Source Test Manual (Draft)

Procedures for Compliance Testing

Air Quality Program

Washington State Department of Ecology
Olympia, Washington

February 2025, Publication ##-25-02-001

Publication Information

This document is available on the Department of Ecology's website at:
https://fortress.wa.gov/ecy/publications/summarypages/~~2502001~~.html (not a live link)

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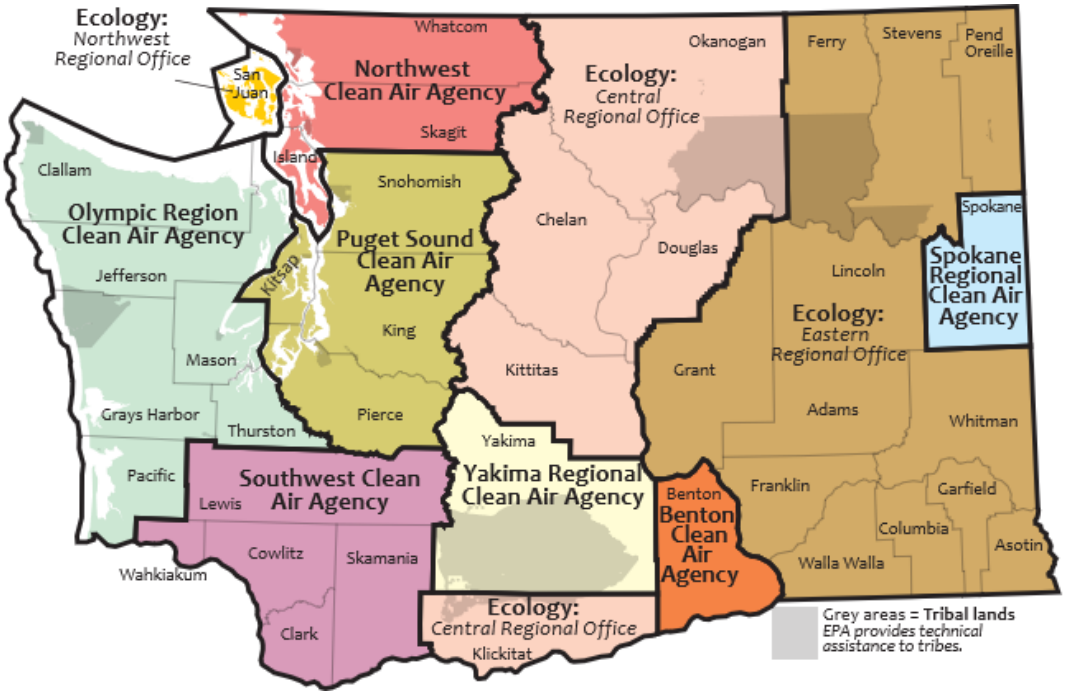

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Introduction

The purpose of this manual is to provide source test methods where other methods are not available. As new methods are developed, Ecology will update this manual to remove outdated methods. Because Ecology does not maintain previous versions of this manual, Ecology encourages state and local air agency staff to update air permits so that they do not rely on methods in previous Ecology manuals. Ecology must include guidance materials, such as this manual, relied on for compliance in a rule.

Ecology and the Washington Clean Air Agencies use the test methods in this manual. The methods represent the minimum standards for the State of Washington. An agency may require more comprehensive procedures or may approve the use of other methods on a case-by-case bases.

This manual contains the updated versions of Source Test Methods 9A and 9B required to demonstrate compliance with requirements in Chapter 173-400 WAC, or other state rules. The updated versions of Methods 9A and 9B reflect historical Ecology announcements (July 27, 1983 and September 27, 1983), which allow EPA's LIDAR Test Method, as alternatives to Ecology Methods 9A and 9B. EPA's LIDAR test method is found in 40 CFR 60 Appendix A-4, and is called "Alternate Method 1–Determination of the Opacity of Emissions from Stationary Sources remotely by LIDAR." As stated within the EPA alternate method:

> "This alternate method provides the quantitative determination of the opacity of an emissions plume remotely by a mobile lidar system."

It then defines a mobile lidar system as including both "laser radar" (or LADAR), and "Light Detection and Ranging" (or LIDAR). The EPA alternate method also provides the following description of how mobile LIDAR systems (both LADAR and LIDAR) work:

> "The lidar is used to measure plume opacity during either day or nighttime hours because it contains its own pulsed light source or transmitter. The operation of the lidar is not dependent upon ambient lighting conditions (light, dark, sunny or cloudy)."

The instructions for how to adapt the EPA alternate method, which is based on "average" opacity, to Ecology's Methods 9A and 9B, which is based on the largest individual opacity values, are provided within the "Analysis" section for both Methods 9A and 9B.

The updated versions of Methods 9A and 9B also address situations with secondary plumes and include grammatical fixes.

Outdated source test methods were removed because there are more suitable methods. The Disposition of Methods section contains the list of removed test methods from the previous (2004) version, as well as the reasons for removing those methods.

Ecology encourages users of the manual to offer comments, suggestions, and corrections.

Source Test Method 9A
Visual Determination of Opacity for a Three-Minute Standard

1. Principle

An observer must be qualified to determine the opacity of emissions from a stationary source.

2. Procedure

The observer must be certified in accordance with the qualifications and testing requirements in Section 3 of Method 9 in 40 C.F.R. Part 60, Appendix A-4 (in effect on the date in WAC 173-400-025).

The qualified observer must stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to their back. Consistent with maintaining the above requirement, the observer must, as much as possible, make their observations from a position such that their line of vision is approximately perpendicular to the plume direction, and when observing opacity of emissions from rectangular outlets (e. g., roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight must not include more than one plume at a time when multiple stacks are involved, and in any case, the observer must make their observations with their line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g., stub stacks on baghouses).

The observer must record the name of the plant, emission location, type of facility, observer's name and affiliation, and the date on a field data sheet. The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded on a field data sheet at the time opacity readings are initiated and completed.

The observer must make note of the ambient relative humidity, ambient temperature, the point in the plume that the observations were made, and the color and condition of the plume. It is also helpful if pictures of the plume are taken.

The observer must observe opacity observations at the point of greatest opacity in the portion of the plume where condensed water vapor is not present. The observer must not look continuously at the plume, but instead must observe the plume momentarily at 15-second intervals.

When condensed water vapor is present within the plume as it emerges from the emission outlet, the observer must observe opacity beyond the point in the plume at which condensed water vapor is no longer visible.

When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the observer must evaluate opacity of emissions at the emission outlet prior to the condensation of water vapor and the formation of the steam plume. Or, as an alternative, if secondary plumes are present downstream of the steam column, the observer may evaluate the opacity of emissions wherever the opacity is greatest, before or after the steam column.

The observer must record opacity of emissions d to the nearest 5 percent at 15-second intervals on an observational record sheet. Each momentary observation recorded must be deemed to represent the average opacity of emissions for a 15-second period.

3. Analysis

The observer will determine the opacity of the plume by individual visual observations. Opacity must be reported as the range of values observed during a specified time period, not to exceed 60 consecutive minutes. The opacity standard is exceeded if there are more than 12 observations, during any consecutive 60-minute period, for which an opacity greater than the standard is recorded.

Or, as an alternative to this approach, the observer may use (EPA LIDAR Test Method) if it satisfies the requirements in "Alternate Method 1-Determination of the Opacity of Emissions from Stationary Sources Remotely by Lidar" in Appendix A-4 to 40 C.F.R. Part 60 (in effect on the date in WAC 173-400-025). The exception to this requirement is that Section 2.6.4 of the EPA LIDAR Test Method must be applied as follows:

> The observed plume opacity shall be determined by the greatest individual actual opacity values, in a 60-minute period such that the sum of the respective time pulse is greater than three minutes. For example, if the firing rate was six pulses per minute, the observed opacity would be determined by the 19 largest individual opacity values.

4. References

Alternate Method 1-Determination of the Opacity of Emissions from Stationary Sources Remotely by Lidar. 40 CFR Part 60, Appendix A–4 To Part 60—Test Methods 6 Through 10b.

"Criteria for Smoke and Opacity Training School 1970-1971" Oregon-Washington Air Quality Committee.

Department of Ecology Announcement, September 27, 1983: "The State of Washington Department of Ecology's Source Test Manual will include EPA's LIDAR Test Method, as alternatives to WDOE Methods 9A and 9B."

Federal Register, Vol. 36, No. 247, page 24895, Dec. 23, 1971.

"Guidelines for Evaluation of Visible Emissions" EPA 340/1-75-007.

Source Test Method 9B
Visual Determination of Opacity for a Six-Minute Standard

1. Principle

An observer must be qualified to determine the opacity of emissions from a stationary source.

2. Procedure

The observer must be certified in accordance with the qualifications and testing requirements in Section 3 of Method 9 in 40 C.F.R. Part 60, Appendix A-4 (in effect on the date in WAC 173-400-025).

The qualified observer must stand at a distance sufficient to provide a clear view of the emissions with the sun oriented in the 140° sector to their back. Consistent with maintaining the above requirement, the observer must, as much as possible, make their observations from a position such that their line of vision is approximately perpendicular to the plume direction, and when observing opacity of emissions from rectangular outlets (e. g., roof monitors, open baghouses, noncircular stacks), approximately perpendicular to the longer axis of the outlet. The observer's line of sight must not include more than one plume at a time when multiple stacks are involved, and in any case, the observer must make their observations with their line of sight perpendicular to the longer axis of such a set of multiple stacks (e.g., stub stacks on baghouses).

The observer must record the name of the plant, emission location, type of facility, observer's name and affiliation, and the date on a field data sheet. The time, estimated distance to the emission location, approximate wind direction, estimated wind speed, description of the sky condition (presence and color of clouds), and plume background are recorded on a field data sheet at the time opacity readings are initiated and completed.

The observer must make note of the ambient relative humidity, ambient temperature, the point in the plume that the observations were made, and the color and condition of the plume. It is also helpful if pictures of the plume are taken.

The observer must observe opacity observations at the point of greatest opacity in the portion of the plume where condensed water vapor is not present. The observer must not look continuously at the plume, but instead must observe the plume momentarily at 15-second intervals.

When condensed water vapor is present within the plume as it emerges from the emission outlet, the observer must observe opacity beyond the point in the plume at which condensed water vapor is no longer visible.

When water vapor in the plume condenses and becomes visible at a distinct distance from the emission outlet, the observer must evaluate opacity of emissions at the emission outlet prior to the condensation of water vapor and the formation of the steam plume. Or, as an alternative, if secondary plumes are present downstream of the steam column, the observer may evaluate the opacity of emissions wherever the opacity is greatest, before or after the steam column.

The observer must record opacity of emissions to the nearest 5 percent at 15-second intervals on an observational record sheet. Each momentary observation recorded must be deemed to represent the average opacity of emissions for a 15-second period.

3. Analysis

The observer will determine the opacity of the plume by individual visual observations. Opacity must be reported as the range of values observed during a specified time period, not to exceed 60 consecutive minutes. The opacity standard is exceeded if there are more than 24 observations, during any consecutive 60-minute period, for which an opacity greater than the standard is recorded.

Or, as an alternative to this approach, the observer may use (EPA LIDAR Test Method) if it satisfies the requirements in "Alternate Method 1-Determination of the Opacity of Emissions from Stationary Sources Remotely by Lidar" in Appendix A-4 to 40 C.F.R. Part 60 (in effect on the date in WAC 173-400-025). The exception to this requirement is that Section 2.6.4 of the EPA LIDAR Test Method must be applied as follows:

> The observed plume opacity shall be determined by the greatest individual actual opacity values, in a 60-minute period such that the sum of the respective time pulse is greater than six minutes. For example, if the firing rate was six pulses per minute, the observed opacity would be determined by the largest 37 opacity values.

4. References

Alternate Method 1-Determination of the Opacity of Emissions from Stationary Sources Remotely by Lidar. 40 C.F.R. Part 60, Appendix A–4 To Part 60—Test Methods 6 Through 10b.

"Criteria for Smoke and Opacity Training School 1970-1971" Oregon- Washington Air Quality Committee.

Department of Ecology Announcement, September 27, 1983: "The State of Washington Department of Ecology's Source Test Manual will include EPA's LIDAR Test Method, as alternatives to WDOE Methods 9A and 9B."

Federal Register, Vol. 36, No. 247, page 24895, Dec. 23, 1971.

"Guidelines for Evaluation of Visible Emissions" EPA 340/1-75-007.

Disposition of Methods

This section contains information on test methods removed from the test manual. Ecology started the Source Test Manual in the early 1970s with the Oregon-Washington Air Quality Committee: Criteria for Smoke and Opacity Training School around 1970/71 followed by the Washington-Oregon 1973 Hog Fuel Boiler Study Committee Method. Ecology prepared later versions in April 1976, May 1977, March 1983, July 1990, and September 2004. Ecology expanded the Manual to 34 methods in the 1983 version at its peak but has since reduced the number of methods in later versions as most of those methods have become outdated. The list of methods removed from the September 2004 version of this manual, as well as the reasons for removing those methods, are provided below.

- Source Test Method 8 Particulate Sampling by an Impinger Train
- Source Test Method 14 Carbonyl Determination Bisulfite Absorption
- Source Test Method 17 Combustible Gas Detection using Catalytic Oxidation
- Source Test Method 18 Particulate Measurement using an Intermediate Volume Sampler
- Source Test Method 19 Particulate Size using a Cascade Impactor
- Source Test Method 101 Washington-Oregon 1973 Hog Fuel Boiler Study Committee Method
- Source Test Calibration Method 4 Barton Analyzer Calibration
- Source Test Calibration Method 5 Ecocal Generator Calibration
- Source Test Laboratory Procedure) 3 Hydrocarbons Condensables Determination
- Source Test Laboratory Procedure 4 Dichloromethane Extraction f Filters
- Conditional Source Test Method 038 Measurement of Ammonia Emissions from Highway, Nonroad and Stationary Use Diesel Engines by Extractive Fourier Transform Infrared (FTIR) Spectroscopy
- Conditional Source Test Method 039 Measurement of PM2.5 and PM10 Emissions by Dilution Sampling (Constant Sampling Rate Procedures)

Source Test Method 8 Particulate Sampling by an Impinger Train

In 2025 Ecology removed the duplicative state method because we determined that EPA Method 5, 17, 02 201A in 40 C.F.R. Part 60 are more appropriate or complete.

Source Test Method 14 Carbonyl Determination Bisulfite Absorption

The portions of WAC 173-400-050 (parts 2 and 2b) requiring a 100 ppm carbonyl limit Ecology using Method 14 has been removed from the rule. This change is consistent with the State Implement Plan, from which this Method has already been removed .

Source Test Method 17 Combustible Gas Detection using Catalytic Oxidation

In 2025 Ecology removed Method 17 because it has determined that there are more appropriate or complete methods available such as EPA Method 18, TO-15, and EPA Method 320 (FTIR)

Source Test Method 18 Particulate Measurement using an Intermediate Volume Sampler

In 2025 Ecology removed Method 18 because it is not aware of this Method being used or required anywhere in Washington State. It is outdated.

Source Test Method 19 Particulate Size using a Cascade Impactor

In 2025 Ecology removed Method 19 because it has determined that there are more appropriate or complete methods available such as from EPA or from CARB (Method 501 for [particle size distribution].

Source Test Method 101 Washington-Oregon 1973 Hog Fuel Boiler Study Committee Method

In 2025 Ecology removed Method 101 because it has determined that there are more appropriate or complete methods available from EPA or from CARB such as Method 5, 17 or 201A with a 202 back half depending on the source.

Source Test Calibration Method 4 Barton Analyzer Calibration

In 2025 Ecology removed this method because it has determined that there are more appropriate or complete methods available from EPA or from CARB. Ecology is not aware of this Method being used or required anywhere in Washington State. It is outdated.

Source Test Calibration Method 5 Ecocal Generator Calibration

In 2025 Ecology removed this method because it has determined that there are more appropriate or complete methods available from EPA or from CARB.

Source Test Laboratory Procedure 3 Hydrocarbons Condensables Determination

In 2025 Ecology removed this method because it uses [dichloromethane] DCM which is highly hazardous and WA state laws regarding its use in the workplace are restrictive. There are

generally less harmful solvents that can replace DCM. EPA studies have shown similar recoveries with hexane.

Source Test Laboratory Procedure 4 Dichloromethane Extraction of Filters

In 2025 Ecology removed this method because it uses [dichloromethane] DCM which is highly hazardous and WA state laws regarding its use in the workplace are restrictive. There are generally less harmful solvents that can replace DCM. EPA studies have shown similar recoveries with hexane.

Conditional Source Test Method 038 Measurement of Ammonia Emissions from Highway, Nonroad and Stationary Use Diesel Engines by Extractive Fourier Transform Infrared ~~(FTIR)~~ Spectroscopy

In 2025 Ecology removed this method because it is already part of EPA's list of conditional test methods. There is no reason to repeat them in Ecology's Source Test Manual, which is intended for methods not found elsewhere.

Conditional Source Test Method 039 Measurement of PM2.5 and PM10 Emissions by Dilution Sampling (Constant Sampling Rate Procedures)

In 2025 Ecology removed this method because it is already part of EPA's list of conditional test methods. There is no reason to repeat them in Ecology's Source Test Manual, which is intended for methods not found elsewhere.