) of this section.

(1) Your CPMS must satisfy the accuracy requirements of Table 8 of this specification.

(2) Your CPMS must be capable of measuring the appropriate parameter (currently temperature, pressure, liquid flow rate, gas flow rate, mass flow rate, pH, or conductivity) over a range that extends from a value that is at least 20 percent less than the lowest value that you expect your CPMS to measure, to a value that is at least 20 percent greater than the highest value that you expect your CPMS to measure.

(3) The signal conditioner, wiring, power supply, and data acquisition and recording system of your CPMS must be compatible with the output signal of the sensors used in your CPMS.

(4) The data acquisition and recording system of your CPMS must be able to record values over the entire range specified in paragraph (2) of this section.

(5) The data recording system associated with your CPMS must have a resolution of one-half of the required overall accuracy of your CPMS, as specified in Table 8 of this specification, or better.

6.2 Are there any exceptions to the range requirements specified in section 6.1 of PS–17? A pH CPMS must be capable of measuring pH over the entire range of pH values from 0 to 14.

6.3 What additional guidelines should I use for selecting the sensor of my CPMS? Additional guidelines for selecting temperature and pressure sensors are listed in paragraphs (1) and (2) of this section.

(1) For a temperature CPMS, you should select a sensor that is consistent with the standards listed in Table 2 of this specification.

(2) If your pressure CPMS uses a pressure gauge as the sensor, you should select a gauge that conforms to the design requirements of ASME B40.100–2005, "Pressure Gauges and Gauge Attachments" (incorporated by reference—see § 60.17).

6.4 What types of equipment do I need for checking the accuracy of my CPMS? The specific types of equipment that you need for checking the accuracy of your CPMS depend on the type of CPMS and the method that you choose for conducting the initial validation check of your CPMS, as specified in sections 8.4 through 8.8 of this specification. In most cases, you will need the equipment specified in paragraphs (1) and (2) of this section.

(1) A separate device that either measures the same parameter as your CPMS, or that simulates the same electronic signal or response that your CPMS generates, and

(2) Any work platform, test ports, pressure taps, valves, fittings, or other equipment required to perform the specific procedures of the validation check method that you choose, as specified in sections 8.4 through 8.8 of this specification.

6.5 What are the accuracy requirements for the equipment that I use for checking the accuracy of my CPMS? Any measurement instrument or device that is used to conduct the initial validation check of your CPMS must have an accuracy that is traceable to National Institute of Standards and Technology (NIST) standards and must have an accuracy hierarchy of at least three. To determine if a measurement instrument or device satisfies this accuracy hierarchy requirement, follow the procedure described in section 12.1 of this specification.

6.6 Are there any exceptions to the accuracy requirement of section 6.5 of PS–17? There are two exceptions to the NIST-traceable accuracy requirement specified in section 6.5 of this specification, as described in paragraphs (1) and (2) of this section.

(1) As an alternative for a calibrated pressure measurement device with NIST-traceable accuracy specified in paragraphs (1) and (3) of section 8.5 and in paragraph (3) of section 8.6 of this specification, you can use a mercury-in-glass or water-in-glass U-tube manometer to validate your pressure CPMS.

(2) When validating a flow rate CPMS using the methods specified in paragraphs (1), (2), or (7) of section 8.6 of this specification, the container used to collect or weigh the liquid or solid is not required to have NIST-traceable accuracy.

7.0 *What reagents or standards do I need to comply with PS–17?*

The specific reagents and standards needed to demonstrate compliance with this specification depend upon the parameter that your CPMS measures and the method that you choose to check the accuracy of your CPMS. Section 8.3 of this specification identifies the specific reagents and standards needed for each initial validation check of CPMS accuracy.

8.0 *What performance demonstrations must I conduct?*

You must satisfy the installation requirements, perform an initial calibration, and perform an initial validation check of your CPMS using the procedures specified in sections 8.1 through 8.8 of this specification.

8.1 How must I install my CPMS? The installation of your CPMS must satisfy the requirements specified in paragraphs (1) and (2) of this section.

(1) You must install each sensor of your CPMS in a location that provides representative measurement of the applicable parameter over all operating conditions, taking into account the manufacturer's guidelines and any location specified in the applicable requirement.

(2) You must also install any work platforms, test ports, pressure taps, valves, fittings, or other equipment needed to perform the initial validation check, as specified in sections 8.4 through 8.8 of this specification.

8.2 What additional guidelines can I use for installing my CPMS? If you are required to install a flow CPMS and the sensor of your flow CPMS is a differential pressure device, turbine flow meter, rotameter, vortex formation flow meter or Coriolis mass flow meter, you can use the standards listed in Table 3 of this specification as guidelines for installation.

8.3 What initial quality assurance measures are required by PS–17 for my CPMS? You must perform an initial calibration of your CPMS based on the procedures specified in the manufacturer's owner's manual. You also must perform an initial validation check of the operation of your CPMS using the methods described in sections 8.4 through 8.8 of this specification.

8.4 How do I perform the initial validation check of my temperature CPMS? To perform the initial validation check of a temperature CPMS, you can choose one of the methods described in paragraphs (1) and (2) of this section.

(1) Comparison to Calibrated Temperature Measurement Device. Place the sensor of a calibrated temperature measurement device adjacent to the sensor of your temperature CPMS so that the sensor of the calibrated test device is subjected to the same environment as the sensor of your temperature CPMS. The calibrated temperature measurement device must satisfy the accuracy requirements specified in section 6.5 of this specification. The calibrated temperature measurement device must also have a range equal to or greater than the range of your temperature CPMS. Allow sufficient time for the response of the calibrated temperature measurement device to reach equilibrium. With the process or control device that is monitored by your CPMS operating under normal conditions, concurrently record the temperatures measured by your temperature CPMS and the calibrated temperature measurement device. Using the temperature measured by the calibrated measurement device as the value for V_c, follow the procedure specified in section 12.2 to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8, the validation check is complete. If your CPMS does not satisfy the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check procedure until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record temperatures at multiple locations, repeat this procedure for each location.

(2) Temperature Simulation Procedure. Disconnect the sensor from your temperature CPMS and connect to your CPMS a calibrated simulation device that is designed to simulate the same type of response as the sensor of your CPMS. The calibrated simulation device must satisfy the accuracy requirements specified in section 6.5 of this specification. Simulate a typical temperature that is measured by your temperature CPMS under normal operating conditions. Allow sufficient time for the response of the calibrated simulation device to reach equilibrium. Record the temperature that is indicated by your temperature CPMS. Using the temperature simulated by the calibrated simulation device as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8, the validation check is complete. If the calculated accuracy does not meet the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check procedure until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record temperatures at multiple locations, repeat this procedure for each location.

8.5 How do I perform an initial validation check of my pressure CPMS? To perform the initial validation check of your pressure CPMS, you can choose one of the methods described in paragraphs (1) through (3) of this section.

(1) Comparison to Calibrated Pressure Measurement Device. Connect a mercury-in-glass U-tube manometer, a water-in-glass U-tube manometer, or calibrated pressure measurement device to operate in parallel with your pressure CPMS so that the manometer or sensor of the calibrated pressure measurement device is subjected to the same pressure as the sensor of your pressure CPMS. If a calibrated pressure measurement device is used, the device must satisfy the accuracy requirements of section 6.5 of this specification. The calibrated pressure measurement device also must have a range equal to or greater than the range of your pressure CPMS. Perform a leak test on all manometer or calibrated pressure measurement device connections using the procedure specified in section 8.10 of this specification. Allow sufficient time for the response of the manometer or calibrated pressure measurement device to reach equilibrium. With the process or control device that is monitored by your pressure CPMS operating under normal conditions, concurrently record the pressures that are measured by your pressure CPMS and by the calibrated pressure measurement device. Using the pressure measured by the calibrated pressure measurement device as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not meet the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check procedure until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record pressure at multiple locations, repeat this procedure for each location.

(2) Pressure Simulation Procedure Using a Calibrated Pressure Source. Disconnect or close off the process line or lines to your pressure CPMS. Connect an adjustable calibrated pressure source to your CPMS so that the pressure source applies a pressure to the sensor of your pressure CPMS. The calibrated pressure source must satisfy the accuracy requirements of section 6.5 of this specification. The calibrated pressure source also must be adjustable, either continuously or incrementally over the pressure range of your pressure CPMS. Perform a leak test on all calibrated pressure source connections using the procedure specified in section 8.10 of this specification. Using the calibrated pressure source, apply a pressure that is within ±10 percent of the normal operating pressure of your pressure CPMS. Allow sufficient time for the response of the calibrated pressure source to reach equilibrium. Record the pressure applied by the calibrated pressure source and the pressure measured by your pressure CPMS. Using the pressure applied by the calibrated pressure source as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not meet the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check procedure until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record pressure at multiple locations, repeat this procedure for each location.

(3) Pressure Simulation Procedure Using a Pressure Source and Calibrated Pressure Measurement Device. Disconnect or close off the process line or lines to your pressure CPMS. Attach a mercury-in-glass U-tube manometer, a water-in-glass U-tube manometer, or a calibrated pressure measurement device (the reference pressure measurement device) in parallel to your pressure CPMS. If a calibrated pressure measurement device is used, the device must satisfy the accuracy requirements of section 6.5 of this specification. Connect a pressure source to your pressure CPMS and the parallel reference pressure measurement device. Perform a leak test on all pressure source and parallel reference pressure measurement device connections using the procedure specified in section 8.10 of this specification. Apply pressure to your CPMS and the parallel reference pressure measurement device. Allow sufficient time for the response of your CPMS and the parallel reference pressure measurement device to reach equilibrium. Record the pressure measured by your pressure CPMS and the reference pressure measurement device. Using the pressure measured by the parallel reference pressure measurement device as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not meet the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check procedure until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record pressure at multiple locations, repeat this procedure for each location.

8.6 How do I perform an initial validation check of my flow CPMS? To perform the initial validation check of your flow CPMS, you can choose any one of the methods described in paragraphs (1) through (7) of this section that is applicable to the type of material measured by your flow CPMS and the type of sensor used in your flow CPMS.

(1) Volumetric Method. This method applies to any CPMS that is designed to measure liquid flow rate. With the process or control device that is monitored by your flow CPMS operating under normal conditions, record the flow rate measured by your flow CPMS for the subject process line. At the same time, collect the liquid that is flowing through the same process line for a measured length of time using the Volumetric Method specified in one of the standards listed in Table 4 of this specification. Using the flow rate measured by the Volumetric Method as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not satisfy the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record flow rate at multiple locations, repeat this procedure for each location.

(2) Gravimetric Method. This method applies to any CPMS that is designed to measure liquid flow rate, liquid mass flow rate, or solid mass flow rate. With the process or control device that is monitored by your flow CPMS operating under normal conditions, record the flow rate measured by your flow CPMS for the subject process line. At the same time, collect the material (liquid or solid) that is flowing or being transferred through the same process line for a measured length of time using the Weighing, Weigh Tank, or Gravimetric Methods specified in the standards listed in Table 5. Using the flow rate measured by the Weighing, Weigh Tank, or Gravimetric Methods as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not satisfy the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record flow rate at multiple locations, repeat this procedure for each location.

(3) Differential Pressure Measurement Method. This method applies only to flow CPMS that use a differential pressure measurement flow device, such as an orifice plate, flow nozzle, or venturi tube. This method may not be used to validate a flow CPMS that measures gas flow by means of one or more differential pressure tubes. With the process or control device that is monitored by your CPMS operating under normal conditions, record the flow rate measured by your flow CPMS. Under the same operating conditions, disconnect the pressure taps from your flow CPMS and connect the pressure taps to a mercury-in-glass U-tube manometer, a water-in-glass U-tube manometer, or calibrated differential pressure measurement device. If a calibrated pressure measurement device is used, the device must satisfy the accuracy requirements of section 6.5 of this specification. Perform a leak test on all manometer or calibrated differential pressure measurement device connections using the procedure specified in section 8.10 of this specification. Allow sufficient time for the response of the calibrated differential pressure measurement device to reach equilibrium. Within 30 minutes of measuring and recording the flow rate using your CPMS, record the pressure drop measured by the calibrated differential pressure measurement device. Using the manufacturer's literature or the procedures specified in ASME MFC–3M–2004 (incorporated by reference—see § 60.17), calculate the flow rate that corresponds to the differential pressure measured by the calibrated differential pressure measurement device. For CPMS that use an orifice flow meter, the procedures specified in ASHRAE 41.8–1989 (incorporated by reference—see § 60.17) also can be used to calculate the flow rate. Using the calculated flow rate as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not satisfy the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this procedure until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record flow rate at multiple locations, repeat this procedure for each location.

(4) Pressure Source Flow Simulation Method. This method applies only to flow CPMS that use a differential pressure measurement flow device, such as an orifice plate, flow nozzle, or venturi tube. This method may not be used to validate a flow CPMS that measures gas flow by means of one or more differential pressure tubes. Disconnect your flow CPMS from the pressure taps. Connect separate pressure sources to the upstream and downstream sides of your pressure CPMS, where the pressure taps are normally connected. The pressure sources must satisfy the accuracy requirements of section 6.5 of this specification. The pressure sources also must be adjustable, either continuously or incrementally over the pressure range that corresponds to the range of your flow CPMS. Perform a leak test on all connections between the calibrated pressure sources and your flow CPMS using the procedure specified in section 8.10 of this specification. Using the manufacturer's literature or the procedures specified in ASME MFC–3M–2004 (incorporated by reference—see § 60.17), calculate the required pressure drop that corresponds to the normal operating flow rate expected for your flow CPMS. For CPMS that use an orifice flow meter, the procedures specified in ASHRAE 41.8–1989 (incorporated by reference—see § 60.17) also can be used to calculate the pressure drop. Use the calibrated pressure sources to apply the calculated pressure drop to your flow CPMS. Allow sufficient time for the responses of the calibrated pressure sources to reach equilibrium. Record the flow rate measured by your flow CPMS. Using the flow rate measured by your CPMS when the calculated pressure drop was applied as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not satisfy the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this procedure until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record flow rate at multiple locations, repeat this procedure for each location.

(5) Electronic Signal Simulation Method. This method applies to any flow CPMS that uses a flow sensor that generates an electronic signal. Disconnect the sensor from your flow CPMS and connect to your CPMS a calibrated simulation device that is designed to simulate the same type of electrical response as the sensor of your CPMS. The calibrated simulation device must satisfy the accuracy requirements of section 6.5 of this specification. Perform a leak test on all connections between the calibrated simulation device and your flow CPMS using the procedure specified in section 8.10 of this specification. Simulate a typical flow rate that is monitored by your flow CPMS under normal operating conditions. Allow sufficient time for the response of the calibrated simulation device to reach equilibrium. Record the flow rate measured by your flow CPMS. Using the flow rate simulated by the calibrated simulation device as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If the calculated accuracy does not meet the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record flow rate at multiple locations, repeat this procedure for each location.

(6) Relative Accuracy (RA) Test. This method applies to any flow CPMS that measures gas flow rate. If your flow CPMS uses a differential flow tube as the flow sensor, you must use this method to validate your flow CPMS. The reference methods (RM's) applicable to this test are Methods 2, 2A, 2B, 2C, 2D, 2F of 40 CFR part 60, appendix A–1 and Method 2G of 40 CFR part 60, appendix A–2. Conduct three sets of RM tests. Mark the beginning and end of each RM test period on the flow CPMS chart recordings or other permanent record of output. Determine the integrated flow rate for each RM test period. Perform the same calculations specified by section 7.5 in PS–2 of this appendix. If the RA is no greater than 20 percent of the mean value of the RM test data, the RA test is complete. If the RA is greater than 20 percent of the mean value of the RM test data, check all system components and take any corrective action that is necessary to achieve the required RA. Repeat this RA test until the RA requirement of this section is satisfied. If you are required to measure and record flow rate at multiple locations, repeat this procedure for each location.

(7) Material Weight Comparison Method. This method applies to any solid mass flow CPMS that uses a combination of a belt conveyor and scale and is equipped with a totalizer. To conduct this test, pass a quantity of pre-weighed material over the belt conveyor in a manner consistent with actual loading conditions. To weigh the test quantity of material that is to be used during the initial validation, you must use a scale that satisfies the accuracy requirements of section 6.5 of this specification. The test quantity must be sufficient to challenge the conveyor belt-scale system for at least three revolutions of the belt. Record the length of the test. Calculate the mass flow rate using the measured weight and the recorded time. Using this mass flow rate as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not satisfy the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record flow rate at multiple locations, repeat this procedure for each location. In addition, you must perform an initial validation check on the integrator used by your material feed CPMS according to the manufacturer's specifications.

8.7 How do I perform an initial validation check of my pH CPMS? You must perform an initial validation check of your pH CPMS using either of the methods described in paragraphs (1) and (2) of this section.

(1) Comparison to Calibrated pH Measurement Device. Place a calibrated pH measurement device adjacent to your pH CPMS so that the calibrated test device is subjected to the same environment as your pH CPMS. The calibrated pH measurement device must satisfy the accuracy requirements specified in section 6.5 of this specification. Allow sufficient time for the response of the calibrated pH measurement device to reach equilibrium. With the process or control device that is monitored by your CPMS operating under normal conditions, concurrently record the pH measured by your pH CPMS and the calibrated pH measurement device. If concurrent readings are not possible, extract a sufficiently large sample from the process stream and perform measurements using a portion of the sample for each meter. Using the pH measured by the calibrated pH measurement device as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not satisfy the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check procedure until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record pH at multiple locations, repeat this procedure for each location.

(2) Single Point Calibration. This method requires the use of a certified buffer solution. All buffer solutions used must be certified by NIST and accurate to ±0.02 pH units at 25 °C (77 °F). Set the temperature on your pH meter to the temperature of the buffer solution, typically room temperature or 25 °C (77 °F). If your pH meter is equipped with automatic temperature compensation, activate this feature before calibrating. Set your pH meter to measurement mode. Place the clean electrodes into the container of fresh buffer solution. If the expected pH of the process fluid lies in the acidic range (less than 7 pH), use a buffer solution with a pH value of 4.00. If the expected pH of the process fluid lies in the basic range (greater than 7 pH), use a buffer solution with a pH value of 10.00. Allow sufficient time for the response of your pH CPMS to reach equilibrium. Record the pH measured by your CPMS. Using the buffer solution pH as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not satisfy the accuracy requirement of Table 8 of this procedure, calibrate your pH CPMS using the procedures specified in the manufacturer's owner's manual. If the manufacturer's owner's manual does not specify a two-point calibration procedure, you must perform a two-point calibration procedure based on ASTM D1293–99 (2005) (incorporated by reference—see § 60.17). If you are required to measure and record pH at multiple locations, repeat this procedure for each location.

8.8 How do I perform an initial validation check of my conductivity CPMS? You must perform an initial validation check of your conductivity CPMS using either of the methods described in paragraphs (1) and (2) of this section.

(1) Comparison to Calibrated Conductivity Measurement Device. Place a calibrated conductivity measurement device adjacent to your conductivity CPMS so that the calibrated measurement device is subjected to the same environment as your conductivity CPMS. The calibrated conductivity measurement device must satisfy the accuracy requirements specified in section 6.5 of this specification. Allow sufficient time for the response of the calibrated conductivity measurement device to reach equilibrium. With the process or control device that is monitored by your CPMS operating under normal conditions, concurrently record the conductivity measured by your conductivity CPMS and the calibrated conductivity measurement device. If concurrent readings are not possible, extract a sufficiently large sample from the process stream and perform measurements using a portion of the sample for each meter. Using the conductivity measured by the calibrated conductivity measurement device as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the accuracy requirement of Table 8 of this specification, the validation check is complete. If your CPMS does not satisfy the accuracy requirement of Table 8 of this specification, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this validation check procedure until the accuracy requirement of Table 8 of this specification is satisfied. If you are required to measure and record conductivity at multiple locations, repeat this procedure for each location.

(2) Single Point Calibration. This method requires the use of a certified conductivity standard solution. All solutions used must be certified by NIST and accurate to ±2 percent micromhos per centimeter (µmhos/cm) (±2 percent microsiemens per centimeter (µS/cm)) at 25 °C (77 °F). Choose a conductivity standard solution that is close to the measuring range for best results. Since conductivity is dependent on temperature, the conductivity tester should have an integral temperature sensor that adjusts the reading to a standard temperature, usually 25 °C (77 °F). If the conductivity meter allows for manual temperature compensation, set this value to 25 °C (77 °F). Place the clean electrodes into the container of fresh conductivity standard solution. Allow sufficient time for the response of your CPMS to reach equilibrium. Record the conductivity measured by your CPMS. Using the conductivity standard solution as the value for V_c, follow the procedure specified in section 12.2 of this specification to determine if your CPMS satisfies the accuracy requirement of Table 8 of this specification. If you determine that your CPMS satisfies the

accuracy requirement of Table 8, the validation check is complete. If your CPMS does not satisfy the accuracy requirement of Table 8 of this procedure, calibrate your conductivity CPMS using the procedures specified in the manufacturer's owner's manual. If the manufacturer's owner's manual does not specify a calibration procedure, you must perform a calibration procedure based on ASTM D 1125–95 (2005) or ASTM D 5391–99 (2005) (incorporated by reference—see § 60.17). If you are required to measure and record conductivity at multiple locations, repeat this procedure for each location.

8.9 Are there any acceptable alternative procedures for installing and verifying my CPMS? You may use alternative procedures for installing and verifying the operation of your CPMS if the alternative procedures are approved by the Administrator. In addition, for temperature and pressure CPMS, you can use the methods specified in paragraphs (1) and (2) of this section, respectively, to satisfy the initial validation check.

(1) Alternative Temperature CPMS Validation Check. As an alternative to the procedures for the temperature CPMS initial validation check in this specification, you may use the methods listed in Table 6 of this specification to determine the accuracy of thermocouples or resistance temperature detectors. However, you also must check the accuracy of the overall CPMS system using the methods specified in section 8.4 of this specification or an alternative method that has been approved by the Administrator.

(2) Alternative Pressure CPMS Validation Check. As an alternative to the procedure for the pressure CPMS initial validation check in this specification, you may use the methods listed in Table 7 of this specification to check the accuracy of the pressure sensor associated with your pressure CPMS. However, you also must check the accuracy of the overall CPMS using the methods in section 8.5 of this specification or an alternative method that has been approved by the Administrator.

8.10 How do I perform a leak test on pressure connections, as required by this specification? You can satisfy the leak test requirements of sections 8.5 and 8.6 of this specification by following the procedures described in paragraphs (1) through (3) of this section.

(1) For each pressure connection, apply a pressure that is equal to the highest pressure the connection is likely to be subjected to or 0.24 kilopascals (1.0 inch of water column), whichever is greater.

(2) Close off the connection between the applied pressure source and the connection that is being leak-tested.

(3) If the applied pressure remains stable for at least 15 seconds, the connection is considered to be leak tight. If the applied pressure does not remain stable for at least 15 seconds, take any corrective action necessary to make the connection leak tight and repeat this leak test procedure.

9.0 *What ongoing quality control measures are required?*

Ongoing quality control procedures for CPMS are specified in Procedure 4 of appendix F of this part.

10.0 *Calibration and Standardization* [Reserved]

11.0 *Analytical Procedure* [Reserved]

12.0 *What calculations are needed?*

The calculations needed to comply with this performance specification are described in sections 12.1 and 12.2 of this specification.

12.1 How do I determine if a calibrated measurement device satisfies the accuracy hierarchy specified in section 6.5 of this specification. To determine if a calibrated measurement device satisfies the accuracy hierarchy requirement, follow the procedure described in paragraphs (1) and (2) of this section.

(1) Calculate the accuracy hierarchy (A_h) using Equation 17–1.

$$A_h = \frac{A_r}{A_c} \qquad \text{(Eq. 17-1)}$$

Where:

A_h = Accuracy hierarchy, dimensionless.

A_r = Required accuracy (A_p or A_v) specified in Table 8 of this specification, percent or units of parameter value (e.g., degrees Celsius, kilopascals, liters per minute).

A_c= Accuracy of calibrated measurement device, same units as A_r.

(2) If the accuracy hierarchy (A_h) is equal to or greater than 3.0, the calibrated measurement device satisfies the accuracy hierarchy of Section 6.5 of this specification.

12.2 How do I determine if my CPMS satisfies the accuracy requirement of PS–17? To determine if your CPMS satisfies the accuracy requirement of PS–17, follow the procedure described in paragraphs (1) through (4) of this section.

(1) If your CPMS measures temperature, pressure, or flow rate, calculate the accuracy percent value (A_{pv}) using Equation 17–2. If your CPMS measures pH, proceed to paragraph (2) of this section.

$$A_{pv} = V_c \quad \frac{A_p}{100} \qquad \text{(Eq. 17-2)}$$

Where:

A_{pv} = Accuracy percent value, units of parameter measured (e.g., degrees Celsius, kilopascals, liters per minute).

V_c = Parameter value measured by the calibrated measurement device or measured by your CPMS when a calibrated signal simulator is applied to your CPMS during the initial validation check, units of parameter measured (e.g., degrees Celsius, kilopascals, liters per minute).

A_p = Accuracy percentage specified in Table 8 of this specification that corresponds to your CPMS, percent.

(2) If your CPMS measures temperature, pressure, or flow rate other than mass flow rate or steam flow rate, compare the accuracy percent value (A_{pv}) to the accuracy value (A_v) in Table 8 of this specification and select the greater of the two values. Use this greater value as the allowable deviation (d_a) in paragraph (4) of this section. If your CPMS measures pH, use the accuracy value (A_v) specified in Table 8 of this specification as the allowable deviation (d_a). If your CPMS measures steam flow rate, mass flow rate, or conductivity, use the accuracy percent value (A_{pv}) calculated using Equation 17–2 as the allowable deviation (d_a).

(3) Using Equation 17–3, calculate the measured deviation (d_m), which is the absolute value of the difference between the parameter value measured by the calibrated device (V_c) and the value measured by your CPMS (V_m).

$$d_m = |V_c - V_m| \qquad \text{(Eq. 17-3)}$$

Where:

d_m = Measured deviation, units of the parameter measured (e.g., degrees Celsius, kilopascals, liters per minute).

V_c = Parameter value measured by the calibrated measurement device or measured by your CPMS when a calibrated signal simulator is applied to your CPMS during the initial validation check, units of parameter measured (e.g., degrees Celsius, kilopascals, liters per minute).

V_m = Parameter value measured by your CPMS during the initial validation check, units of parameter measured (e.g., degrees Celsius, kilopascals, liters per minute).

(4) Compare the measured deviation (d_m) to the allowable deviation (d_a). If the measured deviation is less than or equal to the allowable deviation, your CPMS satisfies the accuracy requirement of this specification.

13.0 *What initial performance criteria must I demonstrate for my CPMS to comply with PS–17?*

You must demonstrate that your CPMS meets the accuracy requirements specified in Table 8 of this specification.

14.0 *What are the recordkeeping requirements for PS–17?*

You must satisfy the recordkeeping requirements specified in Sections 14.1 and 14.2 of this specification.

14.1 What data does PS–17 require me to record for my CPMS? For each affected CPMS that you operate, you must record the information listed in paragraphs (1) through (6) of this section.

(1) Identification and location of the CPMS;

(2) Manufacturer's name and model number of the CPMS;

(3) Range of parameter values you expect your CPMS to measure and record;

(4) Date of the initial calibration and system validation check;

(5) Results of the initial calibration and system validation check; and

(6) Name of the person(s) who performed the initial calibration and system validation check.

14.2 For how long must I maintain the data that PS–17 requires me to record for my CPMS? You are required to keep the records required by this specification for your CPMS for a period of 5 years. At a minimum, you must maintain the most recent 2 years of data onsite and available for inspection by the enforcement agency.

15.0 *Pollution Prevention* [Reserved]

16.0 *Waste Management* [Reserved]

17.0 *Which references are relevant to PS–17?*

1. Technical Guidance Document: Compliance Assurance Monitoring. U.S. Environmental Protection Agency Office of Air Quality Planning and Standards Emission Measurement Center. August 1998. (*http://www.epa.gov/ttn/emc/cam.html*).

2. NEMA Standard Publication 250. "Enclosures for Electrical Equipment (1000 Volts Maximum)". National Electrical Manufacturers Association. 1997.

3. ASTM E–220–86 (1996): Standard Test Methods for Calibration of Thermocouples by Comparison Techniques. American Society for Testing and Materials. May 1986.

4. MC96–1–1982: Temperature Measurement Thermocouples. American National Standards Institute. August 1982.

5. The pH and Conductivity Handbook. Omega Engineering, Inc. 1995.

6. ASTM E–452–89: "Standard Test Method for Calibration of Refractory Metal Thermocouples Using an Optical Pyrometer". American Society of Testing and Materials. April 1989.

7. ASTM E 644–06: "Standard Test Methods for Testing Industrial Resistance Thermometers". American Society of Testing and Materials. 2006.

8. ASME B 40.100–2005: "Pressure Gauges and Gauge Attachments". American Society of Mechanical Engineers. 2005.

9. ASTM E 251–92 (2003): "Standard Test Methods for Performance Characteristics of Metallic Bonded Resistance Strain Gages". American Society for Testing and Materials. 2003.

10. ASHRAE 41.8–1989: "Standard Methods of Measurement of Flow of Liquids in Pipes Using Orifice Flow Meters". American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 1989.

11. ISA RP 16.6–1961: "Methods and Equipment for Calibration of Variable Area Meters (Rotameters)". Instrumentation, Systems, and Automation Society. 1961.

12. ANSI/ISA–RP31.1–1977: "Specification, Installation, and Calibration of Turbine Flow Meters". Instrumentation, Systems, and Automation Society. 1977.

13. ASTM E 1–95: "Standard Specifications for ASTM Thermometers". American Society for Testing and Materials. 1995.

14. ANSI/ASHRAE 41.1–1986: "Standard Method for Temperature Measurement" American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. February 1987.

15. ANSI/ASHRAE 41.3–1989: "Standard Method for Pressure Measurement". American Society of Heating, Refrigerating, and Air-Conditioning Engineers, Inc. 1989.

16. ISA RP 16.5–1961: "Installation, Operation, and Maintenance Instructions for Glass Tube Variable Area Meters (Rotameters)". Instrumentation, Systems, and Automation Society. 1961.

17. ASME MFC–3M–2004: "Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi". American Society of Mechanical Engineers. 1989.

18. ASTM E–1137–97: "Standard Specification for Industrial Platinum Resistance Thermometers". American Society for Testing and Materials. 1997.

19. The Temperature Handbook. Omega Engineering, Inc. 2000.

20. The Pressure, Strain and Force Handbook. Omega Engineering, Inc. 1999.

21. The Flow and Level Handbook. Omega Engineering, Inc. 2000.

22. ASTM D–5464–93 (1997): "Standard Test Methods for pH Measurement of Water of Low Conductivity". American Society for Testing and Materials. 1993.

23. ASTM D–1293–99: "Standard Test Methods for pH of Water". American Society for Testing and Materials. 1999.

24. ANSI/ASME MFC–4M–1986 (R2003): "Measurement of Gas Flow by Turbine Meters". American Society of Mechanical Engineers. 2003.

25. ASME/ANSI MFC–6M–1987: "Measurement of Fluid Flow in Pipes Using Vortex Flow Meters". American Society of Mechanical Engineers. 1987.

26. ASME/ANSI MFC–7M–1987: "Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles". American Society of Mechanical Engineers. 1987.

27. ASME/ANSI MFC–9M–1988: "Measurement of Liquid Flow in Closed Conduits by Weighing Method". American Society of Mechanical Engineers. 1989.

28. ASME/ANSI MFC–10M–1994: "Measurement of Liquid Flow in Closed Conduits by Volumetric Method". American Society of Mechanical Engineers. 1994.

29. ISO 8316:1987: "Measurement of Liquid Flow in Closed Conduits-Method by Collection of Liquid in a Volumetric Tank". International Organization for Standardization. 1987.

30. NIST Handbook 44—2002 Edition: "Specifications, Tolerances, And Other Technical Requirements for Weighing and Measuring Devices, as adopted by the 86th National Conference on Weights and Measures 2001", Section 2.21: "Belt-Conveyor Scale Systems".

31. ISO 10790:1999: "Measurement of Fluid Flow in Closed Conduits-Guidance to the Selection, Installation, and Use of Coriolis Meters (Mass Flow, Density and Volume Flow Measurements". International Organization for Standardization. 1999.

32. ASTM D 1125–95 (2005): "Standard Test Methods for Electrical Conductivity and Resistivity of Water". American Society for Testing and Materials. 2005.

33. ASTM D 5391–99 (2005): "Standard Test Method for Electrical Conductivity and Resistivity of a Flowing High Purity Water Sample". American Society for Testing and Materials. 2005.

18.0 *What tables are relevant to PS–17?*

TABLE 1—SENSOR COMPONENTS OF COMMONLY USED CPMS

For a CPMS that measures . . .	Using a . . .	The sensor component consists of the . . .
1. Temperature	a. Thermocouple	Thermocouple.
	b. Resistance temperature detector (RTD)	RTD.
	c. Optical pyrometer	Optical assembly and detector.
	d. Thermistor	Thermistor.
	e. Temperature transducer	Integrated circuit sensor?
2. Pressure	a. Pressure gauge	Gauge assembly, including bourdon element, bellows element, or diaphragm.
	b. Pressure transducer	Strain gauge assembly, capacitance assembly, linear variable differential transformer, force balance assembly, potentiometer, variable reluctance assembly, piezoelectric assembly, or piezoresistive assembly.
	c. Manometer	U-tube or differential manometer.
3. Flow rate	a. Differential pressure device	Flow constricting element (nozzle, Venturi, or orifice plate) and differential pressure sensor.
	b. Differential pressure tube	Pitot tube, or other array of tubes that measure velocity pressure and static pressure, and differential pressure sensor.
	c. Magnetic flow meter	Magnetic coil assembly.

TABLE 1—SENSOR COMPONENTS OF COMMONLY USED CPMS—Continued

For a CPMS that measures . . .	Using a . . .	The sensor component consists of the . . .
	d. Positive displacement flow meter	Piston, blade, vane, propeller, disk, or gear assembly.
	e. Turbine flow meter	Rotor or turbine assembly.
	f. Vortex formation flow meter	Vortex generating and sensing elements.
	g. Fluidic oscillating flow meter	Feedback passage, side wall, control port, and thermal sensor.
	h. Ultrasonic flow meter	Sonic transducers, receivers, timer, and temperature sensor.
	i. Thermal flow meter	Thermal element and temperature sensors.
	j. Coriolis mass flow meter	U-tube and magnetic sensing elements.
	k. Rotameter	Float assembly.
	l. Solids flow meter	Sensing plate.
	m. Belt conveyor	Scale.
4. pH	pH meter	Electrode.
5. Conductivity	Conductivity meter	Electrode.

TABLE 2—DESIGN STANDARDS FOR TEMPERATURE SENSORS

If the sensor is a . . .	You can use the following design standards as guidance in selecting a sensor for your CPMS . . .
1. Thermocouple	a. ASTM E235–88 (1996), "Specification for Thermocouples, Sheathed, Type K, for Nuclear or Other High-Reliability Applications."
	b. ASTM E585/E 585M–04, "Specification for Compacted Mineral-Insulated, Metal-Sheathed, Base Metal Thermocouple Cables."
	c. ASTM E608/E 608M–06, "Specification for Mineral-Insulated, Metal-Sheathed Base Metal Thermocouples."
	d. ASTM E696–07, "Specification for Tungsten-Rhenium Alloy Thermocouple Wire."
	e. ASTM E1129/E 1129M–98 (2002), "Standard Specification for Thermocouple Connectors."
	f. ASTM E1159–98 (2003), "Specification for Thermocouple Materials, Platinum-Rhodium Alloys, and Platinum."
	g. ISA–MC96.1–1982, "Temperature Measurement Thermocouples."
2. Resistance temperature detector	ASTM E1137/E1137M–04, "Standard Specification for Industrial Platinum Resistance Thermometers."

TABLE 3—STANDARDS FOR THE INSTALLATION OF FLOW SENSORS

If the sensor of your flow CPMS is a . . .	You should install the flow sensor according to . . .
1. Differential pressure device	ASME MFC–3M–2004, "Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi".
2. Critical flow venturi flow meter used to measure gas flow rate.	ASME/ANSI MFC–7M–1987 (R2001), "Measurement of Gas Flow by Means of Critical Flow Venturi Nozzles".
3. Turbine flow meter	ANSI/ISA RP 31.1–1977, "Recommended Practice: Specification, Installation, and Calibration of Turbine Flowmeters", or, if used for gas flow measurement, ANSI/ASME MFC–4M–1986 (R2003), "Measurement of Gas Flow by Turbine Meters".
4. Rotameter	ISA RP 16.5–1961, "Installation, Operation, and Maintenance Instructions for Glass Tube Variable Area Meters (Rotameters)".
5. Coriolis mass flow meter	ISO 10790:1999, "Measurement of fluid flow in closed conduits—Guidance to the selection, installation and use of Coriolis meters (mass flow, density and volume flow measurements).
6. Vortex formation flow meter	ASME/ANSI MFC–6M–1998 (R2005), "Measurement of Fluid Flow in Pipes Using Vortex Flow Meters".

TABLE 4—VOLUMETRIC METHODS FOR INITIAL VALIDATION CHECK OF FLOW METERS

Designation	Title
1. ISA RP 16.6–1961	"Methods and Equipment for Calibration of Variable Area Meters (Rotameters)".
2. ANSI/ISA RP 31.1–1977	"Specification, Installation, and Calibration of Turbine Flow Meters".
3. ISO 8316:1987	"Measurement of Liquid Flow in Closed Conduits—Method by Collection of Liquid in a Volumetric Tank".

TABLE 5—WEIGHING METHODS FOR INITIAL VALIDATION CHECK OF FLOW METERS

Designation	Title
1. ASHRAE 41.8–1989	"Standard Methods of Measurement of Flow of Liquids in Pipes Using Orifice Flow Meters".
2. ISA RP 16.6–1961	"Methods and Equipment for Calibration of Variable Area Meters (Rotameters)".
3. ANSI/ISA RP 31.1–1977	"Specification, Installation, and Calibration of Turbine Flow Meters".

TABLE 5—WEIGHING METHODS FOR INITIAL VALIDATION CHECK OF FLOW METERS—Continued

Designation	Title
4. ANSI/ASME MFC–9M–1988	"Measurement of Liquid Flow in Closed Conduits by Weighing Method".

TABLE 6—ALTERNATE METHODS FOR INITIAL VALIDATION CHECK OF TEMPERATURE SENSORS

If the temperature sensor in your CPMS is a . . .	And is used in . . .	You can perform the initial validation check of the sensor using . . .
1. Thermocouple	Any application	ASTM E220–07e1.
2. Thermocouple	A reducing environment	ASTM E452–02 (2007).
3. Resistance temperature detector	Any application	ASTM E644–06.

TABLE 7—ALTERNATE METHODS FOR INITIAL VALIDATION CHECK OF PRESSURE SENSORS

If the pressure sensor in your CPMS is a . . .	You can perform the initial validation check of the sensor using . . .
1. Pressure gauge	ASME B40.100–2005.
2. Metallic bonded resistance strain gauge	ASTM E251–92 (2003).

TABLE 8—CPMS ACCURACY REQUIREMENTS

If your CPMS measures . . .	You must demonstrate that your CPMS operates within . . .
1. Temperature, in a non-cryogenic application.	An accuracy percentage (A_p) of ±1.0 percent of the temperature measured in degrees Celsius or within an accuracy value (A_v) of 2.8 degrees Celsius (5 degrees Fahrenheit), whichever is greater.
2. Temperature, in a cryogenic application.	An accuracy percentage (A_p) of ±2.5 percent of the temperature measured in degrees Celsius or within an accuracy value (A_v) of 2.8 degrees Celsius (5 degrees Fahrenheit), whichever is greater.
3. Pressure	An accuracy percentage (A_p) of ±5 percent or an accuracy value (A_v) of 0.12 kilopascals (0.5 inches of water column), whichever is greater.
4. Liquid flow rate	An accuracy percentage (A_p) of ±5 percent or an accuracy value (A_v) of 1.9 liters per minute (0.5 gallons per minute), whichever is greater.
5. Gas flow rate	a. A relative accuracy of ±20 percent, if you demonstrate compliance using the relative accuracy test, or b. An accuracy percentage (A_p) of ±10 percent, if your CPMS measures steam flow rate, or c. An accuracy percentage (A_p) of ±5 percent or an accuracy value (A_v) of 280 liters per minute (10 cubic feet per minute), whichever is greater, for all other gases and accuracy audit methods.
6. Mass flow rate	An accuracy percentage (A_p) of ±5 percent.
7. pH	An accuracy value (A_v) of ±0.2 pH units.
8. Conductivity	An accuracy percentage (A_p) of ±5 percent.

5. Appendix F to part 60 is amended as follows:

a. In Procedure 1, by:

i. Revising the second (last) sentence in the first paragraph of section 1.1; and

ii. Adding sections 4.1.1, 4.1.2, 4.3.3, 4.4.1, 5.5.5, and 5.1.7.

b. Adding Procedure 4 in numerical order to read as follows:

Appendix F to Part 60—Quality Assurance Procedures

Procedure 1. Quality Assurance Requirements for Gas Continuous Emission Monitoring Systems Used for Compliance Determination

1. Applicability and Principle

1.1 * * * The CEMS may include systems that monitor one pollutant (e.g., SO_2 or NO_X), a combination of pollutants (e.g., benzene and hexane), or diluents (e.g., O_2 or CO_2).

* * * * *

4. CD Assessment

* * * * *

4.1.1 Multiple Organic Pollutant CEMS. Source owners and operators of gas chromatographic CEMS that are subject to PS 9 and are used to monitor multiple organic pollutants must perform the daily CD requirement specified in section 4.1 of this procedure using any one of the target pollutants specified in the applicable regulation.

4.1.2 CEMS Subject to PS 15. To satisfy the daily CD requirement of this procedure, source owners and operators of extractive Fourier Transfer Infrared (FTIR) CEMS that are subject to PS 15 must perform at least once daily the calibration transfer standards check, analyte spike check, and background deviation check specified in PS–15 (40 CFR part 60, appendix B), sections 10.1, 10.4, and 10.6, respectively. The analyte spike check can be performed using any of the target analytes.

* * * * *

4.3.3 Out-of-Control Definition for CEMS Subject to PS 15. If the calibration transfer standards check, analyte spike check, or background deviation check exceeds twice the accuracy criterion of ±5 percent for five, consecutive daily periods, the CEMS is out of control. If the calibration transfer standards check, analyte spike check, or background deviation check exceeds four times the accuracy criterion of ±5 percent during any daily calibration check, the CEMS is out of control. If the CEMS is out of control, take necessary corrective action. Following corrective action, repeat the calibration checks specified in this section.

* * * * *

4.4.1 Data Storage Requirements for CEMS Subject to PS 15. In addition to the requirements of section 4.4 of this procedure, source owners and operators of CEMS subject to PS–15 (40 CFR part 60, appendix B) must satisfy the data storage requirements of section 6.3 of PS–15.

* * * * *

5. Data Accuracy Assessment

* * * * *

5.1.5 Audits for CEMS Subject to PS 9. For CEMS that are subject to PS 9, the requirements of section 5.1 of this procedure apply, with the following exceptions:

(1) The RATA specified in sections 5.1.1 and 5.1.4 of this procedure does not apply.

(2) The CGA must be conducted every calendar quarter.

(3) The CGA must be conducted according to the procedures specified in section 5.3 of PS–9 (40 CFR part 60, appendix B), except that the audit must be performed at two points as specified in section 5.1.2 of this procedure.

(4) The CGA must be conducted for each target pollutant specified in the applicable regulation.

(5) The RAA specified in section 5.1.3 of this procedure does not apply.

(6) Audits conducted under this procedure fulfill the requirement of section 5.3 of PS–9 (40 CFR part 60, appendix B) for quarterly performance audits.

5.1.6 Audits for CEMS Subject to PS–15. For CEMS that are subject to PS–15 (40 CFR part 60, appendix B), the requirements of section 5.1 of this procedure apply, with the following exceptions:

(1) The RATA specified in sections 5.1.1 and 5.1.4, the CGA specified in section 5.1.2, and the RAA specified in section 5.1.3 of this procedure do not apply.

(2) To satisfy the quarterly accuracy audit requirement of this procedure, one of the accuracy checks specified in PS–15 (40 CFR part 60, appendix B), sections 9.1 (Audit Sample), 9.2 (Audit Spectra), and 9.3 (Submit Spectra for Independent Analysis) must be performed at least once each calendar quarter, consistent with the following additional criteria:

(i) The audit sample check, specified in section 9.1 of PS–15 (40 CFR part 60, appendix B), must be conducted at least once every four calendar quarters.

(ii) The audit spectra check, specified in section 9.2 of PS–15 (40 CFR part 60, appendix B), can be used to satisfy the quarterly accuracy audit requirement only once every four calendar quarters.

(3) Audits conducted under this procedure fulfill the requirement of section 9 of PS–15 (40 CFR part 60, appendix B) for quarterly or semiannual QA/QC checks on the operation of extractive FTIR CEMS.

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Procedure 4. Quality Assurance Requirements for Continuous Parameter Monitoring Systems at Stationary Sources

1.0 *What is the purpose of this procedure?*

The purpose of this procedure is to establish the minimum requirements for evaluating on an ongoing basis the quality of data produced by your continuous parameter monitoring system (CPMS), and the effectiveness of quality assurance (QA) and quality control (QC) procedures that you have developed for your CPMS. This procedure applies instead of the QA and QC requirements for applicable CPMS specified in any applicable subpart to parts 60, 61, or 63, unless otherwise specified in the applicable subpart. This procedure presents requirements in general terms to allow you to develop a QC program that is most effective for your circumstances. This procedure does not restrict your current QA/QC procedures to ensure compliance with applicable regulations. Instead, you are encouraged to develop and implement a more extensive QA/QC program or to continue such programs where they already exist.

1.1 To what types of devices does Procedure 4 apply? This procedure applies to any CPMS that is subject to Performance Specification 17 (PS–17).

1.2 When must I comply with Procedure 4? You must comply with this procedure when conditions (1) or (2) of this section occur.

(1) At the time you install and place into operation a CPMS that is subject to PS–17.

(2) At the time any of your existing CPMS become subject to PS–17.

1.3 How does Procedure 4 affect me if I am also subject to QA procedures under another applicable subpart? This procedure does not apply if any more stringent QA requirements apply to you under an applicable requirement. You are required to comply with the more stringent of the applicable QA requirements.

2.0 *What are the basic requirements of Procedure 4?*

This procedure requires all owners and operators of a CPMS to perform periodic QA evaluations of CPMS performance and to develop and implement QC programs to ensure that CPMS data quality is maintained.

2.1 What types of procedures are required for me to demonstrate compliance? This procedure requires you to meet the requirements of paragraphs (1) and (2) of this section.

(1) Perform periodic accuracy audits of your CPMS; and

(2) Take corrective action when your CPMS fails to meet the accuracy requirements of this procedure.

2.2 What types of recordkeeping and reporting activities are required by Procedure 4? This procedure does not have any reporting requirements but does require you to record and maintain data that identify your CPMS and show the results of any performance demonstrations of your CPMS. Recordkeeping requirements are specified in section 14 of this procedure.

3.0 *What special definitions apply to Procedure 4?*

3.1 Accuracy. A measure of the closeness of a measurement to the true or actual value.

3.2 Accuracy hierarchy. The ratio of the accuracy of a measurement instrument to the accuracy of a calibrated instrument or standard that is used to measure the accuracy of the measurement instrument. For example, if the accuracy of a calibrated temperature measurement device is 0.2 percent, and the accuracy of a thermocouple is 1.0 percent, the accuracy hierarchy is 5.0 ($1.0 \div 0.2 = 5.0$).

3.3 Calibration drift. The difference between a reference value and the output value of a CPMS after a period of operation during which no unscheduled maintenance, repair, or adjustment took place.

3.4 Conductivity CPMS. The total equipment that is used to measure and record liquid conductivity on a continuous basis.

3.5 Continuous parameter monitoring system (CPMS). The total equipment that is used to measure and record parameters, such as temperature, pressure, liquid flow rate, gas flow rate, mass flow rate, pH or conductivity, in one or more locations on a continuous basis.

3.6 Differential pressure tube. A device, such as a pitot tube, that consists of one or more pairs of tubes that are oriented to measure the velocity pressure and static pressure at one of more fixed points within a duct for the purpose of determining gas velocity.

3.7 Electronic components. The electronic signal modifier or conditioner, transmitter, and power supply associated with a CPMS.

3.8 Flow CPMS. The total equipment that is used to measure liquid flow rate, gas flow rate, or mass flow rate on a continuous basis.

3.9 Mass flow rate. The measurement of solid, liquid, or gas flow in units of mass per time, such as kilograms per minute or tons per hour.

3.10 Mechanical component. Any component of a CPMS that consists of or includes moving parts or that is used to apply or transfer force to another component or part of a CPMS.

3.11 pH CPMS. The total equipment that is used to measure and record liquid pH on a continuous basis.

3.12 Pressure CPMS. The total equipment that is used to measure and record the pressure of a liquid or gas at any location or the differential pressure of a gas or liquid at any two locations on a continuous basis.

3.13 Resolution. The smallest detectable or legible increment of measurement.

3.14 Sensor. The component of a CPMS that senses the parameter being measured (currently temperature, pressure, liquid flow rate, gas flow rate, mass flow rate, pH, or conductivity) and generates an output signal. Table 1 identifies the sensor components of some commonly used CPMS.

3.15 Solid mass flow rate. The measurement in units of mass per time of the rate at which a solid material is processed or transferred. Examples of solid mass flow rate are the rate at which ore is fed to a material dryer or the rate at which powdered lime is injected into an exhaust duct.

3.16 Temperature CPMS. The total equipment that is used to measure and record the temperature of a liquid or gas at any location or the differential temperature of a gas or liquid at any two locations on a continuous basis.

3.17 Total equipment. The sensor, mechanical components, electronic components, data recording, electrical wiring, and other components of a CPMS.

4.0 *Interferences* [Reserved]

5.0 *What do I need to know to ensure the safety of persons who perform the accuracy audits specified in Procedure 4?*

The accuracy audits required under Procedure 4 may involve hazardous materials, operations, site conditions, and equipment. This QA procedure does not purport to address all of the safety issues associated with these audits. It is the responsibility of the user to establish appropriate safety and health practices and determine the applicable regulatory limitations prior to performing these audits.

6.0 *What are the equipment requirements for Procedure 4?*

6.1 What types of equipment do I need for performing the accuracy audit of my CPMS? The specific types of equipment that you need for your CPMS accuracy audit depend on the type of CPMS, site-specific conditions, and the method that you choose for conducting the accuracy audit, as specified in sections 8.1 through 8.5 of this procedure. In most cases, you will need the equipment described in paragraphs (1) and (2) of this section.

(1) A separate device that either measures the same parameter that your CPMS measures, or that simulates the same electronic signal or response that your CPMS generates, and

(2) Any test ports, pressure taps, valves, fittings, or other equipment required to perform the specific procedures of the accuracy audit method that you choose, as specified in section 8.1 of this procedure.

6.2 What are the accuracy requirements for the equipment that I use to audit the accuracy of my CPMS? Unless you meet one of the exceptions listed in section 6.3 of this procedure, any measurement instrument or device that you use to conduct an accuracy audit of your CPMS must have an accuracy that is traceable to National Institute of Standards and Technology (NIST) standards and must have an accuracy hierarchy of at least three. To determine if a measurement instrument or device satisfies this accuracy hierarchy requirement, follow the procedure described in section 12.1 of this procedure.

6.3 Are there any exceptions to the accuracy requirement of section 6.2 of this procedure? There are three exceptions to the NIST-traceable accuracy requirement specified in section 6.2, as described in paragraphs (1) through (3) of this section.

(1) If you perform an accuracy audit of your CPMS by comparison to a redundant CPMS, you need not meet the NIST-traceability requirement of section 6.2; however, the redundant CPMS must have an accuracy equal to or better than the corresponding minimum required accuracy specified in Table 6 of this procedure for that specific type of CPMS.

(2) As an alternative for the calibrated pressure measurement device with NIST-traceable accuracy that is required in paragraphs (2) and (4) of section 8.2 and in paragraph (4) of section 8.3 of this specification, you can use a mercury-in-glass or water-in-glass U-tube manometer to check the accuracy of your pressure CPMS.

(3) When validating a flow rate CPMS using the methods specified in paragraphs (2), (3), or (7) of section 8.3 of this specification, the container used to collect or weigh the liquid or solid is not required to have NIST-traceable accuracy.

7.0 *What reagents or standards do I need to comply with Procedure 4?*

The specific reagents and standards needed to demonstrate compliance with this procedure depend upon the parameter that your CPMS measures and the method that you choose to check the accuracy of your CPMS. Sections 8.1 through 8.5 of this procedure identify the specific reagents and standards that you will need to conduct accuracy audits of your CPMS.

8.0 *What quality assurance and quality control measures are required by Procedure 4 for my CPMS?*

You must perform accuracy audits, meet the accuracy requirements of this procedure, and perform any additional checks of the CPMS as specified in sections 8.1 through 8.9 of this procedure.

8.1 How do I perform an accuracy audit for my temperature CPMS? To perform the accuracy audit, you can choose one of the methods described in paragraphs (1) through (3) of this section.

(1) Comparison to Redundant Temperature Sensor. This method requires your CPMS to have a primary temperature sensor and a redundant temperature sensor. The redundant temperature sensor must be installed adjacent to the primary temperature sensor and must be subject to the same environment as the primary temperature sensor. To perform the accuracy audit, record three pairs of concurrent temperature measurements within a 24-hour period. Each pair of concurrent measurements must consist of a temperature measurement by each of the two temperature sensors. The minimum time interval between any two such pairs of consecutive temperature measurements is one hour. You must take these readings during periods when the process or control device that is being monitored by the CPMS is operating normally. Calculate the mean of the three values for each temperature sensor. The mean values must agree within the minimum required accuracy specified in Table 6 of this procedure. If your CPMS satisfies the accuracy requirement of Table 6, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this accuracy audit procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your temperature CPMS, you must perform the procedures outlined in PS–17. If you are required to measure and record temperatures at multiple locations, repeat this procedure for each location.

(2) Comparison to Calibrated Temperature Measurement Device. Place the sensor of a calibrated temperature measurement device adjacent to the sensor of your temperature CPMS in a location that is subject to the same environment as the sensor of your temperature CPMS. The calibrated temperature measurement device must satisfy the accuracy requirements specified in section 6.2 of this procedure. Allow sufficient time for the response of the calibrated temperature measurement device to reach equilibrium. With the process or control device that is monitored by your CPMS operating under normal conditions, record concurrently the temperatures measured by your temperature CPMS and the calibrated temperature measurement device. Using the temperature measured by the calibrated measurement device as the value for V_c, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of the primary CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record temperatures at multiple locations, repeat this procedure for each location.

(3) Separate Sensor Check and System Check by Temperature Simulation. This method applies to temperature CPMS that use either a thermocouple or a resistance temperature detector as the temperature sensor. First, perform the temperature sensor check using the appropriate ASTM standard listed in Table 2 of this procedure. To perform the system check, record the temperature using your temperature CPMS with the process or control device that is monitored by your temperature CPMS operating under normal conditions. Under the same operating conditions, disconnect the sensor from the CPMS system and connect a calibrated simulation device that is designed to simulate the same type of response as the CPMS sensor. The simulation device must satisfy the accuracy requirements specified in section 6.2 of this procedure. Within 15 minutes of measuring and recording the temperature using your temperature CPMS, simulate the same temperature recorded for the temperature CPMS. Allow sufficient time for the response of the simulation device to reach equilibrium. Using the temperature simulated by the calibrated simulation device as the value for V_c, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If the calculated accuracy does not meet the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your temperature CPMS, you must perform the procedures outlined in PS–17. If you are required to measure and record temperatures at multiple locations, repeat this procedure for each location.

8.2 How do I perform an accuracy audit for my pressure CPMS? To perform the accuracy audit, you can choose one of the methods described in paragraphs (1) through (4) of this section.

(1) Comparison to redundant pressure sensor. This method requires your CPMS to

have a primary pressure sensor and a redundant pressure sensor. The redundant pressure sensor must be installed adjacent to the primary pressure sensor and must be subject to the same environment as the primary pressure sensor. To perform the accuracy audit, record three pairs of concurrent pressure measurements within a 24-hour period. Each pair of concurrent measurements must consist of a pressure measurement by each of the two pressure sensors. The minimum time interval between any two such pairs of consecutive pressure measurements is one hour. You must take these readings during periods when the process or control device that is being monitored by the CPMS is operating normally. Calculate the mean of the three values for each pressure sensor. The mean values must agree within the minimum required accuracy specified in Table 6 of this procedure. If your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this accuracy audit procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your pressure CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record pressure at multiple locations, repeat this procedure for each location.

(2) Comparison to Calibrated Pressure Measurement Device. With the process or control device that is monitored by your pressure CPMS operating under normal conditions, record the pressure at each location that is monitored by your pressure CPMS. For each pressure monitoring location, connect the process lines from the process or emission control device that is monitored by your pressure CPMS to a mercury-in-glass U-tube manometer, a water-in-glass U-tube manometer, or calibrated pressure measurement device. If a calibrated pressure measurement device is used, the device must satisfy the accuracy requirements of section 6.2 of this procedure. The calibrated pressure measurement device must also have a range equal to or greater than the range of your pressure CPMS. Perform a leak test on all manometer or calibrated pressure measurement device connections using the method specified in section 8.9 of this procedure. Allow sufficient time for the response of the calibrated pressure measurement device to reach equilibrium. Within 30 minutes of measuring and recording the corresponding pressure using your CPMS, record the pressure measured by the calibrated pressure measurement device at each location. Using the pressure measured by the calibrated pressure measurement device as the value for V_c, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If the calculated accuracy does not meet the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the accuracy requirements. Repeat this procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your pressure CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record pressures at multiple locations, repeat this procedure for each location.

(3) Separate Sensor Check and System Check by Pressure Simulation Using a Calibrated Pressure Source. Perform the pressure sensor check using the appropriate ASTM standard listed in Table 3 of this procedure. These sensor check methods apply only to pressure CPMS that use either a pressure gauge or a metallic-bonded resistance strain gauge as the pressure sensor. To perform the system check, begin by disconnecting or closing off the process line or lines to your pressure CPMS. For each location that is monitored by your pressure CPMS, connect a pressure source to your CPMS. The pressure source must be calibrated and must satisfy the accuracy requirements of section 6.2 of this procedure. The pressure source also must be adjustable, either continuously or incrementally over the pressure range of your pressure CPMS. Perform a leak test on the calibrated pressure source using the method specified in section 8.9 of this procedure. Using the calibrated pressure source, apply to each location that is monitored by your CPMS a pressure that is within ±10 percent of the normal operating pressure of your pressure CPMS. Allow sufficient time for the response of the calibrated pressure source to reach equilibrium. Using the pressure applied by the calibrated pressure source as the value for V_c, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not meet the accuracy requirement of Table 6 of this procedure, check all system components and take any other corrective action that is necessary to achieve the required minimum accuracy. Repeat this procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your pressure CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record pressure at multiple locations, repeat this procedure for each location.

(4) Separate Sensor and System Check by Pressure Simulation Procedure Using a Pressure Source and a Calibrated Pressure Measurement Device. Perform the pressure sensor check using the appropriate ASTM standard listed in Table 3 of this procedure. These sensor check methods apply only to pressure CPMS that use either a pressure gauge or a metallic-bonded resistance strain gauge as the pressure sensor. To perform the system check, begin by disconnecting or closing off the process line or lines to your pressure CPMS. Attach a mercury-in-glass U-tube manometer, a water-in-glass U-tube manometer, or a calibrated pressure measurement device (the reference pressure measurement device) in parallel to your pressure CPMS. If a calibrated pressure measurement device is used, the device must satisfy the accuracy requirements of section 6.2 of this procedure. Connect a pressure source to your pressure CPMS and the parallel reference pressure measurement device. Perform a leak test on all connections for the pressure source and calibrated pressure measurement device using the method as specified in section 8.9 of this procedure. Apply pressure to your CPMS and the parallel reference pressure measurement device. Allow sufficient time for the responses of your CPMS and the parallel reference pressure measurement device to reach equilibrium. Record the pressure measured by your pressure CPMS and the reference pressure measurement device. Using the pressure measured by the parallel reference pressure measurement device as the value for V_c, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not meet the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this accuracy audit until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your pressure CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record pressure at multiple locations, repeat this procedure for each location.

8.3 How do I perform an accuracy audit for my flow CPMS? To perform the accuracy audit on your flow CPMS, you can choose one of the methods described in paragraphs (1) through (7) of this section that is applicable to the type of material measured by your flow CPMS and the type of sensor used in your flow CPMS.

(1) Comparison to redundant flow sensor. This method requires your CPMS to have a primary flow sensor and a redundant flow sensor. The redundant flow sensor must be installed adjacent to the primary flow sensor and must be subject to the same environment as the primary flow sensor. If using two Coriolis mass flow meters, care should be taken to avoid cross-talk, which is interference between the two meters due to mechanical coupling. Consult the manufacturer for specifics. To perform the accuracy audit, record three pairs of concurrent flow measurements within a 24-hour period. Each pair of concurrent measurements must consist of a flow measurement by each of the two flow sensors. The minimum time interval between any two such pairs of consecutive flow

measurements is one hour. You must take these readings during periods when the process or control device that is being monitored by the CPMS is operating normally. Calculate the mean of the three values for each flow sensor. The mean values must agree within the minimum required accuracy specified in Table 6 of this procedure. If your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this accuracy audit procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your flow CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record flow at multiple locations, repeat this procedure for each location.

(2) Volumetric Method. This method applies to any CPMS that is designed to measure liquid flow rate. With the process or control device that is monitored by your flow CPMS operating under normal conditions, record the flow rate measured by your flow CPMS for the subject process line. Collect concurrently the liquid that is flowing through the same process line for a measured length of time using the Volumetric Method specified in one of the standards listed in Table 4 of this procedure. Using the flow rate measured by the Volumetric Method as the value for V_c, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your flow CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record flows at multiple locations, repeat this procedure for each location.

(3) Gravimetric Method. This method applies to any CPMS that is designed to measure liquid flow rate, liquid mass flow rate, or solid mass flow rate. With the process or control device that is monitored by your flow CPMS operating under normal conditions, record the flow rate measured by your flow CPMS for the subject process line. At the same time, collect the material (liquid or solid) that is flowing or being transferred through the same process line for a measured length of time using the Weighing, Weigh Tank, or Gravimetric Methods specified in the standards listed in Table 5 of this procedure. Using the flow rate measured by the Weighing, Weigh Tank, or Gravimetric Methods as the value for V_c, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your flow CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record flows at multiple locations, repeat this procedure for each location.

(4) Separate Sensor Check and System Check by Differential Pressure Measurement Method. This method applies only to flow CPMS that use a differential pressure measurement flow device, such as an orifice plate, flow nozzle, or venturi tube. This method may not be used to validate a flow CPMS that measures gas flow by means of one or more differential pressure tubes. To perform the sensor check, remove the flow constricting device and perform a visual inspection for wear or other deformities based on manufacturer's recommendations. Take any corrective action that is necessary to ensure its proper operation. To perform the system check, record the flow rate measured by your flow CPMS while the process or control device that is monitored by your CPMS operating under normal conditions. Under the same operating conditions, disconnect the pressure taps from your flow CPMS and connect the pressure taps to a mercury-in-glass U-tube manometer, a water-in-glass U-tube manometer, or calibrated differential pressure measurement device. If a calibrated pressure measurement device is used, the device must satisfy the accuracy requirements of section 6.2 of this procedure. Perform a leak test on all manometer or calibrated differential pressure measurement device connections using the method specified in section 8.9 of this procedure. Allow sufficient time for the response of the calibrated differential pressure measurement device to reach equilibrium. Within 30 minutes of measuring and recording the flow rate using your CPMS, record the pressure drop measured by the calibrated differential pressure measurement device. Using the manufacturer's literature or the procedures specified in ASME MFC–3M–2004 (incorporated by reference—see § 60.17), calculate the flow rate that corresponds to the differential pressure measured by the calibrated differential pressure measurement device. For CPMS that use an orifice flow meter, the procedures specified in ASHRAE 41.8–1989 (incorporated by reference—see § 60.17) also can be used to calculate the flow rate. Using the calculated flow rate as the value for V_c, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your flow CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record flows at multiple locations, repeat this procedure for each location.

(5) Separate Sensor Check and System Check by Pressure Source Flow Simulation Method. This method applies only to flow CPMS that use a differential pressure measurement flow device, such as an orifice plate, flow nozzle, or venturi tube. This method may not be used to validate a flow CPMS that measures gas flow by means of one or more differential pressure tubes. To perform the sensor check, remove the flow constricting device and perform a visual inspection for wear or other deformities based on manufacturer's recommendations. Take any corrective action that is necessary to ensure its proper operation. To perform the system check, connect separate pressure sources to the upstream and downstream sides of your pressure CPMS, where the pressure taps are normally connected. The pressure sources must be calibrated and must satisfy the accuracy requirements of section 6.2 of this procedure. The pressure sources also must be adjustable, either continuously or incrementally over the pressure range that corresponds to the range of your flow CPMS. Perform a leak test on all connections between the calibrated pressure sources and your flow CPMS using the method specified in section 8.9 of this procedure. Using the manufacturer's literature or the procedures specified in ASME MFC–3M–2004 (incorporated by reference-see § 60.17), calculate the required pressure drop that corresponds to the normal operating flow rate expected for your flow CPMS. For CPMS that use an orifice flow meter, the procedures specified in ASHRAE 41.8–1989 (incorporated by reference-see § 60.17) also can be used to calculate the pressure drop. Use the calibrated pressure sources to apply the calculated pressure drop to your flow CPMS. Allow sufficient time for the responses of the calibrated pressure sources to reach equilibrium. Record the flow rate measured by your flow CPMS. Using the flow rate measured by your CPMS when the calculated pressure drop was applied as the value for Vc, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this accuracy audit until the accuracy

requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your flow CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record flows at multiple locations, repeat this procedure for each location.

(6) Relative Accuracy (RA) Test. This method applies to any flow CPMS that measures gas flow rate. If your flow CPMS uses a differential pressure tube as the flow sensor and does not include redundant sensors, you must use this method to validate your flow CPMS. The reference methods (RM's) applicable to this test are Methods 2, 2A, 2B, 2C, 2D, and 2F in 40 CFR part 60, appendix A–1, and Method 2G in 40 CFR part 60, appendix A–2. Conduct three sets of RM tests. Mark the beginning and end of each RM test period on the flow CPMS chart recordings or other permanent record of output. Determine the integrated flow rate for each RM test period. Perform the same calculations specified by PS–2 (40 CFR part 60, appendix B), section 7.5. If the RA is no greater than 20 percent of the mean value of the RM test data, the RA test is complete. If the RA is greater than 20 percent of the mean value of the RM test data, check all system components and take any corrective action that is necessary to achieve the required RA. Repeat this RA test until the RA requirement of this section is satisfied.

(7) Material Weight Comparison Method. This method applies to any solid mass flow CPMS that uses a combination of a belt conveyor and scale and includes a totalizer. To conduct this test, pass a quantity of pre-weighed material over the belt conveyor in a manner consistent with actual loading conditions. To weigh the test quantity of material that is to be used during the accuracy audit, you must use a scale that satisfies the accuracy requirements of section 6.2 of this procedure. The test quantity must be sufficient to challenge the conveyor belt-scale system for at least three revolutions of the belt. Record the length of the test. Calculate the mass flow rate using the measured weight and the recorded time. Using this mass flow rate as the value for Vc, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this accuracy audit procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your flow CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record flow at multiple locations, repeat this procedure for each location.

8.4 How do I perform an accuracy audit for my pH CPMS? To perform the accuracy audit, you can choose one of the methods described in paragraphs (1) through (3) of this section.

(1) Comparison to redundant pH sensor. This method requires your CPMS to have a primary pH sensor and a redundant pH sensor. The redundant pH sensor must be installed adjacent to the primary pH sensor and must be subject to the same environment as the primary pH sensor. To perform the accuracy audit, concurrently record the pH measured by the two pH sensors. You must take these readings during periods when the process or control device that is being monitored by the CPMS is operating normally. The two pH values must agree within the minimum required accuracy specified in Table 6 of this procedure. If your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this accuracy audit procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of your pH CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record pH at multiple locations, repeat this procedure for each location.

(2) Comparison to Calibrated pH Meter. Place a calibrated pH measurement device adjacent to your pH CPMS so that the calibrated test device is subjected to the same environment as your pH CPMS. The calibrated pH measurement device must satisfy the accuracy requirements specified in section 6.2 of this procedure. Allow sufficient time for the response of the calibrated pH measurement device to reach equilibrium. With the process or control device that is monitored by your CPMS operating under normal conditions, record concurrently the pH measured by your pH CPMS and the calibrated pH measurement device. If concurrent pH readings are not possible, extract a sufficiently large sample from the process stream and perform measurements using a portion of the sample for each meter. Using the pH measured by the calibrated pH measurement device as the value for Vc, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of the primary CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record pH at multiple locations, repeat this procedure for each location.

(3) Single Point Calibration. This method requires the use of a certified buffer solution. All buffer solutions used must be certified by NIST and accurate to ±0.02 pH units at 25 °C (77 °F). Set the temperature on your pH meter to the temperature of the buffer solution, typically room temperature or 25 °C (77 °F). If your pH meter is equipped with automatic temperature compensation, activate this feature before calibrating. Set your pH meter to measurement mode. Place the clean electrodes into the container of fresh buffer solution. If the expected pH of the process fluid lies in the acidic range (less than 7 pH), use a buffer solution with a pH value of 4.00. If the expected pH of the process fluid lies in the basic range (greater than 7 pH), use a buffer solution with a pH value of 10.00. Allow sufficient time for the response of your CPMS to reach equilibrium. Record the pH measured by your CPMS. Using the buffer solution pH as the value for V_c, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, calibrate your pH CPMS using the procedures specified in the manufacturer's owner's manual. If the manufacturer's owner's manual does not specify a two-point calibration procedure, you must perform a two-point calibration procedure based on ASTM D 1293–99 (2005) (incorporated by reference—see § 60.17). If you replace any electrical or mechanical components of your pH CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record pH at multiple locations, repeat this procedure for each location. If you are required to measure and record pH at multiple locations, repeat this procedure for each location.

8.5 How do I perform an accuracy audit for my conductivity CPMS? To perform the accuracy audit, you can choose one of the methods described in paragraphs (1) through (3) of this section.

(1) Comparison to Redundant Conductivity Sensor. This method requires your CPMS to have a primary conductivity sensor and a redundant conductivity sensor. The redundant conductivity sensor must be installed adjacent to the primary conductivity sensor and must be subject to the same environment as the primary conductivity sensor. To perform the accuracy audit, concurrently record the conductivity measured by the two conductivity sensors. You must take these readings during periods when the process or control device that is being monitored by the CPMS is operating normally. The two conductivity values must agree within the minimum required accuracy specified in Table 6 of this procedure. If your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this accuracy audit procedure until the accuracy requirement of Table 6 of this

procedure is satisfied. If you replace any electrical or mechanical components of your conductivity CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record conductivity at multiple locations, repeat this procedure for each location.

(2) Comparison to Calibrated Conductivity Meter. Place a calibrated conductivity measurement device adjacent to your conductivity CPMS so that the calibrated test device is subjected to the same environment as your conductivity CPMS. The calibrated conductivity measurement device must satisfy the accuracy requirements specified in section 6.2 of this procedure. Allow sufficient time for the response of the calibrated conductivity measurement device to reach equilibrium. With the process or control device that is monitored by your CPMS operating under normal conditions, record concurrently the conductivity measured by your conductivity CPMS and the calibrated conductivity measurement device. If concurrent conductivity readings are not possible, extract a sufficiently large sample from the process stream and perform measurements using a portion of the sample for each meter. Using the conductivity measured by the calibrated conductivity measurement device as the value for V_c, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, check all system components and take any corrective action that is necessary to achieve the required minimum accuracy. Repeat this procedure until the accuracy requirement of Table 6 of this procedure is satisfied. If you replace any electrical or mechanical components of the primary CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record conductivity at multiple locations, repeat this procedure for each location.

(3) Single Point Calibration. This method requires the use of a certified conductivity standard solution. All conductivity standard solutions used must be certified by NIST and accurate within ±2 percent micromhos per centimeter (µmhos/cm) (±2 percent microsiemens per centimeter µS/cm)) at 25 °C (77 °F). Choose a conductivity standard solution that is close to the measuring range for best results. Since conductivity is dependent on temperature, the conductivity tester should have an integral temperature sensor that adjusts the reading to a standard temperature, usually 25 °C (77 °F). If the conductivity meter allows for manual temperature compensation, set this value to 25 °C (77 °F). Place the clean electrodes into the container of fresh conductivity standard solution. Allow sufficient time for the response of your CPMS to reach equilibrium. Record the conductivity measured by your CPMS. Using the conductivity standard solution as the value for V_C, follow the procedure specified in section 12.2 of this procedure to determine if your CPMS satisfies the accuracy requirement of Table 6 of this procedure. If you determine that your CPMS satisfies the accuracy requirement of Table 6 of this procedure, the accuracy audit is complete. If your CPMS does not satisfy the accuracy requirement of Table 6 of this procedure, calibrate your conductivity CPMS using the procedures specified in the manufacturer's owner's manual. If the manufacturer's owner's manual does not specify a calibration procedure, you must perform a calibration procedure based on ASTM D 1125–95 (2005) or ASTM D 5391–99 (2005) (incorporated by reference—see § 60.17). If you replace any electrical or mechanical components of your conductivity CPMS, you must perform the procedures outlined in PS–17 (40 CFR part 60, appendix B). If you are required to measure and record conductivity at multiple locations, repeat this procedure for each location.

8.6 Are there any acceptable alternative procedures for evaluating my CPMS? You may use alternative procedures for evaluating the operation of your CPMS if the alternative procedures are approved by the Administrator.

8.7 How often must I perform an accuracy audit of my CPMS? Depending on the parameter measured (temperature, pressure, flow, pH, or conductivity), you must perform the accuracy audits according to the frequencies specified in paragraphs (1) and (2) of this section.

(1) Temperature, Pressure, Flow, and Conductivity. If your CPMS measures temperature, pressure, flow rate, or conductivity, you must perform an accuracy audit of your CPMS at least quarterly using the procedures specified in sections 8.1 through 8.3 and 8.5, respectively, of this procedure. You also must perform within 48 hours an accuracy audit of your CPMS following any periods of at least 24 hours in duration throughout which:

(i) The value of the measured parameter exceeded the maximum rated operating limit of the sensor, as specified in the manufacturer's owner's manual, or

(ii) The value of the measured parameter remained off the scale of the CPMS data recording system.

(2) pH. If your CPMS measures pH, you must perform an accuracy audit of your pH CPMS at least weekly using the procedures specified in section 8.4 of this procedure.

8.8 What other checks must I do on my CPMS? According to the parameter being measured (temperature, pressure, flow, pH, or conductivity), you must perform the additional checks specified in paragraphs (1) through (4) of this section.

(1) Temperature. If your temperature CPMS is not equipped with a redundant temperature sensor, at least quarterly, perform a visual inspection of all components of your temperature CPMS for physical and operational integrity and all electrical connections for oxidation and galvanic corrosion. You must take necessary corrective action to replace or repair any damaged components as soon as possible.

(2) Pressure. At least monthly, check all mechanical connections for leakage. If your pressure CPMS is not equipped with a redundant pressure sensor, at least quarterly, perform a visual inspection of all components of the pressure CPMS for physical and operational integrity and all electrical connections for oxidation and galvanic corrosion. You must take necessary corrective action to replace or repair any damaged components as soon as possible.

(3) Flow Rate. At least monthly, check all mechanical connections for leakage. If your flow CPMS is not equipped with a redundant flow sensor, at least quarterly, perform a visual inspection of all components of the flow CPMS for physical and operational integrity and all electrical connections for oxidation and galvanic corrosion. You must take necessary corrective action to replace or repair any damaged components as soon as possible.

(4) pH. If your pH CPMS is not equipped with a redundant sensor, at least monthly, perform a visual inspection of all components of the pH CPMS for physical and operational integrity and all electrical connections for oxidation and galvanic corrosion. You must take necessary corrective action to replace or repair any damaged components as soon as possible.

(5) Conductivity. If your conductivity CPMS is not equipped with a redundant sensor, at least quarterly, perform a visual inspection of all components of the conductivity CPMS for physical and operational integrity and all electrical connections for oxidation and galvanic corrosion. You must take necessary corrective action to replace or repair any damaged components as soon as possible.

8.9 How do I perform a leak test on pressure connections, as required by this procedure? You can satisfy the leak test requirements of sections 8.2 and 8.3 of this procedure by following the procedures specified in paragraphs (1) through (3) of this section.

(1) For each pressure connection, apply a pressure that is equal to the highest pressure the connection is likely to be subjected to or 0.24 kilopascals (1.0 inch of water column), whichever is greater.

(2) Close off the connection between the applied pressure source and the connection that is being leak-tested.

(3) If the applied pressure remains stable for at least 15 seconds, the connection is considered to be leak tight. If the applied pressure does not remain stable for at least 15 seconds, take any corrective action necessary to make the connection leak tight and repeat this leak test procedure.

9.0 *What quality control measures are required by this procedure for my CPMS?*

You must develop and implement a QA/QC program for your CPMS according to section 9.1 of this procedure. You must also maintain written QA/QC procedures for your CPMS.

9.1 What elements must be covered by my QA/QC program? Your QA/QC program must address, at a minimum, the elements listed in paragraphs (1) through (5) of this section.

(1) Accuracy audit procedures for the CPMS sensor;

(2) Calibration procedures, including procedures for assessing and adjusting the calibration drift (CD) of the CPMS;

(3) Preventive maintenance of the CPMS (including a spare parts inventory);

(4) Data recording, calculations, and reporting; and

(5) Corrective action for a malfunctioning CPMS.

9.1 How long must I maintain written QA/QC procedures for my CPMS? You are required to keep written QA/QC procedures on record and available for inspection by the enforcement agency for the life of your CPMS or until you are no longer subject to the requirements of this procedure.

10.0 *Calibration and Standardization* [Reserved]

11.0 *Analytical Procedure* [Reserved]

12.0 *What calculations are needed?*

The calculations needed to comply with this procedure are described in sections 12.1 and 12.2 of this procedure.

12.1 How do I determine if a calibrated measurement device satisfies the accuracy hierarchy specified in section 6.2 of this procedure? To determine if a calibrated measurement device satisfies the accuracy hierarchy requirement, follow the procedure described in paragraphs (1) and (2) of this section.

(1) Calculate the accuracy hierarchy (A_h) using Equation 4–1.

$$A_h = \frac{A_r}{A_c} \qquad \text{(Eq. 4-1)}$$

Where:

A_h = Accuracy hierarchy, dimensionless.

A_r = Required accuracy (A_p or A_v) specified in Table 6 of this procedure, percent or units of parameter value (e.g., degrees Celsius, kilopascals, liters per minute, pH units).

A_c = Accuracy of calibrated measurement device, same units as A_r.

(2) If the accuracy hierarchy (A_h) is equal to or greater than 3.0, the calibrated measurement device satisfies the accuracy hierarchy of section 6.2 of this procedure.

12.2 How do I determine if my CPMS satisfies the accuracy requirement of Procedure 4? To determine if your CPMS satisfies the accuracy requirement of this procedure, follow the procedure described in paragraphs (1) through (4) of this section.

(1) If your CPMS measures temperature, pressure, or flow rate, calculate the accuracy percent value (A_{pv}) using Equation 4–2. If your CPMS measures pH, proceed to paragraph (2) of this section.

$$A_{pv} = V_c \quad \frac{A_p}{100} \qquad \text{(Eq. 4-2)}$$

Where:

A_{pv} = Accuracy percent value, units of parameter measured (e.g., degrees Celsius, kilopascals, liters per minute).

V_c = Parameter value measured by the calibrated measurement device or measured by your CPMS when a calibrated signal simulator is applied to your CPMS during the initial validation check, units of parameter measured (e.g., degrees Celsius, kilopascals, liters per minute).

A_p = Accuracy percentage specified in Table 6 that corresponds to your CPMS, percent.

(2) If your CPMS measures temperature, pressure, conductivity, or flow rate other than mass flow rate or steam flow rate, compare the accuracy percent value (A_{pv}) to the accuracy value (A_v) specified in Table 6 of this procedure and select the greater of the two values. Use this greater value as the allowable deviation (d_a) in paragraph (4) of this section.

(3) If your CPMS measures pH, use the accuracy value (A_v) specified in Table 6 of this procedure as the allowable deviation (d_a).

(4) If your CPMS measures steam flow rate, mass flow rate, or conductivity, use the accuracy percent value (A_{pv}) calculated using Equation 2 as the allowable deviation (d_a).

(5) Using Equation 4–3, calculate the measured deviation (d_m), which is the absolute value of the difference between the parameter value measured by the calibrated device (V_c) and the value measured by your CPMS (V_m).

$$d_m = |V_c - V_m| \qquad \text{(Eq. 4-3)}$$

Where:

d_m = Measured deviation, units of the parameter measured (e.g., degrees Celsius, kilopascals, liters per minute).

V_c = Parameter value measured by the calibrated measurement device or measured by your CPMS when a calibrated signal simulator is applied to your CPMS during the initial validation check, units of parameter measured (e.g., degrees Celsius, kilopascals, liters per minute).

V_m = Parameter value measured by your CPMS during the initial validation check, units of parameter measured (e.g., degrees Celsius, kilopascals, liters per minute).

(6) Compare the measured deviation (d_m) to the allowable deviation (d_a). If the measured deviation is less than or equal to the allowable deviation, your CPMS satisfies the accuracy requirement of this procedure.

13.0 *What performance criteria must I demonstrate for my CPMS to comply with this quality assurance procedure?*

You must demonstrate that your CPMS meets the applicable accuracy requirements specified in Table 6 of this procedure.

14.0 *What are the recordkeeping requirements for Procedure 4?*

You must satisfy the recordkeeping requirements specified in sections 14.1 and 14.2 of this procedure.

14.1 What data does this procedure require me to record for my CPMS? You must record the results of all CPMS accuracy audits and a summary of all corrective actions taken to return your CPMS to normal operation.

14.2 For how long must I maintain the QA data that this procedure requires me to record for my CPMS? You are required to keep the records required by this procedure for your CPMS for a period of 5 years. At a minimum, you must maintain the most recent 2 years of data onsite and available for inspection by the enforcement agency.

15.0 *Pollution Prevention* [Reserved]

16.0 *Waste Management* [Reserved]

17.0 *Which references are relevant to Procedure 4?*

1. Technical Guidance Document: Compliance Assurance Monitoring. U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Emission Measurement Center. August 1998. (http://www.epa.gov/ttn/emc/cam.html).

2. NEMA Standard Publication 250. "Enclosures for Electrical Equipment, 1000 Volts Maximum".

3. ASTM E–220–07e1: "Standard Test Methods for Calibration of Thermocouples by Comparison Techniques". American Society for Testing and Materials. 2007.

4. ISA–MC96–1–1982: "Temperature Measurement Thermocouples". American National Standards Institute. August 1982.

5. The pH and Conductivity Handbook. Omega Engineering, Inc. 1995.

6. ASTM E–452–02 (2007): "Standard Test Method for Calibration of Refractory Metal Thermocouples Using an Optical Pyrometer". American Society for Testing and Materials. 2002.

7. ASTM E 644–06: "Standard Test Methods for Testing Industrial Resistance Thermometers". American Society for Testing and Materials. 2006.

8. ASME B 40.100–2005: "Pressure Gauges and Gauge Attachments". American Society of Mechanical Engineers. February 2005.

9. ASTM E 251–92 (2003): "Standard Test Methods for Performance Characteristics of Metallic Bonded Resistance Strain Gages". American Society for Testing and Materials. 2003.

10. ANSI/ASME MFC–3M–2004: "Measurement of Fluid Flow in Pipes Using Orifice, Nozzle, and Venturi". American Society of Mechanical Engineers. 1989 (Reaffirmed 1995).

11. ANSI/ASME MFC–9M–1988: "Measurement of Liquid Flow in Closed Conduits by Weighing Method". American Society of Mechanical Engineers. 1989.

12. ASHRAE 41.8–1989: "Standard Methods of Measurement of Flow of Liquids in Pipes Using Orifice Flow Meters". American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. 1989.

13. ISA RP 16.6–1961: "Methods and Equipment for Calibration of Variable Area Meters (Rotameters)". Instrumentation, Systems, and Automation Society. 1961.

14. ANSI/ISA–RP31.1–1977: "Specification, Installation, and Calibration of Turbine Flow Meters". Instrumentation, Systems, and Automation Society. 1977.

15. ISO 8316:1987: "Measurement of Liquid Flow in Closed Conduits—Method by Collection of Liquid in a Volumetric Tank". International Organization for Standardization. 1987.

16. NIST Handbook 44—2002 Edition: "Specifications, Tolerances, And Other

Technical Requirements for Weighing and Measuring Devices, as adopted by the 86th National Conference on Weights and Measures 2001", Section 2.21: "Belt-Conveyor Scale Systems".

17. ISO 10790:1999: "Measurement of Fluid Flow in Closed Conduits—Guidance to the Selection, Installation, and Use of Coriolis Meters (Mass Flow, Density and Volume Flow Measurements". International Organization for Standardization. 1999.

18. ASTM D 1125–95 (2005): "Standard Test Methods for Electrical Conductivity and Resistivity of Water". American Society for Testing and Materials. 2005.

19. ASTM D 5391–99 (2005): "Standard Test Method for Electrical Conductivity and Resistivity of a Flowing High Purity Water Sample". American Society for Testing and Materials. 2005.

18.0 *What tables are relevant to Procedure 4?*

TABLE 1—SENSOR COMPONENTS OF COMMONLY USED CPMS

For a CPMS that measures . . .	Using a . . .	The sensor component consists of the . . .
1. Temperature	a. Thermocouple	Thermocouple.
	b. Resistance temperature detector	(RTD).
	c. Optical pyrometer	Optical assembly and detector.
	d. Thermistor	Thermistor.
	e. Temperature transducer	Integrated circuit sensor?
2. Pressure	a. Pressure gauge	Gauge assembly, including bourdon element, bellows element, or diaphragm.
	b. Pressure transducer	Strain gauge assembly, capacitance assembly, linear variable differential transformer, force balance assembly, potentiometer, variable reluctance assembly, piezoelectric assembly, or piezoresistive assembly.
	c. Manometer	U-tube or differential manometer.
3. Flow rate	a. Differential pressure device	Flow constricting element (nozzle, Venturi, or orifice plate) and differential pressure sensor.
	b. Differential pressure tube	Pitot tube, or other array of tubes that measure velocity pressure and static pressure, and differential pressure sensor.
	c. Magnetic flow meter	Magnetic coil assembly.
	d. Positive displacement flow meter	Piston, blade, vane, propeller, disk, or gear assembly.
	e. Turbine flow meter	Rotor or turbine assembly.
	f. Vortex formation flow meter	Vortex generating and sensing elements.
	g. Fluidic oscillating flow meter	Feedback passage, side wall, control port, and thermal sensor.
	h. Ultrasonic flow meter	Sonic transducers, receivers, timer, and temperature sensor.
	i. Thermal flow meter	Thermal element and temperature sensors.
	j. Coriolis mass flow meter	U-tube and magnetic sensing elements.
	k. Rotameter	Float assembly.
	l. Solids flow meter	Sensing plate.
	m. Belt conveyor	Scale.
4. pH	pH meter	Electrode.
5. Conductivity	Conductivity meter	Electrode.

TABLE 2—METHODS FOR TEMPERATURE SENSOR CHECK

If the temperature sensor in your CPMS is a . . .	And is used in . . .	You can perform the accuracy audit of the sensor using . . .
1. Thermocouple	Any application	ASTM E220–07e1.
2. Thermocouple	A reducing environment	ASTM E452–02 (2007).
3. Resistance temperature detector	Any application	ASTM E644–06.

TABLE 3—METHODS FOR PRESSURE SENSOR CHECK

If the pressure sensor in your CPMS is a . . .	You can perform the accuracy audit of the sensor using . . .
1. Pressure gauge	ASME B40.100–2005.
2. Metallic bonded resistance strain gauge	ASTM E251–92 (2003).

TABLE 4—VOLUMETRIC METHODS FOR FLOW METER ACCURACY AUDITS

Designation	Title
1. ISA RP 16.6–1961	Methods and Equipment for Calibration of Variable Area Meters (Rotameters).
2. ANSI/ISA RP 31.1–1977	Specification, Installation, and Calibration of Turbine Flow Meters.
3. ISO 10790:1999	Measurement of Fluid Flow in Closed Conduits-Guidance to the Selection, Installation and Use of Coriolis Meters (Mass Flow, Density and Volume Flow Measurements).
4. ISO 8316:1987	Measurement of Liquid Flow in Closed Conduits-Method by Collection of Liquid in a Volumetric Tank.

TABLE 5—WEIGHING METHODS FOR FLOW METER ACCURACY AUDITS

Designation	Title
1. ASHRAE 41.8–1989	Standard Methods of Measurement of Flow of Liquids in Pipes Using Orifice Flow Meters.

TABLE 5—WEIGHING METHODS FOR FLOW METER ACCURACY AUDITS—Continued

Designation	Title
2. ISA RP 16.6–1961	Methods and Equipment for Calibration of Variable Area Meters (Rotameters).
3. ANSI/ISA RP 31.1–1977	Specification, Installation, and Calibration of Turbine Flow Meters.
4. NIST Handbook 44–2002 Edition, Section 2.21.	Specifications, Tolerances, And Other Technical Requirements for Weighing and Measuring Devices, as adopted by the 86th National Conference on Weights and Measures 2001: Belt-Conveyor Scale Systems.
5. ANSI/ASME MFC–9M–1988	Measurement of Liquid Flow in Closed Conduits by Weighing Method.

TABLE 6—CPMS ACCURACY REQUIREMENTS

If your CPMS measures . . .	You must demonstrate that your CPMS operates within . . .
1. Temperature, in a non-cryogenic application.	An accuracy percentage (A_p) of ±1.0 percent of the temperature measured in degrees Celsius or within an accuracy value (A_v) of 2.8 degrees Celsius (5 degrees Fahrenheit), whichever is greater.
2. Temperature, in a cryogenic application.	An accuracy percentage (A_p) of ±2.5 percent of the temperature measured in degrees Celsius or within an accuracy value (A_v) of 2.8 degrees Celsius (5 degrees Fahrenheit), whichever is greater.
3. Pressure	An accuracy percentage (A_p) of ±5 percent or an accuracy value (A_v) of 0.12 kilopascals (0.5 inches of water column), whichever is greater.
4. Liquid flow rate	An accuracy percentage (A_p) of ±5 percent or an accuracy value (A_v) of 1.9 liters per minute (0.5 gallons per minute), whichever is greater.
5. Gas flow rate	a. A relative accuracy of ±20 percent, if you demonstrate compliance using the relative accuracy test, or b. An accuracy percentage (A_p) of ±10 percent, if your CPMS measures steam flow rate, or c. An accuracy percentage (A_p) of ±5 percent or an accuracy value (A_v) of 280 liters per minute (10 cubic feet per minute), whichever is greater, for all other gases and accuracy audit methods.
6. Mass flow rate	An accuracy percentage (A_p) of ±5 percent.
7. pH	An accuracy value (A_v) of ±0.2 pH units.
8. Conductivity	An accuracy percentage (A_p) of ±5 percent.