United States
Environmental Protection
Agency

Air Pollution Training Institute (APTI)
MD 17
Environmental Research Center
Research Triangle Park, NC 27711

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APTI SI:445 Introduction To Baseline Source Inspection Techniques

Self-Instructional Manual

Office of Air Quality Planning and Standards
Clean Air
OAQPS

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Content by: David Dunbar, Environmental Quality Management, Inc.
Based on original material by John Richards, Ph.D.
Edited by: Sherry Layton
Instructional design by: Monica Loewy
Typography by: Karen Robertson

Research and Evaluation Associates, Inc.

607 14th Street, N.W., Suite 610
Washington, D.C. 20005
(202) 842-2200

100 Europa Drive, Suite 590
Chapel Hill, N.C. 27514
(919) 968-4961

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Charles Pratt

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Office of Air Quality Planning and Standards
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Contents

Course Description

This training course covers Level 1 baseline inspection techniques and follow-up Level 2 baseline inspection techniques for evaluating air pollution control equipment performance. The lessons present the general concepts of these techniques (including flow charting) and specific inspection procedures for fabric filters, dry and wet scrubbers, mechanical collectors, carbon bed adsorbers, incinerators, and electrostatic precipitators (ESPs). Control technology, air movement systems, and inspection safety procedures are also covered.

How To Use The Course Materials

This self-instructional manual is designed to be used independently, without an instructor. Each lesson has sections that include introductory material, graphics, and review exercises and answers. After studying the information presented in each lesson, complete that lesson's review exercises. Check your answers against those provided. If you are not sure about an item or an answer, review the material in the lesson again.

Three self-graded quizzes are provided to help you review sections of the course. The review items in the quizzes are similar to the types of items that will appear on the final examination. You will find answers to these quizzes in the back of the book. After reading all the lessons and completing the review quizzes, complete the final examination, which is provided in the sealed envelope.

Course Completion Chart

The following chart shows the approximate time it will take you to complete each of the lessons and quizzes for SI:445.

Lesson		Student Involvement Time (Hours)
1	Principles Of Baseline Inspection Techniques	1
2	Principles Of Control Technology	1
3	Air Movement Systems	1
4	Fabric Filters—Operation And Inspection	2
	Quiz 1: Covering Lessons 1-4	1
5	Operation of Dry Scrubbers	1
6	Operation of Wet Scrubbers	2
7	Operation of Mechanical Collectors	1
8	Operation of Multibed-Type Carbon Bed Adsorbers	1
9	Operation of Thermal And Catalytic Incinerators	1
	Quiz 2: Covering Lessons 5-9	1
10	Operation of Electrostatic Precipitators (ESPs)	2
11	Level 1 Inspections	1
12	Level 2 Inspections	2
13	Inspection Safety	2
	Quiz 3: Covering Lessons 10-13	1
	Total	**21**

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Principles Of Baseline Inspection Techniques

Introduction

Baseline inspection techniques have been developed to help source operators and regulatory agency inspectors conduct general evaluations of air pollution control equipment performance. As the title suggests, these techniques provide a means for determining the level of performance at which source control equipment can be expected to operate. Level of performance determinations also serve as a basis of comparison when future inspections are conducted. This enables source operators and regulatory agency inspectors to identify significant changes in performance and the possible reasons for these changes.

Baseline inspections help determine expected performance levels.

Why Is It Important To Identify Changes?

Early diagnosis of emerging process and control equipment operating and maintenance problems is essential to minimize emissions and prevent or minimize repair costs caused by subsequent component damage.

The inspection techniques are designed to identify **abnormal** operating conditions that **might** indicate system malfunctions. The techniques do not necessarily provide definite evidence of noncompliance with regulations, nor do they necessarily provide a specific list of required repairs.

Baseline inspections are designed to identify abnormal operating conditions.

What Education Or Experience Should Inspectors Have?

Persons using baseline inspection techniques should have a scientific background and, in many cases, some engineering experience. In addition, inspectors should be familiar with the potential hazards associated with mechanical equipment. Formal safety training is required for all U.S. Environmental Protection Agency (EPA) inspectors and is highly recommended for any persons (such as state and local agency staff and source personnel) doing field work that involves air pollution control equipment.

Basic Principles Of A Baseline Inspection

The fundamental principle underlying the baseline inspection is that **performance should be evaluated primarily by comparing present conditions with existing site-specific baseline data.** The site-specific baseline data have usually been collected during a source test when emissions and operating parameters have been measured simultaneously. Any current data point that significantly differs from this baseline data is considered symptomatic of possible operation problems.

The inspector should evaluate performance by comparing present conditions with existing site-specific baseline data.

Should All Units Be Approached In The Same Manner?

Assume that each control device is unique.

Each control device should be approached with the assumption that its operating characteristics and performance levels will be unique. This approach is necessary because of the number of site-specific process variables and control device design factors that can singly or collectively influence control device performance. It is often difficult, if not impossible, to determine why apparently similar units operate quite differently.

Although the inspection techniques depend mainly on machine-specific data and shifts in performance levels over time, the inspector should not assume that industry "norms" are irrelevant. In some cases, deviations from certain typical industry operating conditions can indicate operation and maintenance problems.

Is On-Site Data Usually Available?

One of the major problems when inspecting air pollution control systems is that the instruments necessary to monitor basic operating conditions often either do not exist or are malfunctioning. Thus, another basic principle of the baseline inspection is that **it is rarely wise to accept data from on-site gauges that have not been previously checked.** Therefore, baseline inspection techniques include some routine checks of these on-site gauges.

When necessary, the inspector should use portable instruments to obtain data.

When there is concern regarding the completeness or adequacy of the available data, the inspector must obtain data by using portable instruments. These instruments can be used by plant operators (in the presence of the inspector) or by the inspector.

What Types Of Data Should Be Examined?

Performance evaluations should be conducted by examining various types of data. More accurate determinations of existing performance problems can be made by evaluating shifts in a set of operating variables, rather than basing determinations on only one variable. Also, general observations of emission rates and of control device, fan, and ventilation system conditions can be used to support the preliminary conclusions that were reached by examining the operating data. For these reasons, **baseline inspections incorporate information gathered through both measurement and observation.**

Baseline inspections incorporate information gathered through both measurement and observation.

The control agency inspector should organize the collected data to be coherent and consistent, and then focus his or her field work on any specific problems that appear to exist. If the initial information clearly suggests that there are no present or emerging problems, further inspection is not necessary, and the inspection is considered complete with the operating data that have already been collected.

Approaches To Organizing The Field Inspection

Field inspections can be organized in either a counterflow or cocurrent approach.

There are two approaches to organizing a field inspection: (1) a counterflow approach, in which the inspector starts at the end of the process (e.g., at the stack) and works "backward"; and (2) a cocurrent flow approach, in which the inspector begins his or her observations at the beginning of the process and works "forward."

When Is A Counterflow Approach Used?

The counterflow (countercurrent) approach (Figure 1-1) is appropriate when the inspector is making a routine inspection of a facility for which baseline data are available and for which the basic process operation is well documented in the agency files. This can be an efficient approach under these conditions because if a control-device-related problem is discovered, the inspection can be shortened.

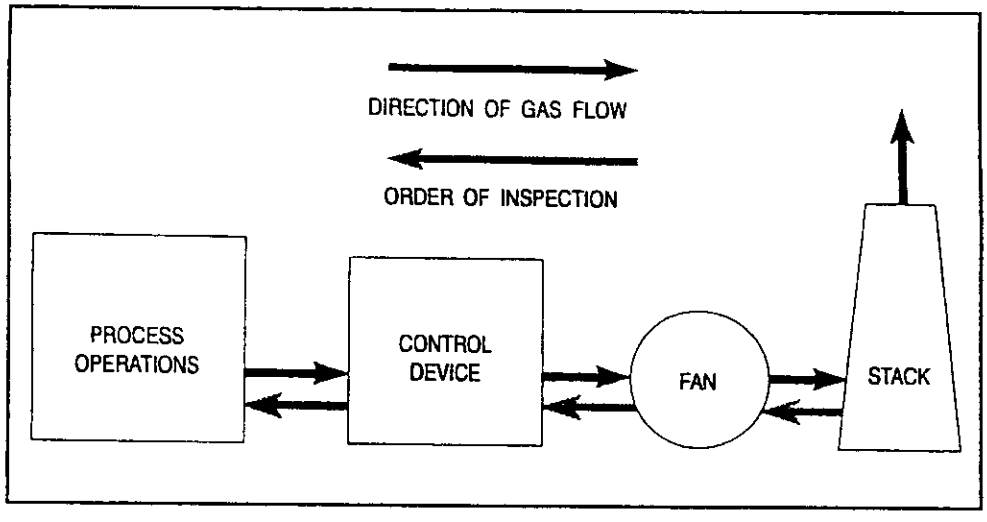

Figure 1-1. Counterflow (Countercurrent) Inspection Approach

The counterflow flowcharting begins with an opacity reading of the stack exhaust gas using EPA Reference Method 9 or equivalent procedures. (Method 9 is a standard method for conducting opacity or visible emissions observations.) In addition to identifying changes in the average opacity since the baseline period, the inspector evaluates the pattern of opacity variability. The inspector also checks for the presence of fugitive emissions (emissions that are not emitted from a stack or vent) from process areas and checks for emissions from bypass stacks and other unauthorized locations. Finally, the inspector must evaluate any transmissometer data if the monitor passes basic quality assurance requirements. (A transmissometer is a device placed in a stack or vent, where it measures opacity.)

In counterflow inspections, the emphasis is on control-device operating conditions.

The emphasis of the counterflow inspection is on control-device operating conditions, both measured and observed. The control device information, coupled with the opacity readings, can be used to (1) identify a potential problem; and (2) determine if the problem is caused primarily by control-device-related conditions or by process-related factors. If process conditions or variations appear to be important, the inspection should continue by evaluating relevant plant processes. If the problem is simply control-device-related, the time-consuming inspection of other processes might involve only gathering minimal data on baseline parameters.

When Is A Cocurrent Flow Approach Used?

A cocurrent flow approach (Figure 1-2) is used mainly on sources that do not have air pollution control devices for minimizing emissions. These sources include oil- and gas-fired boilers, indirect-fired dryers, and refinery heaters. This approach is also appropriate for sources with numerous emissions problems that are related entirely to fluctuations in process operating conditions, raw materials, additives, fuels, and equipment maintenance.

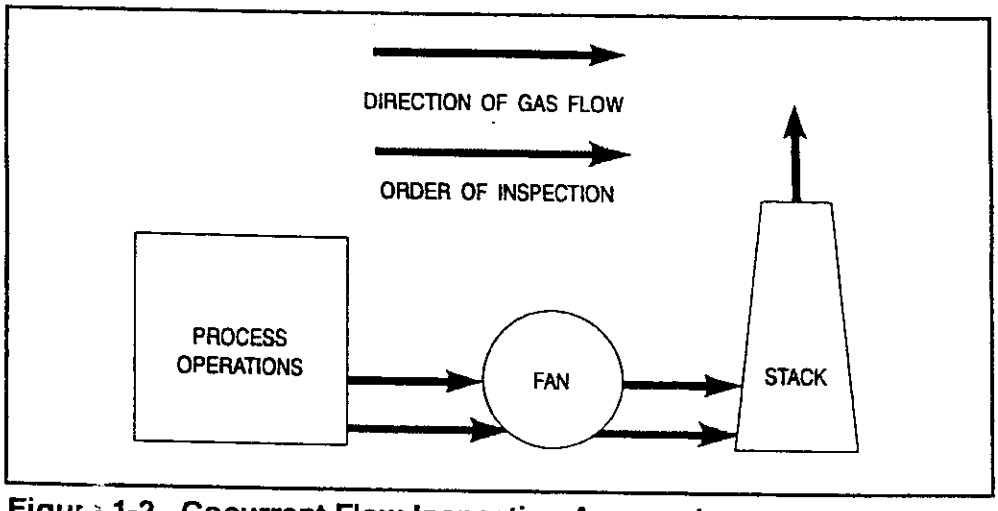

Figure 1-2. Cocurrent Flow Inspection Approach

Begin a cocurrent inspection by preparing a process flowchart and making opacity readin

The cocurrent inspection begins by preparing a process flowchart that includes the locations of all vents and control devices, and by making opacity readings when appropriate. The inspection flowchart is a valuable tool for sorting out the usually complex and sometimes conflicting data concerning the source's operating problems.

Inspection flowcharts should be relatively simple and should not be so cluttered with system design details that it is difficult to add present system operating conditions. An expanded block diagram format has been adopted, including only the system components directly relevant to the inspection. A set of conventional instrument symbols and minor equipment symbols should be used.

A flowchart form that fits entirely on a single 8 1/2-by-11-inch page has been developed. Most of the standard symbols have been reproduced on the back of the flowchart form for the convenience of the inspector. An example is provided in an exercise to follow.

The inspector begins with raw material piles or storage piles and follows these materials in a cocurrent fashion through the process. The emphasis of this type of inspection is on raw material and fuel characteristics, operating rates, operating temperatures and pressures, and other process information relevant to generating air pollutants. Major process variables affecting the characteristics of the effluent gas stream should be noted to the extent possible.

Note to the student: At this point, you should view the videotape entitled "Flowchart Preparation." It presents a step-by-step procedure for preparing inspection flowcharts. The videotape is accompanied by a handout entitled "Flowchart Preparation for Air Pollution Source Inspections," which contains an "Inspection Flowchart Form" and examples of completed flowcharts.

Levels Of Inspection

There are several levels of inspection "intensity."

The diversity of air pollution sources and control systems requires that inspection procedures be flexible. The baseline inspection techniques include several levels of inspection "intensity." Although agency personnel can decide on the appropriate inspection level, the inspector might, based on preliminary data and observations, change his or her decision during the field work.

This flexibility allows the agency to focus on collecting appropriate inspection data instead of simply completing a prescribed number of inspections. Baseline inspection levels are always subject to the judgment of the inspector. When the standard procedures would be unsafe to perform or would be incorrect for a given source, specific inspection activities can be identified for follow-up inspections, at which time new or different procedures can be used as prescribed by regulations or by agency supervisory personnel.

The levels of inspection are designated as Level 1 through Level 4. The most complete and detailed inspections (Level 4) are performed only during compliance testing. When information indicates that there is, or will soon be, a significant emissions problem, agency supervisory personnel should be notified. The types of activities normally associated with each inspection level, and the level of experience necessary for an inspector to conduct the inspection, vary substantially. This course includes detailed discussions of Level 1 through follow-up Level 2 inspections. All four inspection levels are briefly described below.

Level 1 Inspection

Level 1 inspections provide frequent and specific observations of source conditions.

The Level 1 inspection is a field surveillance tool that is intended to provide relatively frequent and specific visual observations of source performance. Entering plant grounds is usually unnecessary, and the inspection is never announced in advance. The inspector makes visible emissions observations for all stacks and vents from the plant boundary

when weather conditions permit. Odor conditions are noted both upwind and downwind of the facility. Observations of general plant operations are compared to previously stated permit requirements to confirm that the requirements are being met. Unusual conditions support grounds for conducting a higher level inspection in the near future. If the visible emissions observations and/or other observations appear to provide the basis for a Notice of Violation (NOV), the information should be transmitted to agency personnel responsible for issuing NOVs, as specified in the agency's regulations.

Level 2 Inspection

Level 2 inspections are characterized as **basic** and **follow-up**. The basic Level 2 inspection is intended to collect specific baseline data to evaluate the performance of air pollution control devices and sources. If any of the basic Level 2 inspection steps indicates a potential problem, a follow-up Level 2 inspection should be conducted.

Level 2 inspections are walk-through evaluations.

Level 2 inspections are limited to "walk-through" evaluations of the air pollutant source and/or the air pollution control equipment. Entering the facility is necessary. The inspection can be performed either cocurrently or countercurrently, depending on the initial baseline specification. In either case, data are gathered only from on-site, permanently mounted instrumentation and from specific observations. No portable instruments are used. An important factor in Level 2 inspections is correctly evaluating the accuracy of the data collected from on-site instrumentation.

Under no circumstances should the inspector enter the control device.

When control devices are not in service during the plant inspection, Level 2 inspections can include observations from access hatches after the hatches are opened by plant personnel. **Under no circumstances should the inspector enter the control device.**

Level 3 Inspection

Level 3 inspections are performed when lower level inspections indicate possible problems.

When Level 1 inspection observations or data collected during Level 2 inspections indicate problems, an inspector might wish to conduct the more detailed and complete Level 3 inspection. Only individual units with obvious problems (noted as a result of a Level 1 or 2 inspection) should be subject to the Level 3 inspection. When applicable, portable gauges (provided by the inspector) are used to measure certain operating parameters to verify on-site permanent monitors. The most commonly used types of portable instruments are listed below:

- Differential pressure gauges.
- Thermocouples and thermometers.
- Combustion gas analyzers (oxygen [O_2] and carbon dioxide [CO_2] monitors).
- Hydrogen-ion concentration (pH) meters or paper.
- Pitot tubes.

The Level 3 inspection includes a detailed evaluation of stack effluent characteristics, continuous emissions monitoring (CEM) data, control device performance parameters, and process operating conditions. Raw material and fuel analyses can be reviewed, and selected samples (e.g.,

fuel, raw material, scrubber liquor) can be collected for later evaluation. Plant personnel might wish to collect failed fabric filter bags or electrostatic precipitator (ESP) discharge electrodes for further evaluation. The inspection might identify the problem(s) that caused the failure and might allow the inspector to confirm that the plant has correctly identified the general type of problem(s) and the appropriate corrective action. In some cases, the Level 3 inspection includes observing from an access hatch of the internal portions of the air pollution control device. **Under no circumstances should the inspector enter the control device.** Access hatch observations are included only when (1) the unit is locked off-line, (2) one or more compartments can be safely and conveniently isolated for evaluation, and (3) plant personnel can open the access hatch for inspector observation.

Under no circumstances should the inspector enter the control device.

Level 4 Inspection

The purpose of the Level 4 inspection is to gather baseline data that can be used later to evaluate performance of the specific sources at a given facility. This type of inspection should be performed jointly by a senior inspector and the EPA personnel who will be assigned responsibility for the plant. The Level 4 inspection techniques and procedures are essentially the same as or equivalent to Level 3 procedures. Level 4 inspections, however, are conducted in conjunction with the stack tests on major collection devices, such as large ESPs, wet scrubbers, and fabric filters. With smaller sources that are rarely tested, the Level 4 inspection is conducted when source personnel believe that the source is in compliance, and that the control devices and continuous monitoring devices are working properly.

Level 4 inspections are used to gather baseline data.

An important part of the Level 4 inspection is preparing general process and control device flowcharts, parameters to be measured, measurement locations, and acceptable ranges for each parameter. As a starting point, the inspector should request the block flow diagrams or drawings for the portions of the plants that are of interest. Specific flowcharts should be prepared so that all of the important information concerning process flow streams, measurement ports, locations of vents and bypass stacks, and locations of all control devices, ducts, dampers, monitoring instruments, instrument ports, and fans are clearly shown.

Summary

Baseline inspections help determine the acceptable ranges for parameters that relate to the performance of control equipment and provide a basis of comparison for future inspections. Inspections can be conducted in either a counterflow manner or a cocurrent flow manner. There are four levels of inspection: (1) Level 1 inspections are field surveillance tools that include visual observations of source performance; (2) Level 2 inspections can be either basic or follow-up. Follow-up Level 2 inspections are used to follow-up problems found during Level 1 or basic Level 2 inspections; (3) Level 3 inspections are more detailed and complete, and are used when earlier inspections indicate a need for a more detailed investigation of problems; and (4) Level 4 inspections are used to gather extensive baseline data.

Review Exercises

1. Baseline inspection techniques provide:

   a. An accurate and complete compliance determination.
   b. A general evaluation of control system performance.
   c. A detailed evaluation of plant maintenance practices.
   d. All of the above.

2. The Baseline Inspection Technique is:

   a. The official inspection technique of the U.S. EPA.
   b. The official inspection technique of Regions 3 and 5 of the U.S. EPA.
   c. A recommended EPA Inspection Procedure.

3. Approaching a control system inspection from the stack to the process (a counterflow approach) is usually advantageous because:

   a. It avoids unnecessary handling of process-oriented confidential data.
   b. It avoids time-consuming process equipment inspection, which is often necessary.
   c Operating data for the control system are easier to obtain and to evaluate.
   d. All of the above.

4. Using a portable inspection instrument is often recommended because:

   a. Many control systems either do not have on-site permanent monitors or have monitors that are inoperative a significant portion of the time.
   b. Highly complex analyses must be performed, and it is usually not possible to complete these without additional data.
   c. Many operators set on-site instruments to give an incorrect indication of control system performance.

5. True or false? Baseline inspections involve detailed internal inspections of the control systems.

6. True or false? The inspection flowchart is a valuable tool for sorting out data concerning a source's operation.

7. In baseline analysis, a "symptom" of a problem means:

   a. A significant difference between an operating parameter at a given plant as compared against a corresponding parameter at a similar facility.
   b. A significant difference between an operating parameter measured during the inspection as compared against the value during the baseline period.
   c. Neither of the above.

8. Baseline inspections involve:

   a. Evaluation of one key operating parameter.
   b. Comparison of current conditions with site-specific baseline data.
   c. Comparison of operating parameters at a given site against similar units at plants known to be in compliance.
   d. None of the above.

9. True or false? Entry onto plant grounds is always necessary to conduct a Level 1 inspection.

10. A Level 2 inspection involves:

    a. A walk-through evaluation of source and control equipment operations.
    b. Collection of data from on-site, permanently mounted instruments.
    c. An evaluation of the accuracy of data collected from on-site instrumentation.
    d. All of the above.

11. Baseline inspections can prove particularly advantageous to regulatory agency personnel because:

    a. They yield data that are often consistent with state and local regulations.
    b. They often allow the inspector to simplify inspections when compliance is highly probable.
    c. Both of the above.

12. True or false? Portable instruments are sometimes used to confirm the operational status of the on-site gauges.

13. True or false? In baseline inspections, as much readily obtainable information as possible is used to evaluate performance.

14. True or false? Baseline inspection observations and data collection should be tailored to the specific source.

Answers

1. b. A general evaluation of control system performance.

2. c. A recommended EPA inspection procedure.

3. e. All of the above.

4. a. Many control systems do not have on-site permanent monitors or have monitors that are inoperative a significant portion of the time.

5. False. Baseline inspections focus primarily on evaluating performance by comparing present conditions with existing site-specific baseline data.

6. True

7. b. A significant difference between an operating parameter measured during the inspection as compared against the value during the baseline period.

8. b. Comparison of current conditions with site-specific baseline data.

9. False

10. d. All of the above.

11. b. They often allow the inspector to simplify inspections when compliance is highly probable.

12. True

13. True

14. True