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SELF-AUDIT GUIDE FOR VISIBLE EMISSION TRAINING AND CERTIFICATION PROGRAMS



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Self-Audit Guide for Visible Emission Training and Certification Programs

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INTRODUCTION

Opacity standards are an integral part of the Federal and State emission control regulations for control of aerosol pollutants nationwide. Compliance with the visible emission opacity standards is usually determined by trained, qualified, visible emissions observers according to EPA Reference Method 9. The success of the visible emission control program is dependent upon the proper training and certification of the Visible Emission (VE) evaluators. Reference Method (RM) 9 contains detailed specifications and procedures for the design and operation of "smoke generators" used to produce training and certification plumes and for the testing and certification of the trained VE evaluators.

Opacity standards are independently enforceable and serve as a primary compliance monitoring tool for Federal, State and Local Control Agency enforcement staff. Many of the Federal and State air pollution emission rules and regulations also require industry to accurately assess and report Method 9 opacity data during the initial compliance tests and at affected facilities thereafter. Regulated sources may be subject to stiff penalties for failure to comply with emission standards, including opacity standards. Therefore it is extremely important that VE evaluators be fully trained and properly certified. This training must be in full accordance with all Method 9 procedures and be included in all aspects of performing Method 9 and other related VE observation methods.

The purpose of this manual is to assist Visible Emission Program supervisors and instructors in the evaluation of the Visible Emission Training and Certification Program. Only through careful auditing and the allocation of necessary resources (time, money, training, and manpower) will the programs produce well trained and fully certified observers.

This guide has been designed as a screening audit to allow you, the VE program administrator, supervisor, or instructor a chance to audit your own program. You may detect any problems or weaknesses in-house, and correct them so that VE evaluators can be trained, qualified, and certified in a technically and legally correct manner.

Experience has also shown that VE training and certification programs set up and operated systematically can also be more efficient and

effective in the overall processing and record keeping of students seeking certification.

This guide contains step by step instructions. First, the questions that need to be asked are presented in a format that may be used verbatim. Second, a range of responses will be supplied that might be anticipated for that question. Third, an explanation of what those responses really mean to your program. Each unit of this manual contains the portion of Method 9 that describes the certification requirements, how to determine if the certification process is valid, as well as the applicable questions and anticipated answers.

This guide has not been designed as a deep technical audit or as a substitute for a comprehensive audit performed by a trained auditor. If any answer falls in a less than desirable response range, a more thorough audit needs to be performed.

I. SCHEDULING THE AUDIT

- A. Schedule a time with the program manager or other lead person responsible for operation of the Visible Emission Training and Certification Program (VETCP). Provide the program manager or lead person with a list of documents required for the audit:
 - 1. smoke generator transmissometer calibration records
 - 2. transmissometer strip charts or printouts
 - 3. VE certification runs' grading masters
 - 4. certifying student papers
 - 5. standard operating procedure guide (SOP) for the VETCP
 - 6. classroom attendance records
 - 7. confidence intervals
- B. As the audit begins, check for availability of required documentation.
- C. Begin the entrance interview. Start with the person(s) in authority and move on to person(s) of responsibility.
- D. Each time a new person enters the audit, be sure to state your purpose.

II. ADMINISTERING THE AUDIT

Appendix B contains all the questions and responses as well as an area for recording other comments in the form of the Self-Audit Questionnaire. It is recommended that Appendix B should be photocopied and used during the actual administration of the audit. All the background information and recommendations may be easily referenced as the questionnaire numbering matches that of the audit guide itself. Be sure to ask the question exactly as written. This will help assure that the responses you receive will be appropriate to compare to the expected responses.

III. STAFF QUALIFICATIONS

Background

The agency needs to assign qualified staff members that are properly qualified to lecture on all aspects of visual emissions enforcement. Also the staff should include technicians trained in generator operation and certification of VE evaluators.

- 1) The lecturers must be qualified to speak on:
 - A) Characteristics of the sources to be evaluated.
 - B) Requirements and techniques of Methods 9 and 22.
 - C) Documentation and reporting of field observations.
 - D) Training and testing procedures.
 - E) Handling special field problems.

- 2) The field staff must be trained to conduct the field training and certification procedures. This training should include:
 - A) Operation and maintenance of the smoke generator.
 - B) Calibration audit of the photocell using neutral density photopic filters.
 - C) Proper site selection so that appropriate smoke reading backgrounds are available to the VE students.
 - D) Comprehensive knowledge of the training and testing procedures.
 - E) How to handle special field testing problems.

Question

Is the Visible Emissions Program Staff qualified to present the training and certification program?

Responses

Satisfactory:

- 1) The lecture staff has a competent grasp of all concepts and information in the qualification list above.

AND

- 2) The field staff is thoroughly competent and trained as described in number 2 above.

Unsatisfactory:

- 1) The staff does not have a thorough knowledge of the content of number 1 above.
- 2) The staff does not have sufficient training to perform field training (number 2, above.)

Recommendations

- 1) A senior, experienced field inspector or equivalent should give the lecture.
- 2) Any person serving as the lead VETC Instructor or smoke generator operator should attend EPA Course 539 - Visible Emissions Instructors Workshop. This course is for training new instructors and operators, as well as for updating experienced instructors on new VE procedures and technical information.

IV. CLASSROOM SESSION

A. Lecture Content

Background

A classroom training session is not specifically required by method 9, however, lectures on certain air pollution topics are essential for the proper training of an inspector. In the classroom, an observer learns to choose a proper viewing position, taking into account both horizontal and vertical sun angles. The observer also learns to document the opacity so that it may hold up under scrutiny in a court of law. Classroom instruction also provides information on how to handle special field problems.

Question

Is there a lecture conducted that prepares the inspector for the field that at a minimum, covers:

- 1) Theory of opacity measurement
- 2) Method 9, 22, and SIP requirements.
 - a. Viewing position
 - b. Angle through the plume.
 - c. Distance from plume, etc.
 - d. Correct viewing procedures
- 3) How to fill out the agency field observation form.
- 4) How the test is conducted.
- 5) How to reduce the data.
- 6) How to handle steam, condensed water or other plume interference.

Responses

Satisfactory

Our lecture covers all the items 1-6 from above.

Unsatisfactory

- 1) No lecture
- 2) Limited lecture

Recommendations

A lecture should be provided for all persons attempting certification for the first time. The lecture should cover the details of the methods used in the agency, how to complete the observation forms, calculate and reduce the data, how to handle and read complex plumes, including steam and secondary reaction plumes. To assist in conducting the field session, the testing procedure should be covered. For persons who will be performing compliance inspections, lectures on types of sources,

emissions, and plume behavior under various meteorological conditions should also be presented.

B. Lecture Attendance

Background

Method 9 as written does not specifically require attendance at a classroom lecture to receive certification as a trained VE observer. However, in performing VE observations under actual field conditions, the VE evaluator must be able to recognize wet plumes and other special conditions that affect how and where the observations should be made in the plume. These conditions can not be demonstrated in the field testing part of the certification. Through lectures, slides and/or videotapes, the proper techniques for applying and documenting Methods 9 and 22 under all field situations can be adequately illustrated. Therefore a minimum series of classroom training lectures (4-6 hours) should be included in the certification process for all new observers and 1-2 hours refresher lecture for persons recertifying every 1-2 years.

Question

Is lecture attendance required of all certifying personnel?

Responses

Satisfactory:

- 1) Lecture is required of all certifying personnel.
- 2) Lecture is required the first time an observer certifies and periodically thereafter (approximately every other year.)

Unsatisfactory:

- 1) No lecture requirements exist.
- 2) Insufficient requirements exist.

Recommendations

Attendance at a lecture or training program should be mandatory prior to observing sources in the field for compliance or permitting status. After the observer has attended their first lecture, it is recommended that he return to lecture in 6 months, one year and then every 2 years. If there has been a major legal or technological change in Method 9, attendance would be recommended for all observers at the next certification school.

V. FIELD SESSION

A. Field Certification Procedures

<u>Background</u>	Safeguards must be taken during testing and grading to assure that the results are valid. Safeguards include the monitoring of tests as well as the proper custodial care and record keeping of all documents demonstrating the basis for the entire certification process.
<u>Question</u>	What safeguards are taken to assure that the certification testing and grading process are valid and free from testing irregularities.
<u>Responses</u>	<p>Satisfactory</p> <ol style="list-style-type: none">1) The test is closely monitored.2) A two part testing form or some other grading system is used to prevent changes by applicants to marked answers after the test has been completed and the answers revealed.3) Chain of custody procedures are stated and followed for the handling of all test forms, both certifying and non-certifying. <p>Unsatisfactory</p> <ol style="list-style-type: none">1) Failure to completely perform the above three requirements.
<u>Recommendations</u>	<p>The certification process is a legal process and must be properly done to withstand close scrutiny during litigation. It is necessary for the certifying agency to assure that no questions or challenges can be legitimately presented as to the proper certification of inspectors. At a minimum, the tests must be monitored, a cheat-proof form and grading system must be used, and chain of custody procedures must be adhered to.</p> <p>The agency should periodically review procedures to assure that all safeguards and guidelines are strictly followed.</p>
<u>Reference documents</u>	Refer to page 32 of this document for additional technical assistance documents.

B. Field Test Structure

Background

Method 9 has very specific requirements regarding testing. It is imperative that these requirements be met to assure the validity of the certification. The testing structure requires that:

- 1) Readings were given in random order.
- 2) The test was conducted across the range of 0-100 opacity on both black and white emissions.
- 3) The run consists of 25 black and 25 white readings.

Question

May I examine the grading master and strip chart of run #_____(1-10) of the _____(location and/or date) smoke school.

Responses

Satisfactory

Upon examination of master and strip chart, requirements 1-3 from above are all met.

Unsatisfactory

- 1) Lack of records.
- 2) No randomness in the test run.
- 3) No values above 50% or 60%.
- 4) The strip chart records are not signed, dated, and individual readings marked.
- 5) Instability shown by actual readings varying by 5% from reported readings.

Recommendations

- 1) Give readings in a random order.
- 2) Conduct the test across the range of 0 - 100 opacity for both the black and white smoke.
- 3) The test should consist of 25 white smoke and 25 black smoke readings.
- 4) An audit and confidence interval should be performed for one run, each smoke school.
- 5) If the record keeping is found to be lacking, reference section VI (next page).

VI. RECORD KEEPING

Background

Certification records are legal documents demonstrating that the observer and program operator were in full compliance with Method 9 requirements and procedures. Program records may be subpoenaed as a part of litigation.

Question

Are bound records available documenting the conduct of every school, including:

- 1) registration forms
- 2) signed and dated strip charts
- 3) grading masters for each certification run
- 4) certifying student test papers.

Responses

Best Answer:

Yes

Acceptable:

Records are signed and available, but not bound.

Least acceptable:

Records are scattered and signed, but available.

Unacceptable

- 1) Records are not available.
- 2) Records are available but not signed and/or dated.

Recommendations

The certifying agency should have a system for documenting the certification process, including transmissometer strip charts or printouts, grading masters, and certifying papers. These are legal documents and should be signed and dated as well as retained in a secure location and kept together, preferably bound. In enforcement litigation involving emission violations documented by certified VE evaluators, the validity of the VE observer certification be questioned. All aspects of the observer's training and certification must be demonstrated to have been in strict accordance with the published procedures contained in EPA Reference Method 9.

VII SMOKE GENERATOR

A. Smoke Meter (Calibration) Specifications

Background

The method states:

The smoke transmissometer optical design and performance shall meet the specifications shown in Table 9-1 in Appendix A. The smoke meter shall be calibrated as prescribed in paragraph 3.3.1 prior to the conduct of each smoke reading test. At the completion of each test, the zero and span drift shall be checked and recorded. If the drift exceeds 1 percent opacity, the condition shall be corrected prior to conducting any subsequent test runs.

Question

Are calibrations performed according to Method 9 specifications?

Responses

Satisfactory

Yes

Unsatisfactory

1. No
2. Yes, but not recorded.
3. yes, but inconsistently.

Question

What is the smoke generator drift?

Responses

Satisfactory

$\leq 1\%$ for 30 minutes, +/- 1%

Unsatisfactory

$> 2\%$ for 30 minutes

B. Frequency of Smoke Meter Checks

Background

The method states:

The smoke meter shall be demonstrated at the time of installation to meet the specifications listed in Table 9-1 (Appendix A). This demonstration shall be repeated following any subsequent repair or replacement of:

- 1) the photocell,
- 2) associated electronic circuitry,
- 3) the chart recorder output meter,

or every 6 months, whichever occurs first.

It is the responsibility of the agency performing the VETCP to assure that the specifications are met. Maintenance and calibration are to be performed at least every six months. Ideally they are performed just prior to the school.

Question

When was the generator last calibrated?

Responses

Satisfactory

- 1) Within the last 6 months

OR

- 2) Following the last repair or replacement of the photocell or electronic circuitry, whichever occurred most recently.

Unsatisfactory

- 1) More than 6 months ago.
- 2) Prior to the last repair or replacement of the photocell, strip-chart recorder or any other associated electronic circuitry

C. Smoke Meter Readings and Recordings

Background

The method states:

Any smoke generator used for the purpose of paragraph 3.2 shall be equipped with a smoke meter installed to measure opacity across the diameter of the smoke generator stack and record this data on a strip chart recorder. Strip chart records are necessary to confirm the records of the certification program.

Since all modern smoke generators are generally equipped with a strip chart recorder, this requirement is usually met. However, the auditor should examine the stack and the transmissometer arm. If the stack is necked down or expanded downstream of the measurement system, further checks should be made to determine if the transmissometer reading is adjusted to reflect the exit path diameter.

The method also states:

The smoke meter output shall display in-stack opacity based upon a path-length equal to the stack exit diameter, on a full 0 to 100 percent chart recorder scale.

Question

Are strip-chart records available to support and document certification?

Responses

Satisfactory

- 1) Yes

Unsatisfactory

- 1) Incomplete records
- 2) No records

Recommendations

- 1) Keep strip-chart records available for auditing and verification. These should that have been signed and dated.

VIII QUALITY ASSURANCE

Background

A Quality Assurance program is necessary to insure that all possible irregularities are discovered and amended. The confidence intervals guarantee the validity of the generated opacity. A confidence interval is a calculation of accumulated precision and accumulated errors inherent to all of the measurements conducted in the certification program. These measurement values should include the standard deviation of the NIST traceable filters, the transmissometer calibration and the reporting error between the strip chart and the grading master for any run. They establish the statistical range of possible values for a given data point, for example: 10% opacity \pm 7.5%.

Question

Does your agency have a fully implemented quality assurance program for the visible emissions training program that includes:

- * Standard Operating Procedures (SOP) Manual
- * In-house audit program
- * Confidence intervals
- * NIST (formerly NBS) traceable calibration standards

Responses

Satisfactory:

Yes, the program has:

- 1) A standard operating procedures manual
- 2) An implemented audit program
- 3) Confidence intervals calculated on the quality of the smoke values presented to the applicants.
- 4) NIST traceable calibration standards

Unsatisfactory:

The program has:

- 1) No standard operating procedures manual
- 2) No program of audits
- 3) Failure to demonstrate confidence intervals
- 4) No NIST traceable calibration standards

Recommendations

- 1) The agency should develop an SOP manual incorporating all aspects of the program.
- 2) The agency should perform audits periodically to insure the agency is adhering to all operating

APPENDIX A

TABLE 9-1 -- SMOKE METER DESIGN AND PERFORMANCE SPECIFICATIONS

<u>Parameter</u>	<u>Specification</u>
a. Light source---	Incandescent lamp operated at nominal rated voltage
b. Spectral response of photocell	Photopic (daylight spectral response of the human eye)
c. Angle of view---	15° maximum total angle
d. Angle of projection	15° maximum total angle
e. Calibration error-	<u>+3%</u> opacity, maximum
f. Zero and span drift	<u>+1%</u> opacity, 30 minutes
g. Response time---	5 seconds maximum

APPENDIX B

SELF-AUDIT GUIDE QUESTIONNAIRE

DATE _____

FACILITY _____

NAME OF AUDITOR _____

TITLE _____

NAME(S) OF PERSON(S) BEING INTERVIEWED _____

TITLE(S) _____

INSTRUCTIONS

These 13 pages may be photocopied and used to record responses and comments during the audit process. Be sure to ask the question exactly as it has been written. The answers may be circled on these pages and other information may be marked at the bottom of the page. The section numbers in this questionnaire match the guide itself for ease of reference.

III. STAFF QUALIFICATIONS

- 1) The lecturers must be qualified to speak on:
 - A) Characteristics of the sources to be evaluated.
 - B) Requirements and techniques of Methods 9 and 22.
 - C) Field observation documentation and reporting.
 - D) Training and testing procedures.
 - E) Handling special field problems.

- 2) The field staff must be trained to conduct the field training and certification procedures. This training should include:
 - A) Operation and maintenance of the smoke generator.
 - B) Calibration audit of the photocell using neutral density photopic filters.
 - C) Proper site selection so that appropriate smoke reading backgrounds are available to the VE students.
 - D) Comprehensive knowledge of the training and testing procedures.
 - E) How to handle special field problems.

Question

Is the Visible Emissions Program Staff qualified to present the training and certification program?

Responses

Satisfactory:

- 1) The lecture staff has a competent grasp of all concepts and information in the qualification list above.

AND

- 2) The field staff is thoroughly competent and trained as described in number 2 above.

Unsatisfactory:

- 1) The staff does not have a thorough knowledge of the content of number 1 above.
- 2) The staff does not have sufficient training to perform field training (number 2, above.)

RESPONSES/COMMENTS

IV. CLASSROOM SESSION

A. Lecture Content

Question

Is there a lecture conducted that prepares the inspector for the field that at a minimum, covers:

- 1) Theory of opacity measurement
- 2) Method 9, 22, and SIP requirements.
 - a. Viewing position
 - b. Angle through the plume.
 - c. Distance from plume, etc.
 - d. Correct viewing procedures
- 3) How to fill out the agency field observation form.
- 4) How the test is conducted.
- 5) How to reduce the data.
- 6) How to handle steam, condensed water or other plume interference.

Responses

Satisfactory

Our lecture covers all the items 1-6 from above.

Unsatisfactory

- 1) No lecture
- 2) Limited lecture

RESPONSES/COMMENTS

B. Lecture Attendance

Question

Is lecture attendance required of all certifiers?

Responses

Satisfactory:

- 1) Lecture is required of all certifying personnel.
- 2) Lecture is required the first time an observer certifies and periodically thereafter (approximately every other year.)

Unsatisfactory:

- 1) No lecture requirements exists.

RESPONSES/COMMENTS

V. FIELD SESSION

A. Field Certification Procedures

Question What safeguards are taken to assure that the certification testing and grading process are valid and free from testing irregularities.

Responses Satisfactory

- 1) The test is closely monitored.
- 2) A two part testing form or some other grading system is used to prevent changes by applicants to marked answers after the test has been completed and the answers revealed.
- 3) Chain of custody procedures are stated and followed for the handling of all test forms, both certifying and non-certifying.

Unsatisfactory

- 1) Failure to address the above three areas.

RESPONSES/COMMENTS

B. Field Test Structure

Question

May I examine the grading master and strip chart of run # _____ (1-10) of the _____ (location and/or date) smoke school.

Responses

Satisfactory

Upon examination of master and strip chart, requirements 1-3 are all met.

- 1) Readings were given in random order.
- 2) The test was conducted across the range of 0-100 opacity on both black and white emissions.
- 3) The run consists of 25 black and 25 white readings.

Unsatisfactory

- 1) Lack of records.
- 2) No randomness in the test run.
- 3) No values above 50% or 60%.
- 4) The strip chart records are not signed, dated, and individual readings marked.
- 5) Instability shown by actual readings varying by 5% from reported readings.

RESPONSES/COMMENTS

VI. RECORD KEEPING

Question

Are bound records available documenting the conduct of the school, including:

- 1) registration forms
- 2) signed and dated strip charts
- 3) grading masters for each certification run
- 4) certifying student test papers.

Responses

Best Answer:

Yes

Acceptable:

Records are signed and available, but not bound.

Least acceptable:

Records are scattered and signed, but available.

Unacceptable

- 1) Records are not available
- 2) Records are available but not signed and/or dated.

RESPONSES/COMMENTS

VII SMOKE GENERATOR

A. Smoke Meter (Calibration) Specifications

Question Are calibrations performed according to Method 9 specifications? (The smoke meter shall be calibrated as prescribed in paragraph 3.3.1 prior to the conduct of each smoke reading test. At the completion of each test, the zero and span drift shall be checked and recorded. If the drift exceeds 1 percent opacity, the condition shall be corrected prior to conducting any subsequent test runs.)

Responses Satisfactory

Yes

Unsatisfactory

1. No
2. Yes, but not recorded.
3. Yes, but inconsistently.

Question What is the smoke generator drift?

Responses Satisfactory

$\leq 1\%$ for 30 minutes, $\pm 1\%$

Unsatisfactory

$> 2\%$ for 30 minutes

RESPONSES/COMMENTS

B. Frequency of Smoke Meter Checks

Question When was the generator last calibrated?

Responses Satisfactory

1) Within the last 6 months.

OR

2) Following the last repair or replacement of the photocell or electronic circuitry, which ever occurred most recently.

Unsatisfactory

1) More than 6 months ago.

2) Prior to the last repair or replacement of the photocell, strip-chart recorder or any other associated electronic circuitry.

RESPONSES/COMMENTS

VIII QUALITY ASSURANCE

Question

Does your agency have a fully implemented quality assurance program for the visible emissions training program that includes:

- * Standard Operating Procedures (SOP) Manual,
- * In-house audit program,
- * Confidence intervals,
- * NIST (formerly NBS) traceable calibration standards ?

Responses

Satisfactory:

Yes, the program has all of the following:

- 1) A standard operating procedures manual
- 2) An implemented audit program
- 3) Confidence intervals calculated on the quality of the smoke values presented to the applicants.
- 4) NIST traceable calibration standards

Unsatisfactory:

The program has:

- 1) No standard operating procedures manual
- 2) No program of audits
- 3) A failure to demonstrate confidence intervals
- 4) No NIST traceable calibration standards

RESPONSES/COMMENTS

REFERENCE DOCUMENTS

These documents contain valuable technical information and guidance on visible emission determinations by trained observers (Reference Method 9):

Method 9 Field Observation Procedures

Guidelines for Evaluation of Visible Emissions:
Certification, Field Procedures, Legal Aspects and
Background Materials, EPA 340/1-75-007, 4/75.

EPA Visible Emission Inspection Procedures, S. 24,
8/75.

Quality Assurance Handbook for Air Pollution
Measurements Systems: Vol. III Stationary Source-Specific
Methods, Section 3.12 - Method 9 Visible
Determination of Opacity of Emissions from Stationary
Sources, EPA 600/4-77-027b, 2/84.

Instructions for the Use of the VE Observation Form, EPA
455/R-93-005.

Guide to effective Inspection Reports for Air Pollution
Violations, EPA 340/1-85-019, 9/85.

VE Observer Training and Certification (Method 9)

Technical Assistance Document: Quality Assurance
Guideline for Visible Emission Training Schools, EPA
600/4-83-011.

APTI Course 439 -Visible Emission Evaluation
Instructor/Student Manuals.

Method 9 Policy Memorandum and Other Background Information

Opacity Guidelines File- Policy Memoranda and Background
Information (Compiled and updated annually for Course # 539 APTI
Visible Emissions Instructors Workshop).

Public Comment Survey: Opacity Provisions Under
Standards of Performance of New Stationary Sources of
Air Pollution, 8/75.

**EPA Response to Remand Ordered by U.S. Court of Appeals
for the District of Columbia in Portland Cement
Association V. Ruckelshaus, EPA 450/2-74-023, 11/74.**

Method 9 Technical Basis and Performance Evaluation

**Optical Properties and Visual Effects of Smoke-Stack
Plumes, AP-30, 5/72.**

**Measurement of the Opacity and Mass Concentration of
Particulate Emissions by Transmissometry, EPA 650/2-
74-128, 11/74.**

**Evaluation and Collaborative Study of Method for Visual
Determination of Opacity of Emissions from Stationary
Sources, EPA 650/4-75-009, 1/75.**