A.10 FABRIC FILTER FOR PM CONTROL--FACILITY J

"This page intentionally left blank."

EXAMPLE COMPLIANCE ASSURANCE MONITORING:
FABRIC FILTER FOR PM CONTROL--FACILITY J

I. Background

A. Emissions Unit

Description:	Line 3 Particleboard Sander
Identification:	M2
Facility:	Facility J Anytown, USA

B. Applicable Regulation, Emission Limit, and Monitoring Requirements

Regulation No.:	OAR 340-21, permit
Emission limits:	
Particulate matter:	0.1 gr/dscf, 3 hr avg.
Monitoring requirements:	Visible emissions, periodic monitoring (RM22)

C. Control Technology

Pulse-jet baghouse operated under negative pressure.

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.10-1.

TABLE A.10-1. MONITORING APPROACH

I. Indicator	Visible emissions	Pressure drop
Measurement Approach	Visible emissions from the baghouse exhaust will be monitored daily using EPA Reference Method 22-like procedures.	Pressure drop across the baghouse is measured with a differential pressure gauge.
II. Indicator Range	An excursion is defined as the presence of visible emissions. Excursions trigger an inspection, corrective action, and a reporting requirement.	An excursion is defined as a pressure drop greater than 5 in. H_2O. Excursions trigger an inspection, corrective action, and a reporting requirement. APCD bypass checked if less than 1 in. H_2O.
QIP Threshold[a]	The QIP threshold is five excursions in a 6-month reporting period.	None selected
III. Performance Criteria A. Data Representativeness[b]	Measurements are being made at the emission point (baghouse exhaust).	Pressure taps are located at the baghouse inlet and outlet. The gauge has a minimum accuracy of 0.25 in. H_2O.
B. Verification of Operational Status	NA	NA
C. QA/QC Practices and Criteria	The observer will be familiar with Reference Method 22 and follow Method 22-like procedures.	The pressure gauge is calibrated quarterly. Pressure taps are checked for plugging daily.
D. Monitoring Frequency	A 6-minute Method 22-like observation is performed daily.	Pressure drop is monitored continuously.
Data Collection Procedure	The VE observation is documented by the observer.	Pressure drop is manually recorded daily.
Averaging Period	NA	None.

[a]Note: The QIP is an optional tool for States; QIP thresholds are not required in the CAM submittal.
[b]Values listed for accuracy specifications are specific to this example and are not intended to provide the criteria for this type of measurement device in general.

A.12 FABRIC FILTER FOR PM CONTROL--FACILITY L

"This page intentionally left blank."

EXAMPLE COMPLIANCE ASSURANCE MONITORING
FABRIC FILTER FOR PM CONTROL -- FACILITY L

I. Background

A. Emissions Unit

Description:	Ceramic Fiber Blanket Manufacture
Identification:	Zone 1 Node 8
Facility:	Facility L Anytown, USA

B. Applicable Regulation, Emission Limit, and Monitoring Requirements

Regulation:	Permit
Emission limits (particulate matter):	0.35 lb/hr
Monitoring requirements:	Bag leak detector required on baghouse exhaust

C. Control Technology

Pulse-jet baghouse operated under negative pressure

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.12-1.

TABLE A.12-1. MONITORING APPROACH

I. Indicator	Triboelectric Signal
Approach	A triboelectric monitor is installed at the baghouse exhaust. An alarm will sound when the signal remains over a preset limit for 15 seconds to indicate a broken filter bag.
II. Indicator Range	An excursion is defined as a triboelectric signal greater than 70 percent of scale for 15 seconds. Excursions trigger an inspection, corrective action, and a reporting requirement. A triboelectric signal of zero during process operation will trigger an investigation for control device bypass.
III. Performance Criteria A. Data Representativeness	The data are collected at the emission point - the probe is located inside the baghouse exhaust duct. The triboelectric signal is directly proportional to the amount of particulate in the exhaust if factors such as velocity and particle size remain relatively constant.
B. Verification of Operational Status	NA
C. QA/QC Practices and Criteria	The triboelectric probe is inspected periodically (at least monthly) for dust buildup. The monitor has an automatic internal calibration function for the electronics.
D. Monitoring Frequency	The triboelectric signal is monitored continuously.
Data Collection Procedures	One hour of data are displayed on the monitor in the control room at 2 second intervals. When an alarm occurs (signal over 70 percent for 15 seconds), it is logged electronically. Six-minute averages also are archived on the computer network as a historical data record.
Averaging Period	None.

JUSTIFICATION

I. Background

The baghouse controls emissions from a ceramic fiberboard felting process and a production line in the spun fiber area that is used to manufacture ceramic fiber blankets used for insulation. The raw material (kaolin) is transferred to melting furnaces that are heated using electric current. The liquid melt stream flows from the bottom of the furnace and is spun into fiber in the collection chamber and formed into a fiber mat on a conveyor traveling below the chamber. Needling is used to lock the fibers together and an oven dries the blanket. The blanket then passes over a cooling table and is cooled by the passage of air through the blanket. It is then trimmed to size and packaged. Dust emission points ducted to the baghouse include the board felting process and cooling table.

The process stream exhaust is controlled by a pulse-jet baghouse operated under negative pressure. The controlled air stream is at ambient conditions. The baghouse was manufactured by Sly and is a single compartment baghouse containing 16 rows and a total of 176 bags. The air flow through the baghouse is approximately 12,000 dscfm. Air flow through the system is maintained by a single induced-draft fan downstream of the baghouse. The cleaned gas is exhausted from a 24-inch wide rectangular duct. The baghouse residue is continuously discharged from the collection hopper into a bin by a screw feeder.

II. Rationale for Selection of Performance Indicators

The bag leak monitor operates using the principles of frictional electrification (triboelectricity) and charge transfer. As particles in the baghouse exhaust gas stream collide with the sensor rod mounted on the inside of the exhaust duct, an electrical charge is transferred, generating a small current that is measured and amplified by the triboelectric monitor. The processing electronics are configured to produce a continuous output and an alarm at a specified level.

The signal produced by the triboelectric monitor is generally proportional to the particulate mass flow, but can be affected by changes in a number of factors, such as humidity, exhaust gas velocity, and particle size. However, in baghouse applications, these factors are not expected to vary considerably during normal operation. Therefore, an increase in the triboelectric signal indicates an increase in particulate emissions from the baghouse.

Pulse-jet baghouse filters are cleaned using a burst of air, which dislodges the filter cake from the bags and causes a momentary increase in particulate emissions until the filter cake builds up again. The triboelectric monitor can be configured with a short (or no) averaging time to display the baghouse cleaning cycle activity and monitor increases in a particular row’s cleaning peak, or with a long signal averaging period to detect an overall increasing trend in the baghouse’s emissions. Trends in the cleaning peaks are monitored and high cleaning peaks that may indicate leaking or broken bags requiring maintenance trigger an alarm.

Bypass of the control device will only occur if the baghouse fan is not operating. In this case, the triboelectric signal would be zero.

III. Rationale for Selection of Indicator Ranges

An excursion is defined as a triboelectric monitor signal greater than 70 percent of scale for 15 seconds. When an excursion occurs, corrective action will be initiated, beginning with an evaluation of the occurrence to determine the action required to correct the situation. All excursions will be documented and reported.

The triboelectric monitoring system has the capability for dual alarms: an early warning alarm and a broken bag alarm. The early warning alarm is set just above the normal cleaning peak height (40 percent of scale). The broken bag alarm was set by injecting dust into the clean air plenum of the baghouse and noting the signal level just before the point at which visible emissions were observed at the baghouse exhaust (70 percent of scale). A 15-second delay time is also used, so the alarm won't activate due to short spikes that are not associated with the cleaning cycle and do not indicate broken bags (e.g., a short spike due to a small amount of particulate that accumulates on the duct wall and then breaks free).

The most recent performance test using EPA Method 5 was conducted on April 22-24, 1997. Three Method 5 test runs (one 240-minute, one 384-minute, and one 288-minute run) were conducted, one test per day. The average measured PM emissions were extremely low: 0.01 lb/hr. During the emissions tests, the triboelectric signal was recorded continuously at a 1-second frequency. Figure A.12-1 shows the triboelectric signal for 1 hour during Run 2. The sharp peaks represent the brief increase in emissions immediately following the baghouse cleaning cycle, before the filter cake builds up again. All cleaning peaks shown on this graph are less than 35 percent of scale, which is below both alarm levels. There was one momentary spike that could not be explained. The alarms were not activated during the emission testing and the emissions were below the emission limit of 0.35 lb/hr.

Monitoring data for a period of approximately 2 months (January 29 - April 2, 1997) were reviewed, including 6-minute average archived triboelectric signal data and the electronic alarm log. Review of these data indicated that the early warning alarm was activated eight times and the broken bag alarm was activated once (i.e., there was one excursion). Based on all data reviewed, the selected indicator and indicator level appears to be appropriate for this facility.

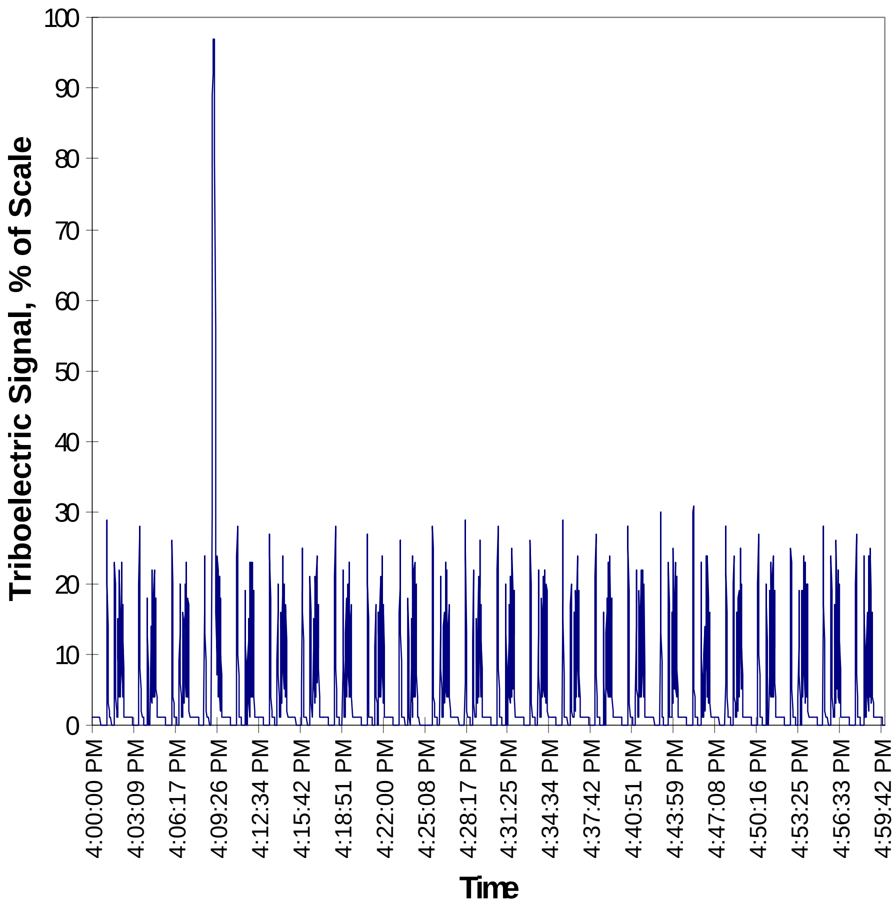

Figure A.12-1. Triboelectric signal during 1-hour of Method 5 Run 2.

"This page intentionally left blank."

A.13 FABRIC FILTER FOR PM CONTROL--FACILITY M

"This page intentionally left blank."

EXAMPLE COMPLIANCE ASSURANCE MONITORING: FABRIC FILTER FOR PM CONTROL -- FACILITY M

I. Background

A. Emissions Unit

Description:	Primary nonferrous smelting and refining
APCD ID:	17-DC-001, 17-DC-002
Facility:	Facility M Anytown, USA

B. Applicable Regulation, Emission Limits, and Monitoring Requirements

Regulation:	Permit; OAR 340-025-0415, 340-021-0030
Emission limits:	
Opacity:	20 percent
Particulate matter:	0.2 gr/dscf
Monitoring requirements:	Visible emissions (VE), pressure drop, fan amperage, inspection and maintenance program

C. Control Technology:

Reverse-air baghouses operated under negative pressure

II. Monitoring Approach

The key elements of the monitoring approach are presented in Table A.13-1.

TABLE A.13-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2	Indicator No. 3	Indicator No. 4
I. Indicator	Visible emissions	Pressure drop	Fan amperage	Inspection/maintenance
Measurement Approach	Method 9 observations performed daily.	Pressure drop through the baghouse is measured continuously using a differential pressure gauge.	Fan amperage is measured continuously using an ammeter.	Daily inspection according to I/M checklist; maintenance performed as needed.
II. Indicator Range	The indicator range is an opacity less than 20 percent (6-min. avg.). Excursions trigger an inspection, corrective action, and a reporting requirement.	The indicator range is a pressure drop between 5 and 15 in. H_2O. Excursions trigger an inspection, corrective action, and a reporting requirement.	The indicator range is fan amperage above 100. Excursions trigger an inspection, corrective action, and a reporting requirement. Fan operation also indicates control device is not being bypassed.	NA
III. Performance Criteria A. Data Representativeness[a]	Observations are performed at the baghouse exhaust while the baghouse is operating.	Pressure drop across the baghouse is measured at the baghouse inlet and exhaust. The minimum accuracy of the device is ±0.5 in. H_2O.	Fan amperage is measured at the fan by an ammeter. The minimum accuracy is ±5A.	Inspections are performed at the baghouse.
B. Verification of Operational Status	NA	NA	NA	NA
C. QA/QC Practices and Criteria	Observer is certified annually.	Pressure gauge calibrated quarterly. Pressure taps checked daily for plugging.	Fans checked during daily inspection. Ammeter zeroed when unit not operating.	Qualified personnel perform inspection.
D. Monitoring Frequency	Daily 6-minute observation.	Pressure drop is measured continuously.	Fan amps are monitored continuously.	Daily inspection.
Data Collection Procedures	Method 9 observations are conducted by a certified RM9 observer.	A strip chart records the pressure drop continuously.	A strip chart records the fan amps continuously.	Records are maintained to document the daily inspection and any required maintenance.
Averaging period	6 minutes	None	None	NA

[a]Values listed for accuracy specifications are specific to this example and are not intended to provide the criteria for this type of measurement device in general.

MONITORING APPROACH JUSTIFICATION

I. Background

Primary nonferrous metal smelting and refining operations include mining; drying; crushing, screening, and rejecting; calcining and melting; refining; casting; and other operations. The ore is dried to remove most of the free moisture. The dried ore is then calcined to remove the remaining free moisture and a portion of the chemically-combined moisture. A portion of the iron is reduced, using carbon. The ore is then melted and reduced. The refined metal is cast into ingots or shot, as requested by the customer.

The monitoring approach outlined here applies to melt furnace baghouses Nos. 1 and 2. These baghouses control dust from four 23 MW electric melt furnaces (Nos. 1 through 4) and two rotary kilns. They are ICA reverse-air baghouses with 12 compartments apiece; each compartment contains 128 bags. Air flow through each baghouse is maintained by two induced-draft variable speed fans downstream of each baghouse. The capacity of each baghouse is 275,000 acfm.

II. Rationale for Selection of Performance Indicators

Visible emissions (opacity) was selected as a performance indicator because it is indicative of good operation and maintenance of the baghouse. When the baghouse is operating optimally, there will be little visible emissions from the exhaust. In general, an increase in visible emissions indicates reduced performance of the baghouse (e.g., loose or torn bags). These emissions units have an opacity standard of 20 percent. A 6-minute Method 9 observation is performed daily.

The pressure drop through the baghouse is monitored continuously. An increase in pressure drop can indicate that the cleaning cycle is not frequent enough, cleaning equipment is damaged, or the bags are becoming blinded. Decreases in pressure drop may indicate significant holes and tears or missing bags. However, opacity is a much more sensitive indicator of holes and tears than pressure drop.

Good operation of the fan is essential for maintaining the required air flow through the baghouse. The fan amps setting is selected to be high enough to draw the air required to collect the dust from the four melting furnaces and two rotary kilns. Excess gas velocity can cause seepage of dust particles through the dust cake and fabric. Fan amperage is an indicator of proper fan operation and adequate air flow through the baghouse (the exhaust gas is not bypassing the baghouse).

Implementation of a baghouse inspection and maintenance (I/M) program provides assurance that the baghouse is in good repair and operating properly. Once per day, proper operation of the compressor is verified to ensure that the bags are being cleaned. Proper operation of the cleaning cycle facilitates gas flow through the baghouse and the removal of particulate, and also helps prevent blinding of the filter bags. Operation at low pressures can result in inadequate cleaning, especially near the bottoms of the bags. Other items on the daily I/M checklist include the dust pump, induced-draft fans, reverse air fan, dust screws, rotary feeders, bins, cleaning cycle operation, leak check, and compartment inspection for bad bags.

III. Rationale for Selection of Indicator Ranges

The indicator range for opacity is a 6-minute average opacity of less than 20 percent. This indicator range was selected based on the facility's permit requirements and historical operating data. Review of data collected in May 1997 indicate an average opacity of 10.9 percent (6-minute average) for baghouse No.1, with 6-minute daily average readings ranging from 2.9 to 19.8 percent. For baghouse No. 2, the average was 11.5 percent, with 6-minute average readings ranging from 3.1 to 18.8 percent. The 6-minute average is made up of observations taken at 15-second intervals.

The indicator range for baghouse pressure drop is a pressure drop between 5 and 15 in. H_2O. This range was selected based on historical data obtained during normal operation. The pressure drop is typically around 10 to 11 in. H_2O. A review of data collected during April and May of 1997 show a range of about 9 to 14 in. H_2O. The indicator range selected for the fan amperage is an amperage greater than 100. This range was set based on the level maintained during normal operation. The fan is operated at a high enough setting to draw the required air for dust collection from the four furnaces and two rotary kilns. It typically operates in the 100 to 157 amp range, with an average of 125 amps. When a problem with the baghouse is detected during an inspection, the problem is recorded on the inspection log and corrective action is initiated immediately.

The most recent performance test using compliance test methods (RM 5) was conducted on July 8-9, 1997. During this test, the average measured PM emissions were 0.080 gr/dscf for baghouse No. 1 and 0.053 gr/dscf for baghouse No. 2 (both were below the compliance limit of 0.2 gr/dscf). Opacity observations during testing averaged 17 percent for both baghouses. The complete test results are documented in the test report. Prior to the performance test, an inspection of the baghouse was performed to ensure that it was in good working order, with no leaks or broken bags.

A.19 BAGHOUSE FOR PM CONTROL – FACILITY V

INTRODUCTION

The examples in section A.19 were developed based on data collected during an EPA study of particulate matter (PM) continuous emissions monitoring systems (CEMS). Data were collected over a period of several months for three PM CEMS installed on a coal-fired boiler. Higher than normal PM concentrations were generated during testing by installing a baghouse bypass line and adjusting a butterfly valve on that line. Examples A.19a and A.19b present two approaches to the use of PM CEMS for CAM using data from one of the PM CEMS evaluated. The first example uses the procedures of proposed Performance Specification 11 (December 2001) to calibrate the PM CEMS over an extended range of PM concentrations. This approach provides a reasonable assurance of compliance over the extended operating range, establishes the indicator level near the high end of the demonstrated operating range, and allows the source flexibility to operate within the extended range without an excursion.

The second example uses a limited amount of test data collected with the APCD operating normally (i.e., no generation of increased emissions utilizing the APCD bypass) to calibrate the PM CEMS. During normal operation there is a large margin of compliance with the emissions limit. However, the indicator range is based on a smaller data set collected over a narrower range of operation. Consequently, the indicator range for an excursion is established at a lower value, near the normal operating range. This approach results in less operating flexibility but lower emissions testing costs because testing is only performed at normal operating conditions.

Details on the PM CEMS evaluation are contained in the report series, "Evaluation of Particulate Matter (PM) Continuous Emission Monitoring Systems (CEMS)," Volumes 1-5, prepared by Midwest Research Institute for the U. S. Environmental Protection Agency's Emissions Measurement Center. The EPA contact is Mr. Dan Bivins at (919) 541-5244, or bivins.dan@epa.gov.

EXAMPLE COMPLIANCE ASSURANCE MONITORING:
BAGHOUSE FOR PM CONTROL – FACILITY V

I. Background

A. Emissions Unit

Description:	375 mmBtu/hr coal-fired boilers
Identification:	Boilers 1 and 2
Facility:	Facility V Anytown, USA

B. Applicable Regulation, Emissions Limit, and Monitoring Requirements

Regulation:	40 CFR 60, Subpart Da Permit
Emissions Limits:	
PM:	0.02 lb/mmBtu
Monitoring Requirements:	A baghouse inspection and maintenance program is performed and a PM continuous emissions monitoring system (CEMS) is used as an additional indicator of compliance with the PM limit. [Note: A COMS is used to assure compliance with the opacity limit and NO_x and SO_2 CEMS are used to assure compliance with the NO_x and SO_2 limits, but that monitoring is not addressed here.]

C. Control Technology:

Both boilers have a pulse jet fabric filter to control particulate emissions from the boiler and the lime slurry spray dryer (used for flue gas desulfurization) that follows each boiler. The boilers exhaust to a common stack.

II. Monitoring Approach

The key elements of the monitoring approach for PM are presented in Table A.19a-1. The selected performance indicators are the signal from a PM CEMS and a baghouse inspection and maintenance program.

TABLE A.19a-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2
I. Indicator	PM concentration.	Bag condition.
Measurement Approach	A light scattering device is installed at a representative location downstream of the baghouse.	The inspection and maintenance program includes a semi-annual internal inspection of the baghouse and analysis of representative bag samples and bi-annual bag replacement.
II. Indicator Range	An excursion is defined as an hourly average PM concentration greater than 13 mg/acm. Excursions trigger an inspection, corrective action, and a reporting requirement.	An excursion is defined as failure to perform the semi-annual inspection and bi-annual bag replacement. Excursions trigger an inspection, corrective action, and a reporting requirement.
III. Performance Criteria A. Data Representativeness	The light scattering instrument is located where a representative sample can be obtained in the baghouse exhaust. The amount of light reflected back at the optical sensor is proportional to the amount of particulate present in the exhaust. A field test was performed to correlate the monitor's response to PM concentration measured by Method 17.	Baghouse inspected visually for deterioration and bag samples taken to determine bag condition and remaining bag life.
B. Verification of Operational Status	Initial correlation test conducted August 1999.	NA
C. QA/QC Practices and Criteria	Daily drift checks, quarterly absolute calibration audit (ACA), and annual response calibration audit (RCA). Daily zero/span drift cannot exceed 4 percent of the upscale value for 5 consecutive days or more than 8 percent of the upscale value in any one day. The ACA involves challenging the PM CEMS with an audit standard at three operating levels, per Performance Specification (PS) 11. The RCA involves gathering simultaneous CEMS response and manual Reference Method data over a range of operating conditions, per PS 11.	Trained personnel perform inspections and maintenance.
D. Monitoring Frequency	Continuous.	Varies.

(TABLE A.19a-1. Continued)

	Indicator No. 1	Indicator No. 2
Data Collection Procedures	The data acquisition system (DAS) collects a data point every second. The 1-second data are reduced to a 1-minute, a 15-minute, and then a 3-hour average PM emissions rate. The 3-hour average data are archived for at least 5 years.	Results of inspections and maintenance activities performed are recorded in baghouse maintenance log.
Averaging period	3-hour.	NA

MONITORING APPROACH JUSTIFICATION

I. Background

Two 375 mmBtu/hr traveling-grate, stoker-fired boilers are operated at this facility. Each boiler is rated at a nominal steam flow of 275,000 pounds per hour at 950˚F and 1,540 psig. The boilers are fired with bituminous coal that averages 13,000 Btu per pound. The boilers were constructed in 1990 and are subject to 40 CFR 60, Subpart Da.

The boilers include mechanical separators in the boiler back-pass section for cinder collection and re-injection into the furnace area. A separate dust collector is located after the air heater section for heavy fly ash collection. The ash from the traveling grate is collected at the front of the boiler for removal to the ash storage silos.

Each boiler is equipped with a dry flue gas desulfurization (FGD) system for SO_2 control and a pulse jet fabric filter for PM control. The FGD uses a motor-driven atomizer to spray a lime slurry mixture into the gas path to neutralize acid mists from the boiler gas. The particulate from the slurry injection and the fine fly ash from the combustion process are collected in the baghouse. The FGD is designed to reduce the average sulfur dioxide concentration by at least 90 percent. The baghouse is designed to collect at least 99 percent of the total particulate in the boiler gas. Exhaust from both baghouses is routed to a common stack that exhausts to the atmosphere.

II. Rationale for Selection of Performance Indicators

The performance indicators selected are the signal from a PM CEMS and baghouse inspections. The PM CEMS is a light-scattering device that detects particulate matter in the baghouse exhaust by reading the back-scattered light from a collimated, near-infrared (IR) light emitting diode (LED). Because this instrument measures in the near-IR range, the sensitivity to changes in particle size is minimal and the response to particles in the 0.1 to 10 µm range is nearly constant. Preventive maintenance is performed on the baghouse to ensure it continues to operate properly and that the bags are in good condition.

III. Rationale for Selection of Indicator Ranges

The unit's PM limit is 0.02 lb/mmBtu, which corresponds to approximately 17 mg/acm. For the light scattering device signal, an excursion is defined as a PM concentration of greater than 13 mg/acm. At this level, the upper tolerance interval is just below the emissions limit and the unit still has a small margin of compliance. Therefore, corrective action will be initiated when the PM CEMS shows the unit is at approximately 75 percent of the emissions limit. Figure A.19a-1 shows a typical day's worth of data while operating at peak load. The PM monitor's signal is normally 2 to 4 mg/acm. Comparing the 1-minute data on a 1-hr, 3-hr, and daily average basis showed that the averaging period made no difference in this case. A 3-hr averaging period was selected as representative.

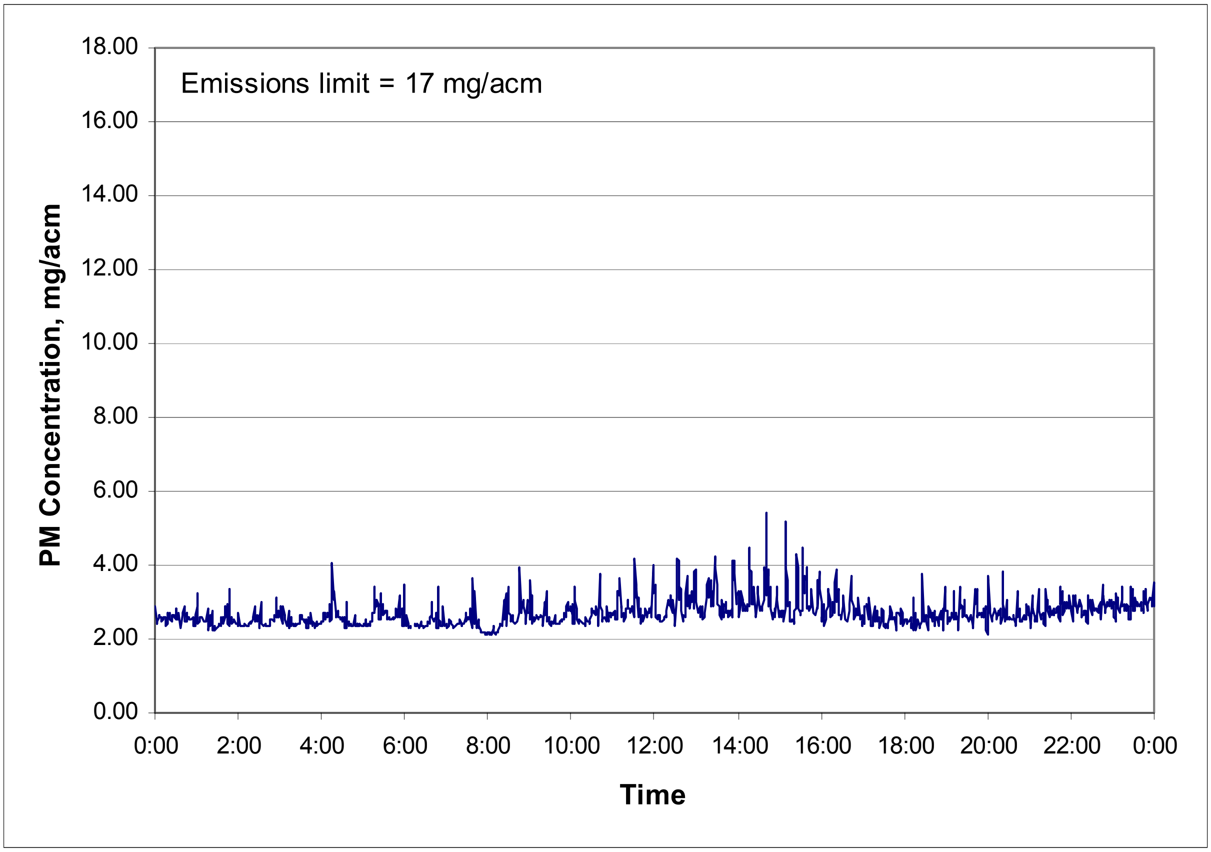

Figure A.19a-1. Light scattering monitor data for a typical day.

A total of 12 Method 17 test runs performed with paired sampling trains at varying PM concentrations were used to develop the relationship between the PM concentration in the baghouse exhaust and the monitor signal. Each test run was one hour in duration. Emissions, boiler load, opacity, and PM CEMS data from the test program are presented in Table A.19a-2. A baghouse bypass line and butterfly valve were installed for the purpose of generating higher than normal PM concentrations to calibrate the PM CEMS. Figure A.19a-2 shows the correlation curve developed during the initial testing, with the upper and lower confidence and tolerance limits calculated per proposed Performance Specification 11. The relationship is a linear equation with an R^2 of 0.96. The confidence interval (CI) is the interval within which one would predict the calibration relationship lies with 95 percent confidence. The tolerance interval (TI) is the interval within which 75 percent of the data are expected to lie with 95 percent confidence.

TABLE A.19a-2. PM CEMS INITIAL CORRELATION TEST DATA

Parameter	Test Run											
	1	2	3	4	5	6	7	8	9	10	11	12
Steam flow, 1,000 lb/hr	271	281	283	282	280	284	281	281	281	285	268	281
Method 17 result, mg/acm[1]	11.6	13.9	14.5	3.03	2.68	3.20	16.3	10.5	9.42	15.4	8.76	18.7
PM CEMS response, mA	9.60	10.0	10.5	5.87	5.78	6.00	12.0	9.45	8.97	13.2	9.57	14.5
Opacity, %	3.72	4.51	5.27	3.71	3.54	3.92	4.01	4.22	4.14	4.25	4.11	5.39

[1]The Method 17 result is the average of sampling train A and sampling train B.

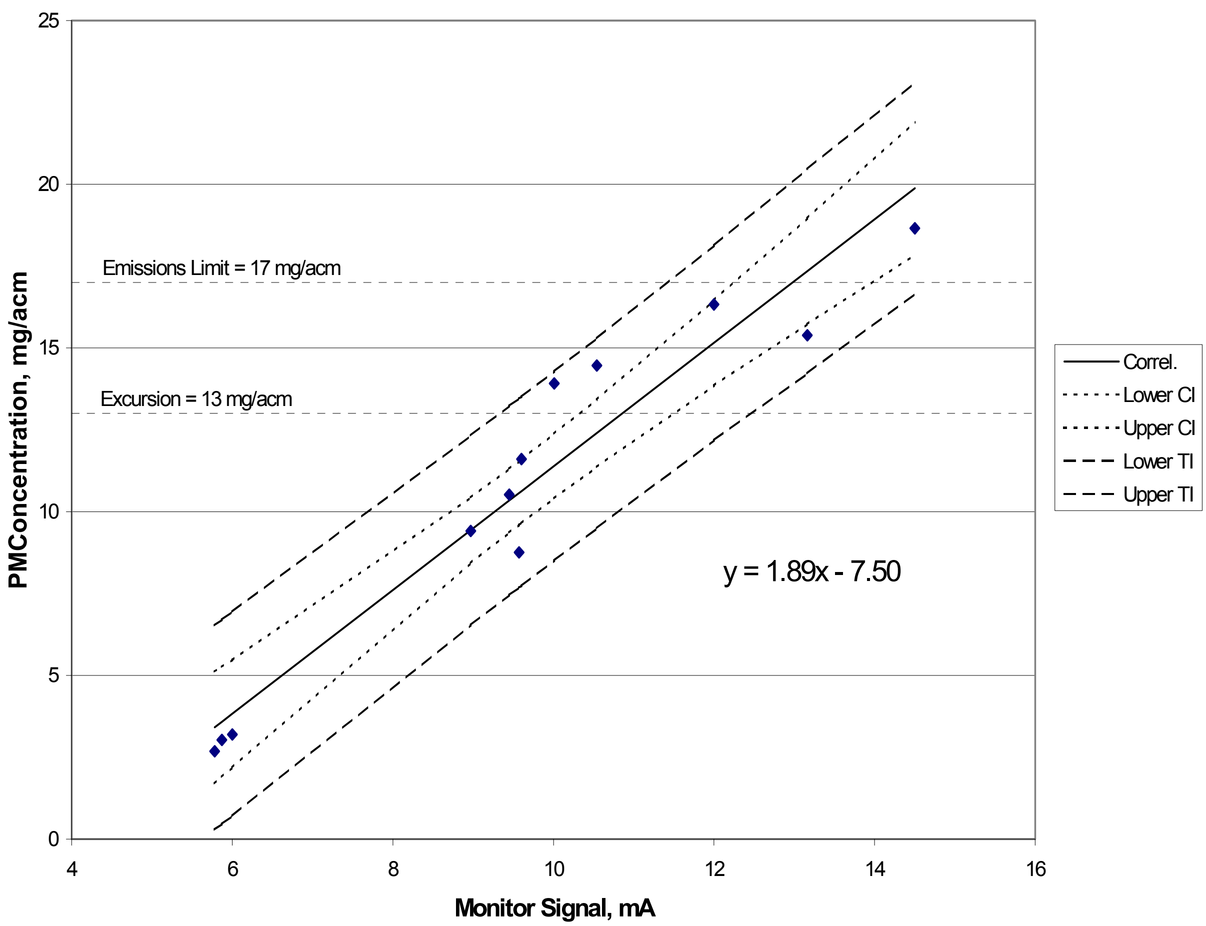

Figure A.19a-2. PM CEMS Correlation Curve.

EXAMPLE COMPLIANCE ASSURANCE MONITORING:
BAGHOUSE FOR PM CONTROL – FACILITY V

I. Background

A. Emissions Unit

Description:	375 mmBtu/hr coal-fired boilers
Identification:	Boilers 1 and 2
Facility:	Facility V Anytown, USA

B. Applicable Regulation, Emissions Limit, and Monitoring Requirements

Regulation:	40 CFR 60, Subpart Da Permit
Emissions Limits: PM:	 0.02 lb/mmBtu
Monitoring Requirements:	A baghouse inspection and maintenance program is performed and a PM continuous emissions monitoring system (CEMS) is used as an additional indicator of compliance with the PM limit. [Note: A COMS is used to assure compliance with the opacity limit and NO_x and SO_2 CEMS are used to assure compliance with the NO_x and SO_2 limits, but that monitoring is not addressed here.]

C. Control Technology:

Both boilers have a pulse jet fabric filter to control particulate emissions from the boiler and the lime slurry spray dryer (used for flue gas desulfurization) that follows each boiler. The boilers exhaust to a common stack.

II. Monitoring Approach

The key elements of the monitoring approach for PM are presented in Table A.19b-1. The selected performance indicators are the signal from a PM CEMS and a baghouse inspection and maintenance program.

TABLE A.19b-1. MONITORING APPROACH

	Indicator No. 1	Indicator No. 2
I. Indicator	PM CEMS response.	Bag condition.
Measurement Approach	A light scattering type PM CEMS is installed at a representative location downstream of the baghouse.	The inspection and maintenance program includes a semi-annual internal inspection of the baghouse and analysis of representative bag samples and bi-annual bag replacement.
II. Indicator Range	An excursion is defined as an hourly average PM CEMS response greater than 7.5 mA. Excursions trigger an inspection, corrective action, and a reporting requirement.	An excursion is defined as failure to perform the semi-annual inspection and bi-annual bag replacement. Excursions trigger an inspection, corrective action, and a reporting requirement.
III. Performance Criteria A. Data Representativeness	The PM CEMS is located where a representative sample can be obtained in the baghouse exhaust. An increase in the PM CEMS signal indicates an increase in the PM concentration. A field test was performed to compare the PM CEMS response to PM concentration measured by Method 17.	Baghouse inspected visually for deterioration and bag samples taken to determine bag condition and remaining bag life.
B. Verification of Operational Status	Initial verification test consisting of 3 test runs.	NA
C. QA/QC Practices and Criteria	Daily drift checks and quarterly absolute calibration audit (ACA). Daily zero/upscale drift cannot exceed 4 percent of the upscale value for 5 consecutive days or more than 8 percent of the upscale value in any one day. The ACA involves challenging the PM CEMS with an audit standard at three operating levels, per PS 11.	Trained personnel perform inspections and maintenance.
D. Monitoring Frequency	Continuous.	Varies.
Data Collection Procedures	The data acquisition system (DAS) collects a data point every 5 seconds. Those 5-second data are reduced to a 1-minute, a 15-minute, and then a 3-hour average PM CEMS response. The 3-hour average data are archived for at least 5 years.	Results of inspections and maintenance activities performed are recorded in baghouse maintenance log.
Averaging period	3-hour.	NA

MONITORING APPROACH JUSTIFICATION

I. Background

Two 375 mmBtu/hr traveling-stoker grate, coal-fired boilers are operated at this facility. Each boiler is rated at a nominal steam flow of 275,000 pounds per hour at 950˚F and 1,540 psig. The boilers are fired with bituminous coal that averages 13,000 Btu per pound. The boilers were constructed in 1990 and are subject to 40 CFR 60, Subpart Da.

The boilers include mechanical separators in the boiler back-pass section for cinder collection and re-injection into the furnace area. A separate dust collector is located after the air heater section for heavy fly ash collection. The ash from the traveling grate is collected at the front of the boiler for removal to the ash storage silos.

Each boiler is equipped with a dry flue gas desulfurization (FGD) system for SO_2 control and a pulse jet fabric filter for PM control. The FGD uses a motor-driven atomizer to spray a lime slurry mixture into the gas path to neutralize acid mists from the boiler gas. The particulate from the slurry injection and the fine fly ash from the combustion process are collected in the baghouse. The FGD is designed to reduce the average sulfur dioxide concentration by at least 90 percent. The baghouse is designed to collect at least 99 percent of the total particulate in the boiler gas. Exhaust from both baghouses is routed to a common stack that exhausts to the atmosphere.

II. Rationale for Selection of Performance Indicators

The performance indicators selected are the signal from a PM CEMS and baghouse inspections. The PM CEMS is a light-scattering device that detects particulate matter in the baghouse exhaust by reading the back-scattered light from a collimated, near-infrared (IR) light emitting diode (LED). Because this instrument measures in the near-IR range, its sensitivity to changes in particle size is minimized and its response to particles in the 0.1 to 10 μm range is nearly constant. Preventive maintenance is performed on the baghouse to ensure it continues to operate properly and that the bags are in good condition.

III. Rationale for Selection of Indicator Ranges

The boiler's PM limit is 0.02 lb/mmBtu, which corresponds to approximately 17 mg/acm. Three Reference Method (Method 17) test runs performed with paired sampling trains were conducted while operating the boiler at full load. These test data were used to develop the relationship between the PM concentration in the baghouse exhaust and the PM CEMS signal. Emissions, load, and PM CEMS data from the test program are presented in Table A.19b-2. Figure A.19b-1 shows a graphical representation of the PM CEMS response versus particulate concentration for the 3 test runs and the indicator range developed based on that data. The linear correlation was forced through the zero point (4 mA). The data showed that when the PM CEMS readings were at or below 6 mA, the PM concentration was less than 3.5 mg/acm, well below the

TABLE A.19b-2. PM CEMS RESPONSE VALIDATION TEST DATA

Parameter	Test Run		
	1	2	3
Steam flow, 1,000 lb/hr	282	280	284
Method 17 result, mg/acm[1]	3.03	2.68	3.20
PM CEMS response, mA	5.87	5.78	6.00

[1]The Method 17 result is the average of sampling train A and sampling train B.

PM limit (see Figure A.19b-1). Figure A.19b-2 shows a typical day's worth of 15-minute average PM CEMS data while operating at peak load. The PM monitor's signal normally is less than 6 mA. Based on the limited test data available and the source's low variability and large margin of compliance, the upper limit of the indicator range was set at 125 percent of the highest measured value. Therefore, for the PM CEMS, an excursion is defined as an hourly average PM CEMS response greater than 7.5 mA (corresponds to a predicted PM concentration of 5.5 mg/acm, about one-third of the PM limit).

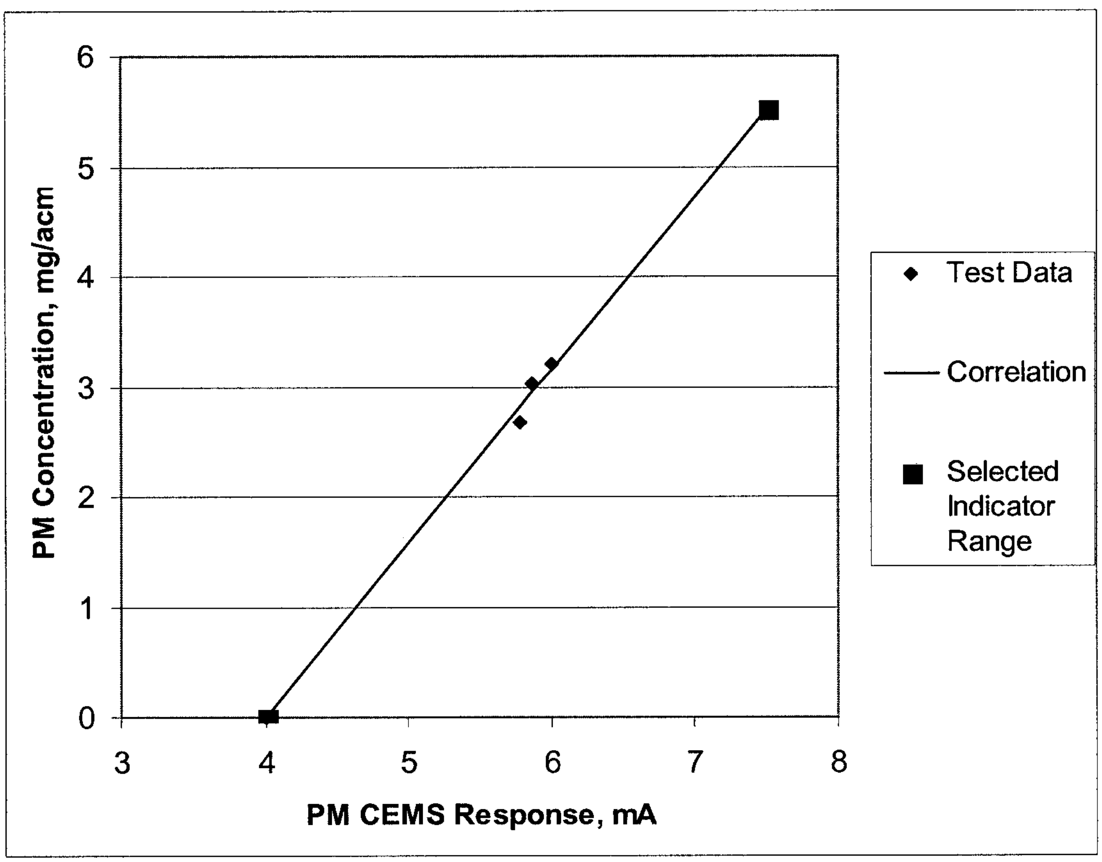

Figure A.19b-1. PM CEMS Calibration Curve and Indicator Range.

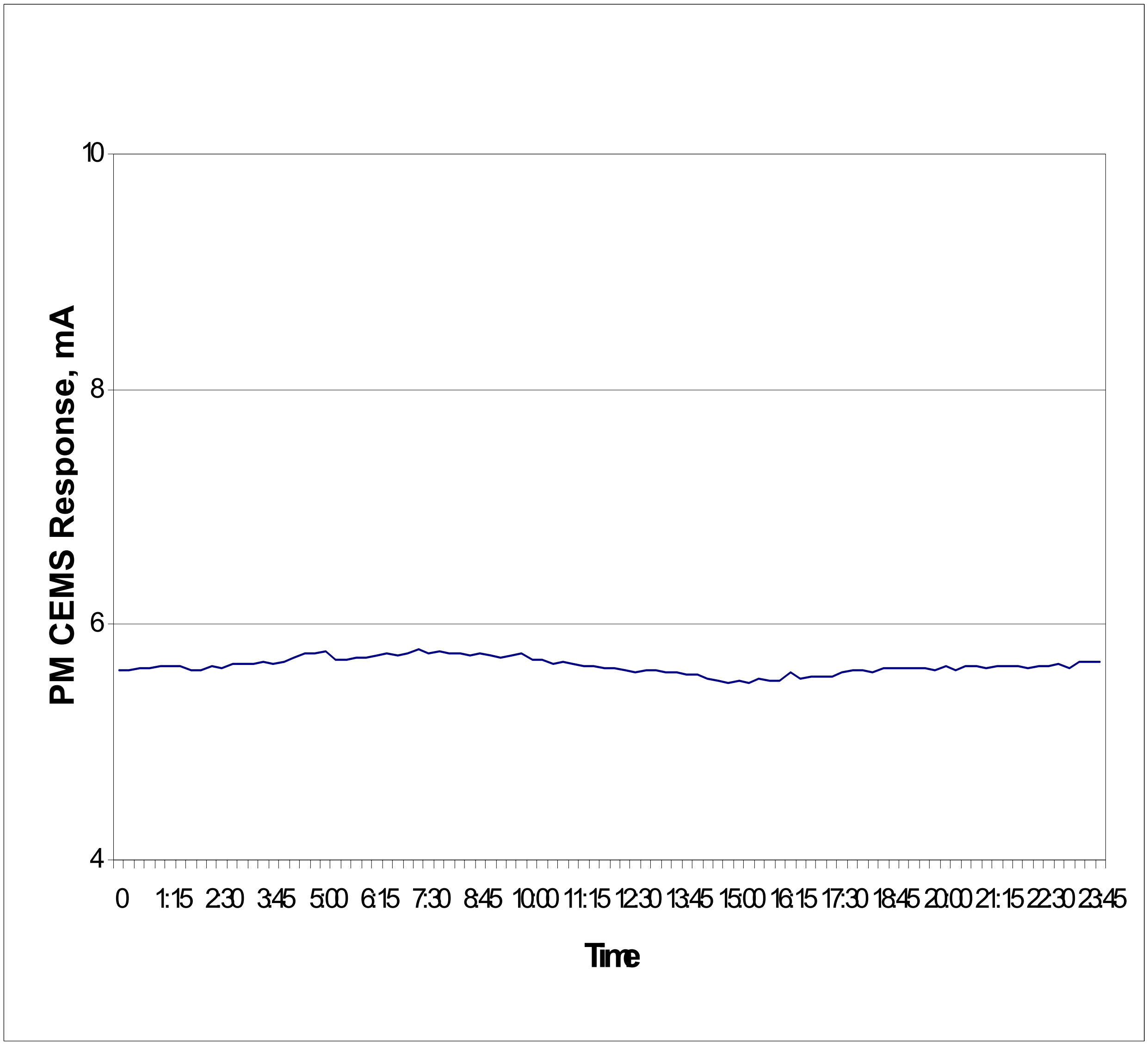

Figure A.19b-2. Typical daily output from PM CEMS while operating boiler at peak load (15-minute averages).