April 5, 2001

TITLE V MONITORING EXAMPLES

Attached are 16 examples of monitoring that, if applied properly, are sufficient to assure compliance with title V permit requirements for different types of emissions sources. The examples are meant to supplement those included the Periodic Monitoring Technical Reference Document (TRD), Appendices A through E, and were developed based on actual operating permits and supporting data. In some cases, we have made minor modifications to the monitoring contained in the permits for the purposes of providing these examples and noted such changes in each example. These examples are intended to provide illustrations of monitoring that provide an assurance of compliance but they do not represent all of the types of acceptable monitoring or an entire range of source types that will be required to implement title V monitoring or all applicable requirement formats. These examples and the other examples in the TRD present only one possible monitoring approach for each situation and are not intended to be prescriptive. Depending on source-specific factors (e.g., size, unit type, fuel, margin of compliance, and variability of emissions), other monitoring approaches may be appropriate for these and similar emissions units.

The examples provide the following information:

1. Source type;
2. Applicable requirements;
3. Monitoring approach; and
4. Basis for selecting the monitoring approach.

Table 1 provides a list of the examples included in this supplement to the TRD.

Table 1. Title V Monitoring Examples In This Supplement

No.	Source	Pollutant	Monitoring Approach
APPENDIX A. Combustion Source Examples			
A.5	200 mmBtu/hr gas- and oil-fired boiler	NO_x, SO_2, opacity	NO_x PEMS; COMS and fuel sulfur content when burning fuel oil.
A.6	>100 mmBtu/hr diesel engine	PM, opacity, SO_2	VE observation, fuel sulfur content.
A.7	40 mmBtu/hr gas turbine	NO_x, SO_2, opacity	NO_x PEMS, fuel sulfur content.
A.8	18.63 mmBtu/hr gas-fired IC engine.	CO, VOC, NO_x	Periodic testing, fuel usage and emission factor calculations.
A.9	40 mmBtu/hr gas turbine	NO_x, SO_2, opacity	Monitor combustor outlet temperature, fuel sulfur content.
A.10	500 mmBtu/hr gas and oil-fired turbine with water injection	NO_x, CO, SO_2, PM, VOC, opacity	NO_x and CO CEMS, water-to-fuel ratio, fuel sulfur content, fuel usage.
A.11	45 mmBtu/hr oil-fired boiler	PM, opacity, SO_2	Exhaust O_2 and CO, fuel sulfur content, inspection and maintenance, periodic testing.
A.12	6 mmBtu/hr oil-fired boiler	PM, opacity, SO_2	Inspection and maintenance, fuel sulfur content.
APPENDIX B. Fugitive Source Examples			
B.6	Paste mixing	VOC	Recordkeeping and emission factor calculations.
APPENDIX C. Coating Source Examples			
C.3	Printing press	VOC	Recordkeeping.
APPENDIX D. Other VOC Source Examples			
D.4	Bread ovens at a bakery	VOC	Recordkeeping.
D.5	Cold cleaner	VOC	Recordkeeping.
D.6	Parts cleaning	VOC	Recordkeeping.
D.7	Vacuum stripping batch process	VOC/HAP	Mass balance and Drager tube.
APPENDIX E. Other PM Source Examples			
E.3	Flour silo with baghouse	PM, opacity	VE observation, baghouse inspection.
E.6	Glass furnace	PM, opacity	VE observation, periodic testing.

Title V Monitoring Example No. A.5

1. Emissions Unit

1.1 Process/Emissions Unit: 200 mmBtu/hr boiler fired with natural gas and oil.
1.2 Pollutants: NO_x, SO_2, Opacity
1.3 Emissions control technique: Proper operation and maintenance, fire low-sulfur oil.

2. Applicable Requirements

When firing natural gas:
NO_x: 0.1 lb/mmBtu (24-hour average)
When firing fuel oil:
NO_x: 0.3 lb/mmBtu (24-hour average)
Opacity: 20 percent (6-minute average)
SO_2: 0.8 lb/mmBtu (24-hour average)

3. Monitoring Approach

Applicable Requirements	NO_x limit	Opacity limit (fuel oil only)	SO_2 limit (fuel oil only)
General Monitoring Approach	Correlation (predictive emissions monitoring system [PEMS]) between NO_x (lb/mmBtu) and fuel flow and air flow. See below for predictive equations.	Continuous opacity monitoring system (COMS).	Fire very low-sulfur fuel oil, keep fuel receipts.
Monitoring Methods and Location	-- Pitot tube to measure air flow; min. accuracy of ±2 percent. -- Turbine meter in natural gas line; mass flow meter in oil line; min. accuracy of ±2 percent. -- Relative accuracy test audit (RATA) per 40 CFR 60, Performance Specification (PS) 2; RA #20 percent.	COMS in the boiler exhaust, installed per 40 CFR 60, PS-1.	Obtain fuel receipts from the fuel supplier.
Indicator Range	When firing natural gas: NO_x <0.1 lb/mmBtu (24-hr average). When firing fuel oil: NO_x <0.3 lb/mmBtu (24-hr average).	Opacity less than 20 percent (6-minute average).	Fuel sulfur content less than 0.5 percent by weight.

Applicable Requirements	NO_x limit	Opacity limit (fuel oil only)	SO_2 limit (fuel oil only)
Data Collection Frequency	1-minute data collection of fuel flow and air flow. Annual RATA.	Continuous.	Per fuel delivery.
Averaging Period	Air flow, fuel flow: Hourly. NO_x: Rolling 24-hour average calculated.	6 minutes.	None.
Recordkeeping	Record hourly averages (air and fuel flow), record 24-hour average NO_x emissions, keep records of annual RATA results.	Data acquisition system records 6-minute averages. Time and duration of any opacity excursions and corrective action taken are logged.	Fuel delivery receipts.
QA/QC	Calibrate fuel flow meters and pitot tube annually. Follow PS-2 for annual RATA.	Operate the COMS per PS-1.	None.

The NO_x emission rate is calculated using the following correlations established during source testing. The hourly average air flow (signal from differential pressure transmitter) and mass flow of fuel are used to calculate a rolling 24-hour average NO_x emission rate.

When firing natural gas:

$$NO_x \text{ (lb/mmBtu)} = 0.052975 + (0.005659 * \text{Air flow}) - (0.000195 * \text{Gas flow})$$

When firing fuel oil:

$$NO_x \text{ (lb/mmBtu)} = 0.101546 - (0.000909 * \text{Air flow}) - (0.008188 * \text{Oil flow})$$

4. Basis

This unit is subject to 40 CFR 60, Subpart Db. The facility chose to monitor for NO_x by developing a predictive emissions model that uses gas flow and air flow to predict NO_x emissions. They developed the equation based on three days of test data obtained over a range of boiler operating conditions. Several operating parameters were monitored during testing, and statistical analysis showed the most significant parameters were air flow and fuel flow. The R^2 value for the equations developed for both fuels is 0.83. The relative accuracy of the natural gas equation is 10 percent, and the relative accuracy of the fuel oil equation is 3.76 percent, compared to a NO_x CEMS that was in place during the PEMS development testing. The facility is required to perform an annual RATA to verify the continuing validity of the predictive equations (RA less than or equal to 20 percent) and to verify compliance with the NO_x emission standard.

The facility monitors for opacity and SO_2 when firing fuel oil. A COMS is used for opacity to provide a continuous assurance of compliance with the limit. Only very low-sulfur fuel (less than 0.5 percent sulfur, as defined in 40 CFR 60.41b) is fired to assure compliance with the SO_2 limit.

5. Additional Comments

None.

6. References/Information Source

1. Permit conditions for a boiler.
2. 40 CFR 60, Subpart Db.
3. Performance Specification 1, Specifications and test procedures for opacity continuous emission monitoring systems in stationary sources.
4. Performance Specification 2, Specifications and test procedures for SO_2 and NO_x continuous emission monitoring systems in stationary sources.
5. Conditional Test Method (CTM) 030, Determination of nitrogen oxides, carbon monoxide, and oxygen emissions from natural gas-fired engines, boilers, and process heaters using portable analyzers.

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Title V Monitoring Example No. A.6

1. Emissions Unit

1.1 Process/Emissions Unit: Diesel engine >100 mmBtu/hr
1.2 Pollutant: PM, Opacity, SO_2
1.3 Emissions control technique: Equipment inspection/maintenance, fuel restrictions

2. Applicable Requirements

PM: 0.05 gr/dscf
Opacity: 20 percent (except 3 minutes in one hour)
SO_2: 500 ppm (3-hour average)

3. Monitoring Approach

Applicable Requirement	PM/Opacity limits	SO_2 limit
General Monitoring Approach	Visible emissions (VE) observation.	Fuel oil sulfur content.
Monitoring Methods and Location	Three-minute VE observation at exhaust plume; if VE are observed, perform maintenance to eliminate VE and perform draft Method 203B if VE are not eliminated.	Keep delivery receipts if using ASTM D1 or D2 grade fuel or measure using appropriate ASTM method, depending on fuel grade (ASTM 975, 3120, 2622, or 4294).
Indicator Range	VE: No VE. Opacity: Less than 20 percent.	Less than 0.5 percent by weight.
Data Collection Frequency	Daily VE/no VE observation for first 30 days of operation; if no VE for 30 days, perform weekly 3-minute VE/no VE observation. If VE are present, perform maintenance to eliminate VE and restart 30-day period or do weekly M203B observation.	Each shipment of fuel oil.
Averaging Period	None.	None.
Recordkeeping	Record results of observations, any corrective action taken, maintenance performed.	Records of fuel shipment (if using ASTM D1 or D2 grade fuel) or results of ASTM method to document fuel sulfur content.
QA/QC	Method 203B opacity observer certified per Method 9. VE observer trained per Method 22.	Follow procedures in appropriate ASTM method, if used.

4. Basis

The facility monitors opacity because as particulate matter emissions increase, visible emissions tend to increase. The facility performs maintenance on the equipment if visible emissions are observed to ensure it is operating properly and at optimal combustion. If the maintenance is unsuccessful in eliminating the visible emissions, a certified observer performs an opacity observation per draft Method 203B to verify compliance with the opacity standard. If no visible emissions are observed, there is a reasonable assurance of compliance with the PM standard. Limiting the fuel sulfur content provides a reasonable assurance of compliance with the SO_2 limit.

5. Additional Comments

The permit reviewed in developing this example required a monthly visible emissions check after the initial 30-day observation period and a Method 9 observation if visible emissions were observed. We revised the ongoing frequency of visible emissions observations to weekly to provide a better assurance of compliance with the opacity standard. We also changed the Method 9 reference in the permit to draft Method 203B in this example (although Method 203B is not yet final) because the opacity standard is a time-exception standard and Method 9 is used to determine compliance with a 6-minute average opacity limit.

6. References/Information Source

1. Diesel-electric generating facility permit.
2. ASTM D975, Standard Specification for Diesel Fuel Oils.
3. ASTM D3120, Standard Test Method for Trace Quantities of Sulfur in Light Liquid Petroleum Hydrocarbons by Oxidative Microcoulometry.
4. ASTM D2622, Standard Test Method for Sulfur in Petroleum Products by Wavelength Dispersive X-ray Fluorescence Spectrometry.
5. ASTM D4294, Standard Test Method for Sulfur in Petroleum Products by Energy-Dispersive X-Ray Fluorescence Spectroscopy.
6. Method 22, Visual Determination of Fugitive Emissions from Material Sources and Smoke Emissions from Flares.
7. Draft Method 203B, Visual Determination of Opacity of Emissions from Stationary Sources for Time-exception Regulations.

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Title V Monitoring Example No. A.7

1. Emissions Unit

1.1 Process/Emissions Unit: 40 mmBtu/hr (15,000 Hp) gas turbine
1.2 Pollutant: NO_x, SO_2, opacity
1.3 Emissions control technique: Low-NO_x burners, fire only with natural gas.

2. Applicable Requirements

NO_x: 150 ppmv at 15 percent O_2; 90 tons per consecutive 12-month period.
SO_2: Fuel sulfur content limited to 0.8 percent by weight.
Opacity: 40 percent.

3. Monitoring Approach

Applicable Requirement	NO_x limit	SO_2 limit	Opacity limit
General Monitoring Approach	Turbine operating parameter values are used in a predictive emissions monitoring system (PEMS) to predict NO_x emissions in ppmv at 15 percent O_2 and lb/hr.	Analyze fuel for sulfur content.	No monitoring.

Applicable Requirement	NO_x limit	SO_2 limit	Opacity limit
Monitoring Methods and Location	The following operating parameters are measured as inputs to the PEMS model: 1. Inlet air temperature: Thermocouple at inlet air duct. Minimum accuracy of ± 4/F or 0.75 percent of the temperature measured in degrees Celsius, whichever is greater. 2. Barometric pressure: Electronic output aneroid barometer. Minimum accuracy of ± 0.5 percent of span. 3. Relative humidity (RH): Electronic output relative humidity sensor. Minimum accuracy of ± 2 percent RH. 4. Turbine inlet temperature: Array of thermocouples at the inlet to the turbine, after the combustor. Minimum accuracy of ± 4/F or 0.75 percent of the temperature measured in degrees Celsius. 5. Compressor speed: Magnetic speed sensor on the air compressor, before the combustor. Air flow through the turbine, used for lb/hr emission rate calculation, is determined from turbine performance curves provided by the manufacturer.	Use appropriate ASTM Method (D1072, D3031, D4084, or D3246) for gaseous fuels to determine sulfur content of natural gas fired.	
Indicator Range	Outlet NO_x concentration less than 150 ppmv at 15 percent O_2. 12-month total emissions less than 90 tons.	Less than 0.8 percent sulfur by weight.	
Data Collection Frequency	Parameters used in the PEMS model are continuously recorded by the turbine control panel (TCP). The emission rate values calculated by the PEMS are continuously updated and averaged into hourly averages within the TCP.	Semi-annual.	
Averaging Period	None.	None.	
Recordkeeping	NO_x mass emissions are calculated and recorded monthly to ensure the 12-month limit is not being exceeded.	Records of analyses.	
QA/QC	Annual relative accuracy test audit (RATA) on PEMS. Sensors calibrated annually.	Follow procedures in ASTM Method.	

4. Basis

A properly designed, operated, and validated PEMS provides accurate emissions data. The PEMS in this example consists of a predictive equation based on combustion principles and turbine performance curves developed by the turbine manufacturer. The operating parameters used in the PEMS are based on the turbine manufacturer's scientific knowledge of NO_x formation. The RATA results for the last 5 years range from 4.75 to 19.2 percent relative accuracy. The most recent RATA showed the turbine's NO_x emissions are around 25 ppmv (corrected to 15 percent O_2), less than 20 percent of the emissions limit.

A turbine fired with natural gas is expected to produce little visible emissions or SO_2 emissions. Therefore, a reasonable assurance of compliance with the 40 percent opacity limit is provided by firing only natural gas in the turbine (the turbine is not equipped to fire another fuel and the PEMS is valid only when firing natural gas). A semi-annual fuel sulfur content analysis is performed to confirm that the fuel has a sulfur content less than 0.8 percent and be sufficient to assure compliance with the SO_2 limit.

5. Comments

The parameters monitored in this example are based on the design of a specific PEMS. Other PEMS might be designed to monitor different combinations of operating parameters to meet the accuracy criteria. Also, a PEMS based on a neural network or predictive algorithm developed by non-linear regression techniques is acceptable if it meets the applicable relative accuracy requirement. The NO_x PEMS monitoring approach also might be applicable for gas turbines that fire alternate fuels if the PEMS relative accuracy criteria were met for each fuel fired.

6. References/Information Source

1. Title V permit for a natural gas-fired turbine.
2. PEMS information from the gas turbine manufacturer and users.

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Title V monitoring Example No. A.8

1. Emissions Unit

1.1 Process/Emissions Unit: Natural gas-fired, 2-cycle, lean-burn, turbocharged internal combustion (IC) engine rated at 2,700 horsepower and 18.63 mmBtu/hr fuel rate.

1.2 Pollutants: CO, VOC, NO_x

1.3 Emissions control technique: Fire only natural gas.

2. Applicable Requirements

NO_x: 54.41 lb/hr, 238.3 tpy
CO: 5.95 lb/hr, 26.1 tpy
VOC: 2.98 lb/hr, 13.0 tpy
Opacity: Less than or equal to 20 percent.

3. Monitoring Approach

Applicable Requirement	NO_x and CO emission limits	NO_x, CO, and VOC emission limits	Opacity limit
General Monitoring Approach	Periodic emissions testing.	Calculations using manufacturer's emission factors.	No monitoring.
Monitoring Methods and Location	Periodic testing using portable analyzers for NO_x and CO per conditional test method (CTM)-030.	Use ASTM D1826 for heat content. Use a non-resetting hour meter for operating hours. Use a turbine meter on fuel line for fuel use. Calculate the CO, NO_x, and VOC emission rate and total emissions using fuel use, heat content, hours of operation, and the emission factors and equation below.	
Indicator Range	NO_x: <54.41 lb/hr, CO: <5.95 lb/hr, VOC: <2.98 lb/hr.		
Data Collection Frequency	Quarterly. If no exceedances for 4 quarters, semi-annually.	Fuel usage, hours of operation, and emission factor calculations: Monthly. Heat content: Semi-annually.	
Averaging Period	1 hour.	NA	

Applicable Requirement	NO_x and CO emission limits	NO_x, CO, and VOC emission limits	Opacity limit
Recordkeeping	Emissions test report.	– Records of semi-annual fuel heat content measurements; – Operating hours and fuel usage each month; – Monthly emissions calculations; – Twelve-month rolling total emissions; – Hourly emission rate calculated by dividing the monthly calculated emissions by the number of hours of operation in the month.	
QA/QC	QA per CTM-030.	Follow ASTM D1826 or equivalent for heat content analysis.	

Manufacturer's emission factors:
NO_x: 2.92 lb/mmBtu
CO: 0.32 lb/mmBtu
VOC: 0.16 lb/mmBtu

Monthly emissions of NO_x, CO, and VOC are calculated by inserting the fuel-based emission factors in the following equation:

$$\text{lb/month} = (\text{EF, lb/mmBtu}) \times (\text{Btu content of fuel, Btu/scf}) \times (\text{Fuel use, mmscf/month})$$

Hourly emissions are calculated by dividing the monthly emissions by the number of hours of operation in the month.

4. Basis

The emissions control technique is the use of natural gas as the fuel for the engine. Monitoring of fuel usage and operating hours combined with the calculation of emissions using the engine manufacturer's emission factors is expected to be sufficient to assure compliance with the emission limits. However, because the emission factors are based on the engine manufacturer's data, periodic emissions testing is necessary to verify the emission factor calculations for this source and ensure compliance with the NO_x and CO emission limits. Therefore, the monitoring incorporates periodic emissions testing using a portable analyzer; the initial monitoring frequency is quarterly. The monitoring frequency is reduced to semi-annually once the quarterly tests verify the emission factors and performance of the unit.

Because the unit is fired only with natural gas, the margin of compliance with the 20 percent opacity limit is expected to be very high; consequently, no monitoring is necessary to demonstrate compliance with the opacity limit.

5. Additional Comments

The permit reviewed for this example contained a requirement for a semi-annual visible emissions observation. Because the permit did not specify the method to be used for the VE observation and to be consistent with our other examples for natural-gas fired units with opacity limits, this example specifies that the engine be fired only with natural gas to show compliance with the 20 percent opacity limit. We also added the reference to CTM-030 because the permit did not specify the approach to periodic testing with the portable analyzer, only that the analyzer be operated in accordance with the manufacturer's recommendations and that a test protocol be submitted within 30 days of the test.

6. References/Information Source

1. Operating permit for a natural gas transmission company.
2. Conditional Test Method 30 (CTM-030), Determination of nitrogen oxides, carbon monoxide, and oxygen emissions from natural gas-fired engines, boilers, and process heaters using portable analyzers.
3. ASTM D1826, Standard test method for calorific (heating) value of gases in natural gas range by continuous recording calorimeter.

Title V monitoring Example No. A.9

1. Emissions Unit

1.1 Process/Emissions Unit: 40 mmBtu/hr stationary gas turbine.
1.2 Pollutants: NO_x, SO_2, Opacity
1.3 Emissions control technique: Good operating practices, fire only natural gas.

2. Applicable Requirements

NO_x: 20 lb/hr
SO_2: 150 ppmvd at 15 percent O_2
Opacity: 40 percent

3. Monitoring Approach

Applicable Requirement	NO_x emissions limit	SO_2 emissions limit	Opacity limit
General Monitoring Approach	Monitor combustor outlet temperature (T5).	Analyze fuel for sulfur content.	No monitoring.
Monitoring Methods and Location	The T5 temperature is measured using an array of thermocouples at the second set of turbine blades after the combustor outlet. The thermocouples have a minimum accuracy of ±4/F or 0.75 percent of the temperature measured in degrees Celsius, whichever is greater.	Use appropriate ASTM Method (D1072, D3031, D4084, or D3246) for gaseous fuels to determine sulfur content of natural gas fired.	
Indicator Range	3-hour average combustor outlet temperature (T5) less than 1160/F.	Fuel sulfur content less than 0.8 percent, by weight.	
Data Collection Frequency	4 times per hour.	Semi-annually.	
Averaging Period	3 hours, rolling hourly.	None.	
Recordkeeping	Data acquisition system records 3-hour average combustor outlet temperature (T5).	Maintain records of fuel analyses.	

Applicable Requirement	NO_x emissions limit	SO_2 emissions limit	Opacity limit
QA/QC	Check calibration of thermocouples annually by comparison to a second thermocouple with equivalent or better accuracy. Acceptance criteria is 1% of the temperature measured in degrees Celsius.	Follow procedures in applicable ASTM method.	

4. Basis

Formation of NO_x from gas turbines is related to the temperature of the combustion gases. As the combustion temperature increases, the general trend is for the turbine outlet NO_x concentration to increase. During the initial compliance test, the measured NO_x emissions were 17.9 lb/hr (average of three runs which ranged from 17.9 to 18.1 lb/hr), which is 89.5 percent of the emission standard. The tests were conducted with the turbine operating at maximum load. The average T5 temperature during the tests was 1151/F. Based on the results of the initial performance testing, the indicator range for the combustion turbine outlet temperature (T5) is established as less than 1160/F; operating the turbine at a temperature below this level will be sufficient to assure compliance with the NO_x standard.

Because the turbine fuel is pipeline-quality natural gas, the sulfur content of the fuel and the resulting SO_2 emissions are expected to be well below the allowable sulfur content and SO_2 emission limits (the typical sulfur content of commercial grade natural gas is less than 8 ppm according to Reference 2). Consequently, the only monitoring required for the SO_2 limit is a semi-annual verification that the fuel sulfur content is less than 0.8 percent.

Because the turbine is configured to burn only natural gas, there is little likelihood of exceeding the opacity limit. Consequently, no title V monitoring is necessary for the 40 percent opacity requirement.

5. Additional Comments

None.

6. References/Information Source

1. Title V permit for a stationary gas turbine.
2. North American Combustion Handbook, North American Manufacturing Company; Third Edition, pg 16.

Title V monitoring Example No. A.10

1. Emissions Unit

1.1 Process/Emissions Unit: 500 mmBtu/hr gas/oil-fired turbine with 83 mmBtu/hr duct burner
1.2 Pollutants: NO_x, CO, SO_2, opacity, PM/PM-10, VOC
1.3 Emissions control technique: Water injection, fuel limitations.

2. Applicable Requirements

Operating condition	NO_x limit (1-hour average)	CO limit (1-hour average)	PM/PM-10 (1-hour average)	VOC (1-hour average)
Firing No. 2 fuel oil in turbine, without duct burner.	125.3 lb/hr 65 ppmvd (at 15 percent O_2)	11 lb/hr 9 ppmvd (at 15 percent O_2)	27.8 lb/hr 0.04 lb/mmBTU	5 lb/hr 0.009 lb/mmBTU
Firing No. 2 fuel oil in turbine, duct burner firing natural gas.	136.1 lb/hr 65 ppmvd (at 15 percent O_2)	28.3 lb/hr 22 ppmvd (at 15 percent O_2)	27.8 lb/hr 0.10 lb/mmBTU	15.8 lb/hr 0.029 lb/mmBTU
Firing natural gas in turbine, without duct burner.	76.6 lb/hr 42 ppmvd (at 15 percent O_2)	11 lb/hr 10 ppmvd (at 15 percent O_2)	3 lb/hr 0.005 lb/mmBTU	5 lb/hr 0.009 lb/mmBTU
Firing natural gas in turbine and duct burner.	87.4 lb/hr 42 ppmvd (at 15 percent O_2)	28.3 lb/hr 23 ppmvd (at 15 percent O_2)	3 lb/hr 0.005 lb/mmBTU	15.8 lb/hr 0.029 lb/mmBTU
Firing No. 2 fuel oil in turbine and duct burner.	136.1 lb/hr 65 ppmvd (at 15 percent O_2)	28.3 lb/hr 22 ppmvd (at 15 percent O_2)	27.8 lb/hr 0.10 lb/mmBTU	15.8 lb/hr 0.029 lb/mmBTU
Firing No. 2 fuel oil and natural gas in turbine, without duct burner.	125.3 lb/hr 65 ppmvd (at 15 percent O_2)	11 lb/hr 9 ppmvd (at 15 percent O_2)	27.8 lb/hr 0.04 lb/mmBTU	5 lb/hr 0.009 lb/mmBTU
Firing No. 2 fuel oil and natural gas in turbine, duct burner firing natural gas.	136.1 lb/hr 65 ppmvd (at 15 percent O_2)	28.3 lb/hr 22 ppmvd (at 15 percent O_2)	27.8 lb/hr 0.10 lb/mmBTU	15.8 lb/hr 0.029 lb/mmBTU

SO_2: Fuel oil sulfur content less than 0.2 by weight. Fuel oil usage not to exceed 10,200,000 gallons per rolling 365-day period.
Natural gas sulfur content less than 0.1 percent by weight.

Opacity: Not to exceed 20 percent, except for one six-minute period per hour not to exceed 27 percent.

Not to exceed 40 percent at any time.

3. Monitoring Approach

Applicable Requirement	NO_x limit	NO_x limit	CO and VOC limit	SO_2 limit
General Monitoring Approach	Water-to-fuel ratio.	NO_x continuous emissions monitoring system (CEMS).[a]	CO CEMS.[a]	Fuel sulfur analysis. Records of natural gas and fuel oil usage.
Monitoring Methods and Location	Fuel flow meters in fuel inlet lines and water flow meter in water inlet line. Minimum accuracy of the system is ±5 percent.	The CEMS is located in the turbine exhaust, after the duct burner, and measures outlet NO_x in ppm. Ambient temperature (±1/F) and load also are measured to determine air flow from manufacturer's performance curves.	The CEMS is located in the turbine exhaust, after the duct burner, and measures outlet CO in ppm. Ambient temperature (±1/F) and load also are measured to determine air flow from manufacturer's performance curves.	Fuel supplier certifications are obtained to document sulfur content and types of fuel burned. Fuel oil usage is monitored and recorded daily using a fuel flow meter with a minimum accuracy of ±5 percent.
Indicator Range	Water-to-fuel ratio between 0.9 and 1.3.	Hourly average NO_x emissions less than NO_x limits (see table above).	Hourly average CO emissions less than CO limits (see table above).	Fuel oil: <0.2 percent sulfur by weight. Fuel oil usage: <10,200,000 gal per 365 days. Nat. gas: <0.1 percent sulfur by weight.
Data Collection Frequency	Continuous.	Continuous.	Continuous.	Fuel oil sulfur content: per shipment. Fuel oil usage: daily. Natural gas: quarterly.
Averaging Period	None.	Hourly.	Hourly.	None.
Recordkeeping	Data acquisition system (DAS) records water-to-fuel ratio.	DAS records hourly average NO_x emissions in ppmvd and lb/hr.	DAS records hourly average CO emissions in ppmvd and lb/hr.	Retain fuel supplier certifications and records of fuel oil usage.
QA/QC	Calibrate flow meters annually.	Install and operate CEMS according to 40 CFR 60, Appendix B and Appendix F. Calibrate temperature sensor annually.	Install and operate CEMS according to 40 CFR 60, Appendix B and Appendix F. Calibrate temperature sensor annually.	Calibrate fuel flow meter annually.

[a] CEMS includes diluent analyzer for correcting measured concentrations to a 15 percent O_2 basis.

Monitoring for PM, PM-10, opacity limits: Initial compliance test (Method 9 and Method 5) and fuel usage records.

4. Basis

This turbine is subject to 40 CFR 60, Subpart GG, so it is not required to have a CEMS. However, the facility installed NO_x and CO CEMS to provide a continuous assurance of compliance with their various NO_x, CO, and VOC limits. Ambient temperature and turbine load are used with the manufacturer's turbine performance curves to determine the air flow needed to calculate emissions in lb/hr. The facility also monitors the water-to-fuel ratio, as required by Subpart GG, to ensure that the water injection system is working properly. The type and amount of fuel burned is monitored to determine which NO_x and CO limits apply and to assure compliance with the SO_2 limit. Fuel supplier certifications are sufficient to comply with the fuel sulfur content limits; they also serve to document the types of fuel burned. A custom fuel sampling schedule (quarterly) was developed for natural gas because natural gas has a very low sulfur content (typically less than 8 percent).

Based on the types of fuel burned in this turbine, it is not likely that the opacity, PM, PM-10, and VOC limits will be exceeded. If the combustion efficiency of the unit decreases to a level sufficient to cause a violation of the PM, PM-10, VOC, or opacity limits, the CO will increase significantly. Therefore, the CO CEMS and records of fuel use are sufficient to monitor compliance with these other emission limitations.

5. Additional Comments

This turbine is a major source of NO_x emissions and uses water injection for control of NO_x emissions. Therefore, it will be subject to CAM requirements for the NO_x monitoring at the next permit renewal. The approach currently used for title V monitoring is adequate for CAM purposes as well.

6. References/Information Source

1. Title V permit for turbine.

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Title V monitoring Example No. A.11

1. Emissions Unit

1.1 Process/Emissions Unit: 45 mmBtu/hr oil-fired boiler
1.2 Pollutant: PM, Opacity, SO_2
1.3 Emissions control technique: Good combustion practices, burn low-sulfur fuel

2. Applicable Requirements

Opacity: 40 percent (except 6 minutes in one hour), less than 60 percent at all times
PM: 0.25 lb/mmBtu, 11 lb/hr
SO_2: 410 tpy.

3. Monitoring Approach

See Table 1.

Combustion efficiency is calculated as follows:

$$CE = \left(\frac{CO_2}{CO_2 + CO} \right) 100 \qquad \text{(Eq. 1)}$$

where:
CE = combustion efficiency, percent
CO_2 = carbon dioxide in exhaust, percent
CO = carbon monoxide in exhaust, percent

The concentration of carbon dioxide (CO_2) in the exhaust gas may be determined by measuring the concentration of oxygen (O_2) in the exhaust gas and using the following formula:

$$CO_2 = 100 \left(\frac{F_c}{F} \right) \left(\frac{20.9 - O_2}{20.9} \right) \qquad \text{(Eq. 2)}$$

where:
CO_2 = carbon dioxide in exhaust, percent
F_c = 1,420 standard cubic feet of CO_2 per mmBtu and
F = 9,190 dry standard cubic feet per mmBtu
O_2 = oxygen in exhaust, percent

Table 1. Monitoring Approach

Applicable Requirement	PM and Opacity limits	SO_2 limit	All limits
General Monitoring Approach	Monitor boiler exhaust O_2 and CO and calculate CO_2 and combustion efficiency using Equations 1 and 2.	Monitor sulfur content of fuel.	Boiler inspection and maintenance program.
Monitoring Methods and Location	Use extractive portable analyzer to measure boiler exhaust O_2 and CO. When combustion efficiency drops, take corrective action and adjust boiler operating parameters.	Obtain fuel supplier certification.	Operators note condition of equipment daily. Burner tips knocked clean of all deposits daily. Boiler floor cleaned of all deposits and debris annually.
Indicator Range	$99.5 percent combustion efficiency.	Less than 2 percent sulfur by weight.	NA
Data Collection Frequency	Use portable monitor once per week to check O_2 and CO and calculate combustion efficiency. If an excursion occurs, closely monitor until the combustion efficiency is at or above 99.5 percent for at least one hour.	Each shipment.	Varies.
Averaging Period	None.	None.	NA
Recordkeeping	Copies of calculations and data.	Maintain copies of fuel supplier certifications and delivery invoices.	Record results of all inspections and any maintenance performed in boiler log.
QA/QC	Conduct zero/span check of portable analyzer before and after use. Acceptance criteria: ±5 percent of span. Follow boiler operation and maintenance plan.	None.	Follow boiler operation and maintenance plan.
Periodic Testing	Perform draft Method 203B for opacity and Method 5 for PM every 3 years.		

4. Basis

Opacity and particulate emissions are inversely related to the boiler's combustion efficiency. Data collected during a 30-day monitoring period showed that when the boiler exhaust O_2 concentration drops dramatically, the CO emissions and the opacity increase, and the combustion efficiency decreases. Maintaining a high combustion efficiency based on measurements of boiler exhaust O_2 and CO and performing regular maintenance on the boiler provides a reasonable assurance of compliance with the PM and opacity limits. The boiler operation and maintenance plan contains the monitoring procedures, corrective action procedures, descriptions of routine inspection and maintenance activities, provisions for maintaining records, provisions for training personnel, and provisions for calibration and maintenance of testing instruments. The two most recent source tests on this boiler have shown that its margin of compliance with the PM limit is around 50 percent, and the boiler exhaust emissions routinely have an opacity of 0 to 10 percent (except during soot blowing, which lasts about 1.5 minutes). Data from the most recent performance test is provided in Table 2. Performance tests for opacity and PM are required every 3 years to further assure continued compliance with the opacity and PM limits. Because the margin of compliance with the PM and opacity limits is high, weekly monitoring is acceptable.

Table 2. Summary of Most Recent Performance Test Results

Run	PM Emissions, lb/hr	PM Emissions, lb/mmBtu	Average opacity, percent
1	3.66	0.0746	0
2 (with soot blow)	7.12	0.1603	<5%
3	3.51	0.0717	<5%
4	4.01	0.0966	6%

Table 3 summarizes data from a combustion efficiency evaluation over a 5-day period. In general, higher CO concentrations indicated lower combustion efficiency. These data were used to establish the indicator range of 99.95 percent combustion efficiency.

Table 3. Summary of Combustion Efficiency Test Results

Date	Run	O_2 (%)	CO (ppm)	CO_2 (%)	CE (%)
Nov 4	1	13	6	6.14	99.99
	2	12	0	6.43	100.00
	3	12	80	6.73	99.88
Nov 6	1	9	10	8.58	99.99
Nov 9	1	9	43	8.50	99.95
	2	9	16	8.65	99.98
	3	9	83	8.95	99.91
	4	11	11	7.61	99.99
Nov 11	1	11	10	7.32	99.99
	2	9	8	9.02	99.99
	3	7	395	10.13	99.61
	4	12	10	6.88	99.99

Date	Run	O_2 (%)	CO (ppm)	CO_2 (%)	CE (%)
Nov 18	1	7	733	9.98	99.27
	2	10	50	8.13	99.94
	3	9	34	8.65	99.96

Table 4 summarizes data from a 30-day monitoring period. There is only one day that showed combustion efficiencies lower than the trigger level of 99.5 percent combustion efficiency, and the outlet CO concentration was abnormally high.

Compliance with the SO_2 limit is maintained by burning only low-sulfur fuel in the boiler. Fuel supplier certifications are adequate for demonstrating compliance with the fuel sulfur limit.

5. Additional Comments

The permit reviewed for this example specified the use of Method F-1 (proposed in 1986) for opacity, which is the current draft Method 203-B, Visual Determination of Opacity of Emissions from Stationary Sources for Time-Exception Regulations.

Monitoring frequency could be modified as necessary to increase the level of confidence, especially if weekly monitoring indicated excessive excursions. Options might include daily monitoring, continuous O_2/CO monitoring, or more frequent opacity observations.

6. References/Information Source

1. Title V permit conditions for a boiler.
2. Method 5, Determination of Particulate Emissions from Stationary Sources.
3. Draft Method 203-B, Visual Determination of Opacity of Emissions from Stationary Sources for Time-Exception Regulations.

Table 4. Summary of 30-day Monitoring Data

Date	CO (ppm)	O_2 (%)	CO_2(%)	CE (%)
09Nov98	43	9.4	8.50	99.95
10Nov98	11	13.1	5.77	99.98
11Nov98	10	11.0	7.32	99.99
12Nov98	3	13.5	5.47	99.99
13Nov98	31	9.4	8.50	99.96
16Nov98	12	10.6	7.61	99.98
17Nov98	29	10.4	7.76	99.96
18Nov98	733	7.4	9.98	99.27
19Nov98	5	13.0	5.84	99.99
20Nov98	8	13.8	5.25	99.98
23Nov98	25	10.1	7.98	99.97
24Nov98	10	16.5	3.25	99.97
25Nov98	5	16.1	3.55	99.99
30Nov98	10	13.9	5.18	99.98
01Dec98	13	8.6	9.09	99.99
02Dec98	5	16.8	3.03	99.98
03Dec98	22	11.2	7.17	99.97
04Dec98	8	13.1	5.77	99.99
07Dec98	17	11.6	6.88	99.98
08Dec98	13	11.1	7.25	99.98
09Dec98	8	8.5	9.17	99.99
10Dec98	15	9.0	8.80	99.98
11Dec98	10	11.8	6.73	99.99
14Dec98	22	7.9	9.61	99.98
15Dec98	5	9.9	8.13	99.99
16Dec98	8	11.3	7.10	99.99
17Dec98	5	12.0	6.58	99.99
18Dec98	20	8.2	9.39	99.98

Date	CO (ppm)	O_2 (%)	CO_2(%)	CE (%)
21Dec98	15	6.8	10.42	99.99
22Dec98	372	6.4	10.72	99.65

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Title V monitoring Example No. A.12

1. Emissions Unit

1.1 Process/Emissions Unit: 6 mmBtu/hr oil-fired boiler
1.2 Pollutant: PM, Opacity, SO_2
1.3 Emissions control technique: Good combustion practices, fire low-sulfur fuel

2. Applicable Requirements

Opacity: 20 percent, 6-minute average (except two 6-minute block averages in a 3-hour period)
PM: 0.20 lb/mmBtu, 1.24 lb/hr, 1.4 tpy
SO_2: 3.14 lb/hr, 3.6 tpy

3. Monitoring Approach

Applicable Requirement	PM/Opacity limits	SO_2 limit
General Monitoring Approach	Inspection and maintenance.	Fuel oil sulfur content.
Monitoring Methods and Location	Perform burner maintenance and cleaning at least once per year and keep a maintenance log for the boiler to ensure proper operation and optimal combustion.	Obtain fuel supplier certificate that documents fuel oil sulfur content.
Indicator Range	NA	Fuel oil sulfur content less than 0.5 percent.
Data Collection Frequency	At least annually.	Each shipment of fuel oil.
Averaging Period	NA	None.
Recordkeeping	Log of all maintenance performed on boiler.	Supplier fuel certificate.
QA/QC	Qualified personnel perform boiler maintenance per manufacturer's recommended practices.	None.

4. Basis

This boiler is not subject to 40 CFR 60, Subpart Dc, and continuous monitoring is not required. This boiler (boiler No. 2) is used to provide space heat when the facility's larger boiler (boiler No. 1) is not available. Boiler No. 1 is a 95 mmBtu/hr biomass- or fuel oil-fired boiler controlled with a multiclone with potential PM emissions of greater than 100 tons per year; the monitoring approach for boiler No. 1 satisfies the CAM rule requirements. The monitoring approach for boiler No. 2 is less rigorous. Its PM emissions are well below the major source threshold, it is operated infrequently, and it has low PM emissions when it is operated. Based on the AP-42 emission factor for PM of 2 lb/1000 gallons of fuel fired, when the boiler is operated at its maximum design fuel use rate (44.3 gallons per hour), the calculated PM emissions are 0.089 lb/hr. Even if the emission factor has a margin of error of 300 percent, the calculated emissions are less than 25 percent of the 1.24 lb/hr PM limit.

Periodic maintenance according to the manufacturer's recommended practices will ensure the boiler continues to operate properly and at optimal combustion efficiency. No other title V monitoring (e.g., visible emissions observations) is required to demonstrate compliance with the opacity and PM limits. Compliance with the SO_2 limit can be maintained by burning only low-sulfur fuel in the boiler. Fuel supplier certifications are adequate for documenting the fuel sulfur content.

5. Additional Comments

None.

6. References/Information Source

1. Title V permit conditions for a boiler.

Title V monitoring Example No. B.6

1. Emissions Unit

1.1 Process/Emissions Unit: Sheet molding compound paste mixer
1.2 Pollutant: VOC
1.3 Emissions control technique: Good operating practices.

2. Applicable Requirements

VOC: 8 lb/hr, 40 lb/day

3. Monitoring Approach

Applicable Requirement	VOC limit.
General Monitoring Approach	Determine VOC content of each ingredient, amount of each ingredient used, and apply an emission factor to estimate emissions.
Monitoring Methods and Location	VOC content of each ingredient is determined using manufacturer's formulation data or Method 24. Usage of each ingredient is recorded per batch. Operators record the number of hours the mixer operated. The daily VOC emission rate is determined by multiplying the total weight of each material mixed by the VOC content of each material, by weight, and then multiplying by an emission factor of 2 percent. The average hourly VOC emission rate is calculated by dividing by the number of hours the mixer operated that day.
Indicator Range	VOC emissions less than 8 lb/hr (average) and 40 lb/day.
Data Collection Frequency	Daily.
Averaging Period	Hourly.
Recordkeeping	Records of material usage, hours of operation of the mixer are recorded by the mixer operators in the operating log. Calculations are performed daily.
QA/QC	Follow the procedures in Method 24, if used.

4. Basis

Ingredients containing VOC are used in the mixing of sheet molding compound paste. During the mixing operation, solvent is lost. According to AP-42, Section 6.4, Paint and Varnish, about 1 to 2 percent of the solvent is lost during paint manufacturing. The background file indicates that this factor applies to mixing operations. Paint manufacturing is similar to the paste mixing process; both involve the dispersion of pigments in an oil or resin vehicle with the addition of solvent for viscosity adjustment. Therefore, the estimate used for paint manufacturing is adequate for this operation as well. The emissions from the paste mixing process are calculated using component VOC content, usage records, and an emission factor of 2 percent.

5. Additional Comments

None.

6. References/Information Source

1. Title V permit conditions for a mixing operation.
2. Method 24, Determination of Volatile Matter Content, Water Content, Density, Volume Solids, and Weight Solids of Surface Coatings.
3. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors (AP-42), Volume I: Stationary, Point, and Area Sources. Fifth Edition. pp. 6.4-1 - 6.4-2.

Title V monitoring Example C.3

1. Emissions Unit

1.1 Process/Emissions Unit: Three-color web screen printing press with infrared dryer.
1.2 Pollutant: VOC
1.3 Emissions control technique: Use non-VOC inks and cleanup materials.

2. Applicable Requirements

Photochemically reactive materials shall not be used in this emissions unit, including cleanup.

3. Monitoring Approach

Applicable Requirement	Use no photochemically reactive materials.
General Monitoring Approach	See Recordkeeping.
Monitoring Methods and Location	
Indicator Range	Use no photochemically reactive materials.
Data Collection Frequency	Monthly.
Averaging Period	NA
Recordkeeping	Record the company identification of each ink or coating and cleanup material employed in this emissions unit on a monthly basis. Certify that each ink, coating, or cleanup material used is a not photochemically reactive material.
QA/QC	Maintain certified product data sheets, manufacturer's formulation data, or Method 24 results that document that each ink, coating, or cleanup material used does not contain VOC.

4. Basis

Use of non-VOC inks provides that there will be no VOC emissions from the printing line. The facility is required to record, on a monthly basis, all inks, coatings, and cleanup materials used on the printing line and certify that they did not contain photochemically reactive materials (VOC). Certified product data sheets, manufacturer's formulation data, or Method 24 results are maintained to document that each material contains no VOC.

5. Additional Comments

The QA/QC requirement to maintain certified product data sheets, manufacturer's formulation data, or Method 24 results that document the materials do not contain VOC was not included in the permit reviewed for this example; this provision has been added to the example. The permit states only that the owner/operator report "whether the materials contain VOC."

6. References/Information Source

1. Title V permit conditions for a printing line.

Title V monitoring Example No. D.4

1. Emissions Unit

1.1 Process/Emissions Unit: Bread ovens
1.2 Pollutant: VOC
1.3 Emissions control technique: Limit production

2. Applicable Requirement

VOC: 230 tons per rolling 12-month period

3. Monitoring Approach

Applicable Requirements	VOC limit
General Monitoring Approach	Yeast usage, yeast action time, and bread production monitored and emissions estimated based on a formulation-specific emission factor developed using the model in the EPA document "Alternative Control Technology Document for Bakery Oven Emissions." Limit the production of straight dough bread to 12,500 tons per rolling 12-month period.
Monitoring Methods and Location	Oven operators record yeast usage, yeast action time, and bread production.
Indicator Range	VOC emissions less than 230 tons per rolling 12-month period.
Data Collection Frequency	Parameters recorded for each batch; emissions estimated monthly.
Averaging Period	None. (Rolling 12-month total.)
Recordkeeping	Yeast usage, yeast action time, and pounds of bread produced are recorded for each dough formulation.
QA/QC	None.

The VOC emissions from the operation of the bakery ovens are calculated via an emission factor derived from a mathematical model based on source testing as presented in EPA Publication 453/R-92-017 titled "Alternative Control Technology Document for Bakery Oven Emissions." The equation is as follows:

$$\text{VOC EF \#X} = (0.95*Yi) + (0.195*Ti) - (0.51*S) - (0.86*Ts) + 1.90$$

where:

VOC EF #X = VOC emission factor, in pounds of VOC per ton of baked bread, for bread formulation number X. Each formulation which results in a change in the variables below must have a different VOC emission factor.

Yi = Initial baker's percent of yeast to the nearest tenth of a percent (baker's percent of an ingredient refers to the weight of that ingredient per 100 pounds of flour in the formula).

Ti = Total yeast action time, in hours, to the nearest tenth of an hour (includes all time between the moment the yeast comes in contact with water and the moment the bread enters the oven).

S = Final (spike) baker's percent of yeast to the nearest tenth of a percent.

Ts = Spiking time in hours to the nearest tenth of an hour.

4. Basis

Based on results of bakery oven testing documented in EPA's *Alternative Control Technology (ACT) Document for Bakery Oven Emissions*, a relationship was found between VOC emissions and the initial yeast concentration and total fermentation and proof time. The facility monitors usage of yeast, action time of yeast, and production of bread, and uses the VOC emission factor equation provided in the ACT document to estimate mass emissions of VOC. The ACT states that greater than 90 percent of bakery VOC emissions are from the ovens. Although the limit on bread production limits the total VOC emissions from the facility, emission factor calculations based on product formulas show estimated VOC emissions of 68 tons per year from oven No. 1 and 32 tons per year from oven No. 2, less than half the permitted amount of 230 tons per year.

5. Comments

None.

6. References/Information Source

1. Title V Operating permit and background information for a bakery.
2. U. S. Environmental Protection Agency, *Alternative Control Technology Document for Bakery Oven Emissions*, EPA 453/R-92-017.

Title V monitoring Example No. D.5

1. Emissions Unit

1.1 Process/Emissions Unit: Solvent cold cleaners
1.2 Pollutant: VOC
1.3 Emissions control technique: Design standards and work practices. If the solvent is heated above 120°F, additional control techniques must be used (additional design standards, work practices or add-on control device).

2. Applicable Requirements

Design Standards:
- Air/vapor interface of 10 square feet or less.
- The cold cleaner must be equipped with a cover.
- The cover must be mechanically assisted if the solvent has a Reid vapor pressure (RVP) greater than 0.3 psia, the solvent is agitated, or the solvent is heated to a temperature above 120°F.
- A device shall be available for draining cleaned parts.

Work practices:
- Close the cover whenever parts are not being handled in the cleaner.
- Drain parts for 15 seconds or until dripping ceases.
- Perform routine maintenance on the cold cleaning machine as recommended by the manufacturer.
- Store waste solvent only in closed containers, unless the stored solvent is demonstrated to be a safety hazard and is disposed so that not more than 20 percent, by weight, is allowed to evaporate into the atmosphere.
- Develop written procedures to demonstrate compliance with the requirements, and post the procedures in an accessible, conspicuous location near the cold cleaner.
- If the solvent has an RVP >0.6 psia or is heated above 120°F, one of the following is also applicable: (1) use a cold cleaner designed such that the freeboard height to the width of the cleaner is equal to or greater than 0.7; (2) cover the solvent bath with water if the solvent is insoluble and has a specific gravity of more than 1.0; or (3) control emissions from the cold cleaner with a carbon adsorption system, condensation system, or other method of equivalent control.

3. Monitoring Approach

Applicable Requirement	Work practices.
General Monitoring Approach	Inspection, maintenance, recordkeeping.
Monitoring Methods and Location	The identification, name/number, air/vapor interface area, and type of solvent used (including the RVP and VOC content) are maintained for each cold cleaner. If the solvent is heated, the temperature of the solvent is monitored. A daily inspection is conducted to confirm compliance with work practices.
Data Collection Frequency	Daily inspection. Monthly monitoring of solvent temperature, if solvent is heated.
Averaging Period	NA
Recordkeeping	The identification, name/number, air/vapor interface area, and type of solvent used (including the RVP and VOC content) are maintained for each cold cleaner. All inspections and maintenance performed are logged.
QA/QC	Annual operator training.

4. Basis

Initial determination of the RVP of the cleaning solvent is needed to determine which requirements are applicable. Maintenance ensures that each cleaner's cover fits properly and that all components work as designed. Inspections verify that procedures are being followed, and annual training reinforces the proper procedures. Periodically checking the solvent composition ensures that changes are identified and the impact on applicable requirements can be assessed. Recordkeeping identifies each cold cleaner and the solvent that is used in it. These cold cleaners are not subject to 40 CFR 63, subpart T.

5. Additional Comments

The permit reviewed for this example requires only that records be maintained. Daily work practice inspections were added to this example as a means of ensuring the work practices are being performed. Furthermore, annual operator training was not included in the permit; it was added to this example.

6. References/Information Source

1. Permit conditions for three cold cleaners.

Title V monitoring Example No. D.6

1. Emissions Unit

1.1 Process/Emissions Unit: Parts cleaning by wiping
1.2 Pollutant: VOC
1.3 Emissions control technique: Good operating practices, limit solvent vapor pressure

2. Applicable Requirements

Work practices:

- Immediately after use, store used rags in covered containers labeled as waste solvent and handled in accordance with local, state, and federal regulations.
- Store waste solvent only in covered containers labeled as waste solvent and handled in accordance with local, state, and federal regulations.
- Do not allow solvent to drip from the applicator during solvent application.
- Provide a permanent, conspicuous label, summarizing the operating procedure of preceding requirements.
- Provide supervision or instruction adequate to ensure that the procedures are followed.
- Use only solvents that have a volatility less than 0.3 psia at 100°F.

3. Monitoring Approach

Applicable Requirement	Vapor pressure limit	Other work practice standards
General Monitoring Approach	Documentation of solvent vapor pressure.	Documentation of work practices performed.
Monitoring Methods and Location	Determine volatility based on MSDS, manufacturer's product spec sheet, or other vendor data (testing in accordance with Method 24 also is acceptable).	Work practice audits and certification.
Indicator Range	Less than 0.3 psia at 100/F.	NA
Data Collection Frequency	For each new solvent.	Monthly certification, at least monthly audits.
Averaging Period	None.	NA
Recordkeeping	Determine and document volatility of each solvent before initial use. Maintain monthly records of each solvent used and its volatility.	Audit checklists and monthly certification.
QA/QC	Follow procedures in Method 24 if used to determine vapor pressure.	Annual training of staff in work practices.

4. Basis

Requirements to periodically document the solvent volatilities and that work practice procedures are being followed helps maintain awareness of the procedures; following the procedures will minimize VOC emissions from cleaning operations and used applicators. Annual staff training ensures employees are aware of the importance of carrying out the required work practices.

5. Additional Comments

None.

6. References/Information Sources

1. Title V operating permit and State regulation.

Title V monitoring Example No. D.7

1. Emissions Unit

1.1 Process/Emissions Unit: Vacuum stripping batch process
1.2 Pollutant: VOC/HAP
1.3 Emissions control technique: Carbon adsorption (two carbon canisters in series)

2. Applicable Requirements

Emission limits:
2,3-Dichloro-1,3-butadiene (DCD): 0.001 lb/hr, 0.004 tons/yr
Methylene chloride (MeCl): 0.103 lb/hr, 0.451 tons/yr

3. Monitoring Approach

Applicable Requirement	DCD and MeCl emission limits	
General Monitoring Approach	Mass balance.	Check for breakthrough of first canister when canisters are switched.
Monitoring Methods and Location	Calculate the quantity of DCD and MeCl emitted from the process using a mass balance equation and compare to adsorption capacity of carbon canister. When the mass balance indicates the capacity of the first canister has been reached, the first canister is removed, the second canister is switched to the first canister position, and a new canister is installed as the second canister.	During the next batch after the canisters are switched, an emission sample is taken at the outlet of the first canister to ensure breakthrough is not occurring. A Drager tube is used as the sampling method.
Indicator Range	Total emissions # capacity of first carbon canister.	No MeCl detected (range of Drager tube is 100-2000 ppm).
Data Collection Frequency	Each batch.	During the next batch after a new canister is added (batch length varies).
Averaging Period	None.	None.
Recordkeeping	Amount of DCD and MeCl processed, DCD concentrate, and MeCl distillate per batch.	Dates of canister replacement, Drager tube measurement results.
QA/QC	Keep records of manufacturer's stated canister capacity. Supervisor reviews calculations periodically.	Tube checked to ensure it is calibrated for MeCl.

4. Basis

The process involves vacuum stripping of MeCl from a mixture of MeCl and DCD. The following equation is used to determine the amount of emissions from the process after each batch:

(DCD + MeCl processed) - (DCD concentrated + MeCl distilled) = Quantity of DCD +MeCL emitted

The results are totaled for each batch processed since the last canister change. Once the quantity emitted exceeds the capacity of the first canister in the system, that canister is removed, the second canister is installed as the first canister, and a new canister is installed as the second canister. During the first batch after the canisters are changed, an emission sample is taken to ensure breakthrough is not occurring from the new first canister. The sampling is conducted using a Drager tube. The Drager tube is calibrated to detect MeCl.

The emission limit is based upon a design control efficiency of 99 percent. The carbon canister inlet mass loading is approximately 10.26 lb/hr MeCl and 0.06 lb/hr of DCD. At the maximum design inlet flow rate of the canister, the MeCl inlet concentration would be approximately 12,000 ppm. At the allowed emission rate of 0.103 lb/hr, the MeCl outlet concentration would be approximately 120 ppm. Any positive Drager tube response for MeCl at the outlet of the first canister is considered an indication of breakthrough and the canister is replaced.

The combination of the mass balance/Drager tube approach, in conjunction with the fact that there is a secondary carbon canister in use at all times, provides a reasonable assurance that the carbon canisters continue to perform at the design efficiency and achieve compliance with the MeCl and DCD limits.

5. Additional Comments

None.

6. References/Information Source

1. Title V permit conditions.

Title V monitoring Example No. E.3

1. Emissions Unit

1.1 Process/Emissions Unit: Flour silo at baking company.
1.2 Pollutants: PM, Opacity.
1.3 Emissions control technique: Fabric filter.

2. Applicable Requirements

Opacity: 40 percent.
PM: $E = 4.1*P^{0.67}$
At the maximum production rate of P = 11.75 tons dough/hr, E = 21.3 lb/hr. The PM emissions rate applies to the entire bread making process.

3. Monitoring Approach

Applicable Requirement	Opacity and PM limits	
General Monitoring Approach	Visible emissions (VE) observation.	Filter inspection.
Monitoring Methods and Location	Observe silo fabric filter during the fill cycle and document any periods during which visible emissions occur.	Remove, clean, and inspect filters for holes.
Indicator Range	No visible emissions.	NA
Data Collection Frequency	During each fill cycle.	Monthly.
Averaging Period	None.	NA
Recordkeeping	Document periods during which VE observed.	Inspection checklist.
QA/QC	Train observer as per Method 22.	None.

4. Basis

There are applicable requirements for both opacity and PM from the fabric filter. Based on the maximum bread production rate, the PM limit is 21.3 lb/hr. This limit includes the emissions from the entire process. The actual PM emissions from the facility are 0.3 lb/hr and there typically are no visible emissions from the fabric filter. Therefore, since the facility's margin of compliance with both limits is so high, checking for VE each time the silos are filled and periodically inspecting and cleaning the filters is adequate title V monitoring.

5. Additional Comments

None.

6. References/Information Source

1. Title V permit, permit application, and permit review document for a baking company.

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Title V monitoring Example No. E.6

1. Emissions Unit

1.1 Process/Emissions Unit: Glass furnace
1.2 Pollutant: Opacity, PM
1.3 Emissions control technique: Proper operation.

2. Applicable Requirements

Opacity: 20 percent (except 3 minutes in any hour), 60 percent at any time.
PM: 0.04 gr/dscf

3. Monitoring Approach

Applicable Requirement	PM and Opacity limits		PM limit
General Monitoring Approach	Visible emissions (VE) observation.	Opacity observation.	Periodic emissions test.
Monitoring Methods and Location	An observer monitors the furnace stack for the presence or absence of abnormal VE. Abnormal VE are defined as changes in the normal range in physical characteristics of the plume, including color change, apparent increase in density/opacity, and puffing. If abnormal VE are observed and cannot be corrected within 24 hours, a Method 9 certified observer determines the opacity of the emissions.	Opacity observations are conducted according to Method 203B.	Perform PM emissions testing at furnace exhaust.
Indicator Range	No or normal VE.	Opacity less than 20 percent.	PM emissions less than 0.04 gr/dscf.
Data Collection Frequency	Daily for 6 minutes. If no VE or no abnormal VE are detected for 30 days, observe weekly. Revert to daily for a period of not less than 30 days if abnormal VE are observed during a weekly observation.	Quarterly.	Annually.

Applicable Requirement	PM and Opacity limits		PM limit
Averaging Period	None.	Each 15-second observation represents the average opacity for that 15-second period.	Not Applicable.
Recordkeeping	Results of observations and records of any corrective action.	Results of observations.	Results of test.
QA/QC	Observer trained per Method 22. Same observer conducts each observation. Employees are trained to report abnormal VE to supervisor.	Observer certified per Method 9.	Perform test per Method 5 and the permitting authority's source testing manual.

4. Basis

This source typically has a low level of visible emissions during normal operation. Therefore, a daily VE/no VE observation is not a useful approach to assure compliance with the PM and opacity limits. However, the opacity of the emissions (5 to 10 percent opacity) is typically well below the standard (20 percent opacity), the source operates with little variability in its emissions, and a simple observation method was desired. Therefore, a non-certified observer views the furnace stack for the presence of abnormal VE on a daily basis, and a certified observer confirms that the unit is operating under the opacity limit on a quarterly basis. Abnormal VE are defined in the permit as changes in the normal range in physical characteristics of the plume, including color change, apparent increase in density/opacity, and puffing. The opacity of the emissions from this source is not expected to vary when the unit is properly operated. To further confirm compliance with the PM limit, a performance test is conducted annually using Method 5.

5. Additional Comments

The permit reviewed for this example required a Method 9 opacity observation every quarter. However, since the opacity standard is a time-exception standard, this example specifies the use of Method 203B. In addition, the permit did not specify a length for the VE observation. This example specifies a 6-minute observation. The initial PM compliance test required by the permit will be conducted sometime during 2000; the test results will be included in this example to document margin of compliance when available.

The opacity of the emissions from this source is not expected to vary when the unit is properly operated. Therefore, the approach of checking for "normal" visible emissions by a non-certified observer on a frequent basis and conducting opacity observations by a certified observer on a less frequent basis is acceptable. This approach would not be appropriate for situations where the opacity and PM emissions had the potential to be highly variable, as in the case of a coal-fired boiler.

6. References/Information Source

1. Permit conditions for a glass manufacturing plant.