Stack Test Guide

Indiana Department of Environmental Management

www.idem.IN.gov

Purpose

The purpose of this guidance is to provide information about the activities a source can perform prior to conducting a formal stack test. Sources may elect to verify whether a process or air pollution control device is operating within its permitted limits prior to conducting a formal stack test. This guidance includes information intended to assist sources in reaching their environmental goals of being fully compliant with all applicable emission limitations.

Scope

This guidance discusses the activities a source may take once they have identified a stack test is required pursuant to a condition in their operating permit, a state or federal rule, or upon making a decision to establish a formally acceptable emission factor for permitting, billing, or emission estimation purposes. The guidance briefly discusses stack test protocol submittal, operating requirements, proper air pollution control device (APCD) operations, documentation, and test report submittal requirements. Additionally, this guidance contains several commonly encountered control technologies and provides suggestions on items a source may check prior to compliance testing in order to ensure their control device(s) are operating properly.

Preparing for a Test

Notification to Indiana Department of Environmental Management is not necessary if the stack test is not required by a permit or rule and the results of the test are to be used for internal informational purposes only. Data from stack tests may be subject to Federal Enforceable State Operating Permit (FESOP) or Title V permit reporting requirements and need to be considered by the source when submitting reports and certifying compliance pursuant to the FESOP or Title V program. Pretesting does not relieve a source from reporting deviations as required by a permit, New Source Performance Standards (NSPS), or National Emission Standard for Hazardous Air Pollutants (NESHAPs).

Testing Companies and Consultants

Consultants may be of particular use for sources that are not familiar with stack testing procedures. Sources may feel more comfortable having an experienced party oversee their test. Operating and maintaining test equipment can be very expensive; especially for a one-time test or infrequent tests. Most sources hire a test company or consultant to conduct stack testing. A link to IDEM's consultant list has been provided in appendix A, as well as, links to pages containing protocol forms for criteria pollutant, and Volatile Organic Compound/Hazardous Air Pollutants (VOC/HAP) testing. Regardless of the path taken, a source must ensure that appropriate plant personnel are involved in the operations and testing process. An internal review of the operations and test procedures as prepared by a consultant should always be performed by a source in order to verify the test and results will be accurate and achievable. One of the most common problems during compliance testing is the plant or equipment operator not being involved in pretest preparations. This often results in failure to identify potential operational issues such as not operating the unit being tested at the production rate indicated on the protocol. This can result in costly delays and even test postponement in some cases.

Process Operations and Pretesting

No matter the type of process or control device used, the best course of action a source can take when readying their process or control device for an emission test is to follow the recommendations of the manufacturer who designed or installed the equipment. Attention to process operations, air pollution control device operations, and preventative maintenance will go a long way to ensuring the process and control device operates properly during the emission test.

Another useful tool is to perform pretesting on the unit(s) prior to the formal compliance demonstration. A test company can often schedule preliminary testing a few days or a few weeks prior to the test. Data generated during pretests will confirm for the source whether they are in compliance or not. If not, pretesting may make a source aware that repairs need to be made prior to the formal demonstration. Pretesting may also be used to optimize the control system such that parametric monitoring limits are set at the most advantageous levels for the company. An example of this would be pretesting performed on a thermal oxidizer to establish the lowest baseline temperature where the oxidizer shows it can meet its destruction efficiency requirements. Establishing this temperature prior to the test allows the source to run the formal compliance test at a temperature range that ensures compliance, while not setting the baseline destruction efficiency temperature such that an excessive amount of natural gas is needed to maintain the temperature requirement.

Remember that a pretest notification to IDEM is not necessary if the stack test is not required by a permit or rule. However, data from stack tests may be subject to FESOP or Title V permit reporting requirements and needs to be considered by the source when submitting reports and certifying compliance pursuant to the FESOP or Title V program. Pretesting does not relieve a source from reporting deviations as required by a permit, NSPS, or NEHSAPs.

Processes and Air Pollution Control Devices (APCD)

While process operations, manufacturing devices, and emission units vary from industry to industry, air pollution control devices are well established and generally operate in the same manner from process to process. Most stack tests are required to be conducted while the facility is operating at 95 percent to 100 percent of permitted capacity. Monitored parameters (pressure drop, air flow rates, etc.), as well as, APCD efficiency can significantly change if a source is not accustomed to operating at an increased capacity. Prior to the compliance test, it is recommended that the source operate the facility at the proposed capacity of the compliance test and observe the operation of the APCD

for any abnormalities that may occur. The following is a brief discussion of APCD items that can be checked prior to conducting a pretest or required test:

FABRIC FILTER AND BAGHOUSE CONTROLS

Review Fabric Filter Inspection/Maintenance Program

Reviewing a fabric filter operational log (if available) can inform a facility whether there have been recent issues with the air pollution control device (APCD). An updated, well-kept log can provide detailed information regarding the operation of the control device and any relevant maintenance actions or issues. Potential issues affecting the performance of the APCD could include problems with the fans, bags, structure, dampers, and ductwork. If a problem is suspected with the APCD, a thorough inspection of all of the bags is recommended. The source may elect to conduct a 'black-light' test to identify any potential holes in the baghouse bags. This test is done by injecting fluorescent dye on the dirty side of the baghouse and then using a fluorescent light on the clean side to check the inside of the bags, area around the seals and exposed surfaces of the clean air side to see if any of the dye has made it past the bags. Affected bags can then be identified and changed as needed.

Parametric Monitoring

Most fabric filters are required by permit to operate within a certain range. Additionally, a facility is often required to maintain records of the parametric monitoring. A review of the parametric monitoring records can provide information regarding trends that can be used to predict potential issues with the APCD. If possible, compare the value of the parametric monitoring to the value from a previous successful demonstration of compliance. Verify that the device used for measuring any relevant parameter is current with its calibration schedule and is collecting accurate data. For a magnehelic or manometer gauge, you should blow out (clear) the lines periodically.

Daily Checks

In the days leading up to the stack test, a facility may find it useful to conduct the following checks:

- Inspect the baghouse area for normal or abnormal visual and audible conditions;
- Check the differential pressure;
- Check the cleaning cycle;
- Check compressed air and water traps on pulse jet baghouses;
- Monitor the discharge system by making sure dust is removed as needed; and,
- Observe the stack plume opacity.

Source Operation

Prior to the compliance test, it is recommended that the source operate the facility at the proposed capacity of the compliance stack test and observe the operation of the APCD. Bag failure can be indicated by a significant change in the baghouse's pressure reading with abnormal visible emissions or by other means such as gas temperature differences, air flow rate changes, air infiltration from the dirty air plenum, or dust traces on the clean air side of the air discharge.

ELECTRO STATIC PRECIPITATORS

Review Electrostatic Precipitator (ESP) Inspection/Maintenance Program

Reviewing an ESP operational log (if available) can inform a facility whether there have been recent issues with the APCD. An updated, well-kept log can provide detailed information regarding the operation of the control device and any relevant maintenance actions or issues. Potential issues affecting the performance of the APCD could include problems with the power input, variations in flue gas characteristics, plate rapping sequence, re-entrainment, collection hoppers, structure, dampers, and ductwork. If a problem is suspected with the APCD, a thorough internal inspection of the ESP is recommended.

Parametric Monitoring

Most ESPs are required by permit to operate within a certain range. Additionally, a facility is often required to maintain records of the parametric monitoring. A review of the parametric monitoring records can provide information regarding trends that can be used to predict potential issues with the APCD. If possible, compare the value of the parametric monitoring to the value from a previous successful demonstration of compliance. Verify that the device used for measuring any relevant parameter is current with its calibration and is collecting accurate data.

Daily Checks

In the days leading up to the stack test, it is recommended that the facility conduct the following daily checks:

- Inspect the ESP area for normal or abnormal visual and audible conditions;
- Check the voltages, amperages and spark rates;
- Check the cleaning cycle;
- Monitor the discharge system by making sure dust is removed as needed; and,
- Observe the stack plume opacity.

Source Operation

Prior to the compliance test, it is recommended that the source operate the facility at the proposed capacity of the compliance stack test and observe the operation of the APCD. Electrostatic Precipitators (ESP) failure can be indicated by a significant change in the ESP voltage, current or spark rates and the presence of abnormal visible emissions.

- Thermal Oxidation
- Recuperative Thermal Oxidation
- Regenerative Thermal Oxidation
- Process Boilers Used for Thermal Oxidation
- Flares Used for Thermal Oxidation

The main performance problems associated with high temperature gas phase oxidation systems are low burner temperature, burner combustion problems, short-circuiting through the heat exchanger, and fouling or plugging of the heat exchanger.

Visible emission levels from an oxidizer should be very low. Elevated visible emissions may be caused by: (1) noncombustible particulate matter; (2) soot generated by improperly operating burners; and, (3) nucleation of pollutants generated in the oxidizer.

The most important operating parameter used to evaluate the operation of thermal oxidizers is the gas combustion temperature. High outlet Volatile Organic Compound (VOC) concentrations could be due to low combustion chamber temperature or short-circuiting of inlet gas through the heat exchanger. A short circuit of the heat exchanger would cause inlet gas to by-pass the burner and go straight to the exhaust stack.

- Catalytic Oxidation
- Recuperative Catalytic Oxidation
- Regenerative Catalytic Oxidation

The evaluation of catalytic oxidizers is similar to that for thermal oxidizers. However, the presence of a catalyst bed increases the scope of the performance evaluation.

The inlet and outlet gas temperatures of the catalyst bed provide useful indirect indicators of the performance of the system. The inlet gas temperature should be above the minimum level necessary for high efficiency destruction of the organic compounds. During routine operation, the bed outlet temperature should be 50 degrees fahrenheit to 200 degrees fahrenheit higher than the inlet temperature. The increase in temperature is due to the oxidation of the organic compounds in the waste stream. If the catalyst bed has become fouled, masked, or poisoned, the gas temperature increase across the bed will not be as high as its baseline levels. Proper temperature differences can be established through manufacturer input, as well as, the normal observed ranges during operation.

Outlet VOC concentrations which are considerably higher than baseline levels established during a contractual performance evaluation or previous compliance evaluations may indicate the need to evaluate the catalyst activity and inspect the catalyst bed.

Small non-regenerative adsorbers

The instrumentation on these systems is usually limited. In some cases, gas stream temperature monitors are mounted in the inlet and outlet ducts of the activated carbon. An increase in the inlet temperature from the design or baseline levels indicates that the service life of the activated carbon may have been reduced. Higher inlet temperatures may shorten the life of the bed and a quick pretest check may be warranted. Conversely, an increase in the outlet temperature compared to the inlet temperature may indicate that liquid droplets of solvent are being captured in the bed, reducing its efficiency or shortening the bed's lifespan.

Large Fixed Bed Regenerative Adsorbers and Non-Regenerative Adsorbers

The factors that contribute to organic vapor breakthrough in a large fixed bed regenerative system or a large non-regenerative system are relatively similar. The problems include, but are not limited to:

- Corrosion and subsequent collapse of the pellet bed;
- Infrequent desorption;
- Loss of adsorptive capacity due to high boiling point compounds;
- Plugging of the beds due to particulate;
- Physical deterioration of the activated carbon pellets or carbon fiber materials;
- Increased operating temperature; and,
- Increased organic vapor concentration.

Gas Inlet temperature

The gas inlet temperature is one of the most important variables affecting performance. Increased gas inlet temperature results in substantially reduced removal efficiency in the adsorbent bed leading to breakthrough.

Static Pressure Drop

Changes from the baseline levels of the pressure drop usually are associated with conditions that adversely affect performance. An increase in the static pressure drop (no change in the gas flow rate) can be caused by plugging on the inlet side of the bed. Due to the uneven distribution of the gas flow through the bed, adsorption efficiency is reduced. A decrease in the static pressure drop is usually due to partial or complete collapse of the fixed bed.

Gas Flow Rate

Gas flow rates above the design range could create breakthrough if the mass transfer zone reaches the outlet of the carbon bed before the adsorber is brought off-line for desorption. Increased flow rates are indicated by increased fan motor currents, increased adsorber vessel pressure drop, and/or increased hood static pressure.

Desorption Frequency times

Decreased desorption frequency can result in organic vapor breakthrough if the adsorption beds have insufficient capacity for the on-line period. IDEM recommends the manufacturers recommendations regarding desorption frequency and duration be followed.

ABSORPTION AND SCRUBBERS
(for Particulate Matter or gaseous emission control)

The most common problems affecting absorbers include the following:

- Inadequate recirculation liquid flow;
- Poor gas-liquid contact;
- Inadequate alkali feed rates to neutralize dissolved acids;
- Excessive liquid temperatures; and,
- Corrosion.

Stack Opacity

The presence of visible emissions usually indicates the absorber is not functioning properly. A haze, or the presence of water droplets visibly exiting the stack, could indicate the system is not functioning properly.

Re-entrainment

Observations of the stack and areas around the stack are useful for determining if water droplets are being re-entrained from an improperly operating demister. The presence of re-entrainment indicates the need to check the static pressure drop across the demister. A pressure drop significantly above or below the normal level indicates a problem with the demister. Droplet re-entrainment can also be caused by operating the absorber in a flooded condition. This may occur when the recirculation flow-rates are too high.

Liquid Flow Rate

Large decreases in the liquid flow rate can impair the performance by causing a saturation condition in the remaining water or by causing inadequate gas-particle/liquid contact.

Outlet Gas Temperature

For scrubbers controlling gaseous pollutants, the outlet gas temperature should be close to the adiabatic saturation temperature. Adsorber outlet gas temperatures more than 5 degrees fahrenheit to 10 degrees fahrenheit above the adiabatic saturation temperature are sometimes associated with significant gas-liquid mal-distribution or inadequate recirculation liquid flow.

Static Pressure Drop

The adsorber static pressure drop provides a useful indication of pluggage of packed beds or impingement trays. Static pressure drops above the baseline levels for the unit are usually caused by partial pluggage of the system.

Recirculation Liquor pH

Data concerning the variations in the recirculation liquor pH levels is very useful in evaluating absorber performance. pH levels that are occasionally above 10 indicate the potential for precipitation of calcium and magnesium compounds, which can cause plugging of the spray nozzles, distributors, packed beds, and trays. pH levels below approximately 6 or below indicate that insufficient alkali is being provided to neutralize the acid gases.

High Recirculation Liquid Temperature

High liquid temperatures can reduce absorption efficiency in units in which the dissolved contaminants are not reacted. The solubility of gases is generally much lower at elevated temperatures.

Air Infiltration

Air infiltration can reduce the overall effectiveness of an absorber system. Absorber corrosion, caused by conditions such as low pH liquid, dissolved chlorides, and dissolved fluorides, can create air infiltration problems. A manual inspection of the system to verify its internal and external integrity may be useful in identifying obvious structural integrity problems.

GENERAL TESTING REQUIREMENTS

Test Notifications\Test Protocol

Sources that are required to conduct a compliance test must submit a test protocol to the Indiana Department of Environmental Management no later than 35 days prior to the test pursuant to 326 IAC 3-6-2(a). Test protocols should be submitted to:

Compliance Data Section
Office of Air Quality
Indiana Department of Environmental Management
100 North Senate Avenue
Indianapolis, IN 46204-2251

Please be aware this is a state requirement and sources subject to New Source Performance Standards (NSPS) at 40 CFR 60 or National Emissions Standard for Hazardous Air Pollutants (NESHAPs) at 40 CFR 61 and 63 may be subject to different submittal requirements. For instance, NEHSAPS require that sources submit a test protocol no later than 60 days prior to the actual test. Sources have the option to submit the test protocol themselves, or in certain circumstances they may wish to hire a consultant to handle this part of the process for them. A link to IDEM's consultant list has been provided in appendix A, as well as, links to pages containing protocol forms for criteria pollutants, and VOC/HAP testing.

Regardless of the path taken, a source must ensure that appropriate plant personnel be involved and remain plugged into the source testing process. An internal review of the operations and test procedures prepared by a consultant should always be performed and reviewed by a source in order to verify the test and results will be accurate and achievable.

Upon receipt of the protocol, IDEM reviews the test plan and may contact the source in order to work out any problems discovered in protocol review. The IDEM reviewer will focus on the process to be tested; the proposed production rate to make sure it satisfies 326 IAC 3-6-2 (b)(1),(2) or (3); the proposed sampling methods; and, the proposed location of the test. A detailed explanation of protocol review is beyond the scope of this guidance; however, assuming the test protocol is acceptable, the next step will be for the source to conduct the compliance test.

Timeframe for Conducting Stack Tests

The timeframe for conducting a stack test is usually outlined in a specific rule or a permit. Testing is usually required within 180 days after initial startup for new units. Periodic testing may occur over the life of a permit, such as once every five (5) years. Please consult your permit or the specific rule for the timeframes for conducting a test. Generally, sources cannot be granted an extension to a testing requirement unless allowed or identified in a rule or permit. Individual rules may establish different time periods for testing, and some may be shorter than the general provisions. For example, in 40 CFR 63.152(b), the "notice of compliance status" must be submitted by sources subject to NESHAP subpart G within 150 calendar days after the specified compliance dates. Should you have an issue or problem with the timeframe or test date, please consult the compliance data section prior to the date of the required test.

Observation of Tests

On the day of the compliance test, IDEM may choose to have an observer present for the testing. If present, the observer will discuss all applicable requirements with the source prior to the test being initiated. In some cases, an observer may not be present; therefore, it is the responsibility of the source to ensure the testing is conducted representative conditions. Should there be questions prior to or during the test, IDEM staff are available to assist you. A list of IDEM staff is available in appendix B.

Representative Testing Conditions

The source should verify production rates will meet the rates specified in 326 IAC 3-6-3 (b) (1), (2), or (3), and should record production rates periodically during the test. Sufficient information to allow for the production rates during the individual test runs to be determined must be recorded. Any applicable air pollution control device parameters required to be monitored by the source's permit

should also be recorded in 15 minute increments or more frequently as applicable. Both production rates and parametric monitoring results should be included in the final test report that will be sent to IDEM. A source may elect to provide these records to their testing contractor for incorporation into the test report, or they may elect to retain these records and incorporate them into the report once they receive it from their consultant. During the test, the source should document if any production problems or malfunctions occurred that might influence the results of the test. If an observer is on site, issues of this nature may be discussed with the observer; however, if no observer is present, you may contact a member of the compliance data section directly using the information contained in appendix B of this guidance. It is important that potential problems be identified during the test. While the test company is still on site, further conditional runs may be conducted as necessary to replace potentially biased test runs. If all parties are in agreement that a particular run or runs were conducted under emergency or malfunction conditions, these test runs may then be disqualified and replaced with the conditional test runs.

Test Reports

After the test has been concluded, a source has 45 days to submit the results of the testing to the Compliance Data Section pursuant to 326 IAC 3-6-4(b). The compliance data section reviews the results and confirms compliance. The test report is then filed for future reference if necessary. For non-compliant tests, a source must follow the "actions related to non-compliance" condition in their permit (usually contained in section C of most permits under the section titled, "corrective actions and response steps").

Appendix A

References and Web sites

1. **Compliance testing protocol for criteria pollutants (PM, PM^{10}, SO^2, NOx, CO etc.)**
   www.IN.gov/idem/files/air_compliancetestprotocol.pdf

2. **Compliance testing protocol for VOC/HAPS**
   www.IN.gov/idem/files/aircomp_voctox.pdf

3. **Indiana state rules regarding compliance testing**
   www.ai.org/legislative/iac/title326.html

4. **Environmental consultant/test company list**
   www.IN.gov/idem/idem/4988.htm

5. **Code of federal regulations**
   http://ecfr.gpoaccess.gov/cgi/t/text/text-idx?=ecfr&tpl=%2Findex.tpl

6. **Clean air act national stack testing guidance**
   www.epa.gov/compliance/resources/policies/monitoring/caa/stacktesting.pdf

Appendix B

IDEM Stack Test Contacts – Compliance Data Section (10/30/2009)

Staff Member	Specialty Area
Dave Cline (317) 232-8443	Supervisor of the Compliance Data Section, general compliance testing and continuous emissions monitoring (CEMS) questions. Questions regarding protocol submittal, test scheduling, trial burns.
Steve Friend (317)233-5668	VOC and toxic/HAP testing.
Jarrod Fisher (317)233-2723	General testing questions, continuous emissions monitoring systems (CEMS).
Daniel Harper (317)234-3615	VOC/HAP Sampling.
Doug Vandemark (317)233-3438	General testing questions, steel pickling Maximum Achievable Control Technology (MACT).
Charles Wilson (317)234-2961	Continuous emission monitoring system (CEMS).
Karen Ampil (317)232-8458	Continuous emissions monitor certifications, Continuous opacity monitor Q/A and certification
Sara Cloe (317)232-8338	Test scheduling, protocol, and test report receipt questions.
Tom Kline (317)233-0427	General VOC test questions.
Andrea James (317)234-2752	General test questions, NSPS Subpart I and OOO testing.
Pat Austin (317)234-3491	General compliance testing questions.

Indiana Department of Environmental Management

Compliance Data Section
Office of Air Quality
Indiana Department of Environmental Management
100 North Senate Avenue
Indianapolis, IN 46204-2251

www.idem.IN.gov