Responding to the EPA Information Collection Request for Electric Utility Steam Generating Units

Potential Non-Dioxin/Furan Organic HAP Surrogates

Background

On December 24, 2009, the U.S. Environmental Protection Agency (EPA) issued an Information Collection Request (ICR) requiring owners of coal- and oil-fired power plants to test stack emissions from selected electricity generating units (EGUs) for a range of hazardous air pollutants (HAPs) and potential surrogate species. The ICR also requires facilities to sample and analyze the fuels burned during the test period. The Electric Power Research Institute (EPRI) has prepared a series of technical papers to help power plant owners improve the quality of the test results by raising awareness of technical issues related to the sampling and analytical methods. As EPA's plan is to use the ICR results to establish emission standards for the power industry, it is important to collect and report measurements that are accurate, unbiased, and representative of the stationary sources tested.

The objective of these papers is to provide technical information that will assist power plant owners and stack testing contractors in identifying appropriate technical resources, developing test plans, streamlining testing, selecting appropriate sampling and analytical methods, and avoiding common errors. The information provided includes "lessons learned" and recommendations from several stack testing firms that provided testing services on recent EPA ICRs. These recommendations are not intended as universal guidance; each power plant owner should evaluate their applicability for a specific situation.

Changes and clarifications to the ICR requirements are posted on the Electric Utilities MACT ICR web page: http://utilitymacticr.rti.org/FAQ.aspx. Power plant owners should consult that resource for any guidance that may impact the recommendations in this paper.

About This HAP Group

Emissions of total hydrocarbons (THC), methane (CH_4) and formaldehyde are identified in the ICR as potential surrogates for the non-dioxin/furan organic HAP. These chemicals are indicators of incomplete combustion, and their proposed use as surrogates is based on the theory that emissions of these species could be used to predict emissions of organic HAP. The ICR also requires selected EGUs that measure the potential surrogates to report levels of CO_2, O_2, and carbon monoxide (CO); these measurements use routine methods and are not addressed here.

Results of past testing have indicated that the levels of the target species in coal- and oil-fired utility boiler emissions are low and perhaps below the minimum detection level. These conditions pose a challenge for producing good quality data.

Method Options

The ICR lists the following methods to measure the potential organic HAP surrogates:

Parameter	Primary Method	Alternative Method
THC	EPA Method 25A	None
CH_4	EPA Method 18	EPA Method 320
Formaldehyde	EPA Method 320	SW-846 Method 0011

This document provides a discussion of each of the EPA-recommended test methods listed above except one: Method 320, a spectroscopic method, can be used to simultaneously measure many of the ICR HAPs and potential surrogates, namely HCl, HF, HCN, CH_4, and formaldehyde. Method 320 is covered in detail in another paper in this series: *Acid Gases and Hydrogen Cyanide*.

EPA Method 25A

Method Title and Source

The ICR lists EPA Test Method 25A (M25A) to measure "THC". The full title of this method is:

> TEST METHOD 25A – February, 2000, DETERMINATION OF TOTAL GASEOUS ORGANIC CONCENTRATION USING A FLAME IONIZATION ANALYZER

Method 25A is contained in Appendix A to Title 40 of the Code of Federal Regulations, Part 60 (40 CFR 60). The method is available from: http://www.epa.gov/ttn/emc/promgate/m-25a.pdf

Safety Tips

This method requires the tester to transport and work with high-pressure (up to 3000 psi) gas cylinders, including hydrogen. A complete understanding of the gas, the container, and the gas handling system is essential to the safe use of compressed gases, and the development of any required safety plans. The primary hazard associated with the handling, storage and use of high-pressure gases is from the potential for sudden uncontrolled release of gas propelling a cylinder, whipping gas lines, and flying debris. Hydrogen gas cylinders present the additional hazard of containing a flammable and potentially explosive gas. Finally, all gas cylinders present asphyxiation hazards, are heavy and present crushing hazards to personnel and equipment if the cylinders are not secured properly and handled with care.

Method Overview

M25A is a relatively straightforward instrumental test method that is familiar to most stack testers. A gas sample is extracted from the source through a heated sample probe, heated glass fiber filter, and heated sample line (HSL). The gas is conveyed without further conditioning to a flame ionization analyzer (FIA), an instrument that utilizes a flame ionization detector (FID) to measure organic vapors (the terms FIA and FID are often used interchangeably). For the ICR, propane is the recommended calibration gas (although testers are allowed to use a mixture of the actual organic compounds being emitted). Results are reported as volume concentration equivalents relative to propane.

A major operational difference between this method and other instrumental test methods is that the sample gas must be conveyed to the analyzer hot and wet. The method requires all sampling components leading to the analyzer to be heated to a minimum of 110 °C (220 °F). There is no provision in the method for dilution sampling.

Many of the test locations covered in this ICR will be beyond the maximum practical reach of a 110V AC powered heated sample line, typically 100 feet. It will be logistically challenging to rig multiple HSLs to reach from a sample location to a grade-level continuous emissions monitor (CEM) trailer. Therefore, the contractor may choose to operate the analyzer on the stack platform.

Operating any analytical instrument at the stack sample location poses logistical as well as safety concerns, including:

- Multiple pressurized gas cylinders are required.
- Adequate and stable electrical power for CEM instruments is needed.
- A clean, temperature-stable environment for CEM instruments is preferred.

Method Limitations:
The tester should consider the following limitations with this method relative to ICR testing:

- Condensed water vapor is a major potential negative bias in this method. It is imperative that the gas sample temperature is maintained above 110 °C (220 °F) all the way through the sample delivery system to the analyzer.
- M25A is intended to measure organic vapors consisting primarily of alkanes, alkenes, and/or arenes. However, any chemical that enhances the FID response will be measured.
- M25A does not speciate individual organic compounds.

Method Details

Material Requirements

- The M25A sampling system contains a probe, an in-stack or heated out-of-stack filter, a heated sample line, a heated pump, a flame ionization analyzer and a calibration gas delivery system. The gas path to the FIA does not pass through a moisture removal system.
- A sample is invalidated if water droplets form in the sampled gas stream prior to analysis. Insulate any sample connections and use heated sample lines that can maintain the proper sample temperature in the ambient conditions present during testing.
- Make sure that the power load requirements of the heated sample lines can be met without compromise. This is particularly an issue when multiple sample lines are combined to accommodate ground-based analyzers. Multiple circuits at different plant elevations may be required in these cases. Minimize the use of extension cords to power the FIA and sample lines; however, if used for distances of 50 to 100 feet, select cords with an internal wire size of at least 12 gauge.
- The FIA needs to meet the method specifications for calibration error and calibration drift. The FIA detector block must be heated to a minimum of 120 °C (250 °F).
- Fuel and combustion air requirements for the FIA will vary depending on the make and model of analyzer. Follow the requirements specified for the analyzer you are using.

- Use a single-opening probe capable of reaching at least 34.2% of the stack diameter (this is the minimum probe length required to reach the centrally located 10 percent area of the stack cross-section, specified by the method).
- A particulate filter is recommended. It can be an in-stack filter or an out-of-stack filter heated to at least 110 °C (220 °F). Out-of-stack filtration is recommended if the flue gas contains water droplets. Check the filter between runs for signs of water condensation. A wet filter invalidates the run.
- Maintain a gas temperature of at least 110 °C (220 °F) all the way to the FIA.
- Introduce calibration gases upstream of the particulate removal filter. Calibration gas criteria are different than those of other EPA instrumental test methods. A zero gas and three upscale gases based on the instrument span are required.
- To reduce the effects of oxygen synergism, the calibration gases may need to be balanced in air. However, the magnitude of this effect depends on the specific analyzer and anticipated flue gas oxygen levels. Consult the manufacturer's recommendations for the specific FIA being used.
- The zero gas should always match the balance gas (nitrogen or air) used in the calibration gases.

Sampling and Analysis

- Sampling can be conducted at a constant rate from a single point.
- The ICR requires sample runs to be a minimum of two hours.
- Most FIAs are sensitive to sample pressure, and generally cannot handle any back-pressure. Pay attention to the pressure requirements specified in the analyzer manual. Sampling and calibration must be performed at the same sample pressure.
- Allow the FIA to warm up for one hour (or longer, depending on manufacturer's recommendations) before attempting to calibrate or operate the analyzer.
- Set instrument span to 1.5-2.5 times the expected concentration. For THC below 5 ppm, use a span value of 10 ppm (EPA recommendation for Boiler and CISWI ICR, 2009).
- The calibration procedure differs slightly from that of other EPA instrumental methods.
- An analyzer drift check is required hourly and immediately following a test run.
- A minimum of one THC measurement must be recorded every minute.

Reporting

Test results should be reported as propane in ppmvd @ 7% O_2 and lb/MMBtu, following the procedures outlined in Section 3.2.1 of Enclosure 1 of the ICR.

EPA Method 18

Method Title and Source

The ICR lists EPA Method 18 (M18) to measure methane (CH_4). The full title of this method is:

> TEST METHOD 18 – February, 2000 MEASUREMENT OF GASEOUS ORGANIC COMPOUND EMISSIONS BY GAS CHROMATOGRAHY

The method is currently available from: http://www.epa.gov/ttn/emc/promgate/m-18.pdf

Safety Tip

This method requires the use of compressed gas cylinders. Refer to safety considerations listed under Method 25A.

Method Overview

Method 18 uses gas chromatography (GC) to measure a variety of volatile organic compounds. The method allows several sampling and analytical strategies, and does not specify a particular type of detector for the analysis. When a strategy is chosen, the tester must prove that their method is adequate by meeting certain criteria specified in a recovery study.

This document will focus solely on the ICR application of sampling for methane. There are three likely scenarios a test contractor could use:

- Direct interface sampling
- Collection of sample gas in an inert sample bag, on-site analysis
- Collection of sample gas in an inert sample bag, off-site laboratory analysis

If the direct interface option is chosen, there are two possible scenarios:

- Interface with a dedicated gas chromatograph with a flame ionization detector (FID)
- Interface with a flame ionization analyzer (FIA) that includes a GC loop and is capable of sequentially measuring both methane and THC
  (Note: in this document, FIA refers to a complete analyzer, whereas FID refers only to the detector portion of that analyzer. These two terms are often used interchangeably).

Method Limitations

There are no significant measurement limitations to this method if it is executed in accordance with the procedures and requirements specified in the method. The concentration of methane from some ICR sources may be very low, however, and the tester may be challenged in meeting all of the QA/QC criteria of the method at the low calibration levels required.

Method Details

Direct Interface Sample

If a single instrument is used to measure both THC and CH_4 sequentially, refer to the Method 25A material requirements in addition to those specified below.

Material Requirements

- The direct interface system contains a probe, an in-stack or heated out-of-stack filter, a heated sample line, a heated pump, a GC/FIA (either a GC/FID and sample loop or a CEM-type FIA with a GC column) and a calibration gas delivery system.
- A combination methane/non-methane organic analyzer that uses a methane “cutter” (i.e., not a GC) cannot be used for this method (EPA response for Boiler & CISWI ICR, 2009).
- The gas path to the GC/FIA does not usually pass through a moisture removal system, so the methane is measured on a wet volumetric basis.
- The GC/FIA needs to meet the method specifications for calibration and linearity. The FID block must be heated to a minimum of 120 °C (250 °F).
- Locate the GC/FIA in a clean, temperature-controlled vibration-free place that is free of drafts, sheltered from the weather and has a clean, reliable electrical power source.

- Minimize the use of extension cords to power the GC/FIA; however, if used for distances of 50 to 100 feet, make sure cords have internal wire size of at least 12 gauge.
- Fuel and combustion air requirements for the GC/FIA will vary depending on the make and model of analyzer. Follow the requirements specified for the analyzer you are using.
- A particulate filter is recommended. It can be an in-stack or a heated out-of-stack filter. Out-of-stack filtration is recommended if the flue gas contains water droplets.
- The calibration gases meeting the range requirements of Section 7.1 from EPA Method 7E of 40 CFR 60, Appendix A are preferred. In most cases for the EGU ICR, a 10 ppm calibration span should be acceptable.

Sampling and Analysis

- Set up the GC/FIA according to manufactures recommendations. Allow sufficient warm up time.
- Conduct a calibration of the GC/FIA by triplicate injection of calibration gases directly into the GC/FIA. At least three points are required (more if response is non-linear).
- Prior to testing, perform a recovery study by sampling and analyzing in triplicate a midrange standard drawn through the entire sampling system. The average result must be within 10% of the direct injection calibration value.
- Immediately after GC calibration and prior to sample analyses, analyze any audit materials available following procedures in 40 CFR 61, Appendix C.
- The ICR specifies that sample runs must be at least two hours.
- You must make and record a minimum of five CH_4 measurements per hour.
- Draw all samples and calibration mixtures through the sample loop at the same pressure.
- At the end of each run, analyze a midrange standard by direct injection in triplicate. Repeat the entire calibration if the pre- and post-test responses differ by more than 5%.

Integrated Bag Sample

Material Requirements

- The integrated bag sampling system contains a probe, lung sampler with pump, flow control valve and an inert gas bag (e.g., Teflon®, Tedlar® or aluminized Mylar). A direct pumping system may also be used instead of the lung sampler. SUMMA canisters are not allowed by this method. However, EPA allowed canisters that met the specifications of EPA Method 25 for methane measurements under the Boiler & CISWI ICR, 2009.
- Method 18 has no provisions for flue gas moisture removal. However, since methane will remain a gas at ambient temperature, is extremely stable, is not soluble in water, and will not adhere to the sides of a bag, the tester may want to seek EPA approval to allow moisture removal prior to collection. Otherwise, the bag will either have to be heated until analysis or the sample diluted with inert gas to prevent water condensation inside the bag. (Note that measuring a bag collected without moisture removal will require correction of the CH_4 concentration for the moisture in the bag.)
- A particulate filter is suggested; it can be a glass wool plug in the tip of the probe.
- Always leak check bags before use. Fill with zero-grade air or nitrogen and leave overnight to check for deflation. Also, analyze the air or nitrogen in the bag to check for contamination prior to deflating and using.

Sampling and Onsite or Offsite Analysis

- Sampling may be conducted at a constant rate from a single point.

- The ICR specifies that sample runs must be at least two hours.
- Extract the sample at a rate such that the bag is 50% to 70% full at the end of the run (closer to 50% if bags are to be shipped by air cargo).
- Carefully package bags for transport to the laboratory to prevent punctures or tears.
- Bags are time sensitive, and should be analyzed as quickly as possible after collection. If analysis is done off-site, ship the bags for overnight delivery and notify the laboratory.
- Following analysis, one sample bag is selected for a recovery study.
    - A known mixture of methane is added to the bag.
    - The spiked bag is analyzed after it is stored for the same period of time as the duration that the original sample was held in that bag before analysis.
    - Recovery of the methane spike must be between 70% and 130%.

Reporting

Test results should be reported in ppmvd @ 7% O_2 and lb/MMBtu, following the procedures outlined in Section 3.2.1 of Enclosure 1 of the ICR.

EPA Method 0011

Method Title and Source

The ICR lists EPA Test Method 0011 (M0011) as an alternative method to measure formaldehyde. The full title of this method is:

> METHOD 0011 – SAMPLING FOR SELECTED ALDEHYDE AND KETONE EMISSIONS FROM STATIONARY SOURCES

Method 0011 is contained in the EPA publication SW-846, entitled *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods*. Paper copies of SW-846 are available from the National Technical Information Service (NTIS) and an electronic version of M0011 is available on-line at: http://www.epa.gov/epawaste/hazard/testmethods/sw846/pdfs/0011.pdf

Safety Tips

This method requires the tester to work with two suspected human carcinogens – methylene chloride ($MeCl_2$) and 2, 4-dinitrophenylhydrazine (DNPH).

DNPH crystals and DNPH solution are potential carcinogens and should be handled with appropriate gloves at all times, with prompt and extensive use of running water in case of skin exposure. Absorption of DNPH into the body may cause cyanosis, resulting in a temporary bluish discoloration of lips and tongue. Solid DNPH is classified as a flammable solid, and is explosive when dry. Because of this, solid DNPH is normally stored with water (10 to 30 percent by weight) in the container. Generally, the tester can avoid handling the DNPH in solid form by procuring the mixed reagent directly from one of several commercial laboratories that supply the reagent specifically for this method.

$MeCl_2$ is a regulated toxic compound and a suspected human carcinogen. The OSHA Short-Term Exposure Limit (STEL) for $MeCl_2$ is125 ppm and the action level is 12.5 ppm. Unfortunately, the odor threshold is around 250 ppm. This means that, if you can smell it, you have already been overexposed at a level double the STEL. For adequate protection, methylene chloride must be handled under a laboratory hood. Filtering face piece respirators (half- or full-face) may not be used as a regular solution to control methylene chloride exposures. You will not be able to smell it to know your filter is used up. Testers should also have the proper gloves, goggles and a lab coat or long sleeve shirt when handling $MeCl_2$. If it contacts the skin, wash it off immediately.

Method Overview

Method 0011 is an isokinetic sampling method, adapted from EPA Method 5, in which the impingers are charged with aqueous, acidic DNPH reagent. The DNPH forms a stable hydrazone derivative with formaldehyde and other aldehydes and ketones. The train is recovered in the field with water and methylene chloride. The derivatives are extracted and analyzed by high performance liquid chromatography (HPLC) with ultraviolet (UV) detection.

The method can be used to measure several other aldehydes and ketones, as noted in the method. Some testers combine this method with EPA Method 5 to simultaneously determine filterable particulate matter. This option is **not** offered as an alternative for the ICR.

This method does not differ substantially from Method 5 in the complexity of the field sampling. However, the reagent preparation and handling requirements of the method are considerably more difficult. **It is strongly recommended that the tester use a contract laboratory to supply the purified DNPH reagent.**

Method Limitations

The method is known to have the following measurement limitations:

- The estimated in-stack detection limit for the method is 45 ppbv (56 $\mu g/dscm$) for a gas sample volume of 1.7 m^3 (60 ft^3).
- Acetone can have a significant bias on formaldehyde results. Because of its widespread occurrence in the laboratory and field environments, some degree of acetone contamination is unavoidable. However, the tester and laboratory must exercise caution to make sure that acetone contamination is minimized. If the facility is also testing for dioxins/furans using Method 23, samples and reagents for that method should be handled and shipped separately, as acetone from sample recovery can contaminate the formaldehyde samples.
- Environmental formaldehyde can be a source of contamination. Keep reagent and sample bottles sealed when not being used, and follow the method requirements for maximum hold time for the DNPH reagent.
- A high concentration of nitrogen dioxide (NO_2) is listed as a possible interferent, since it consumes the DNPH. At levels above 60 ppm NO_2 can result in a negative bias. The method-required matrix spike will indicate if this is a problem (albeit, after the fact). Additional impingers of DNPH can be added to the train if reagent consumption is believed to be a problem.

Method Details

Material Requirements

- A heated particulate filter is **not** part of the standard sampling train.
- Use an all-Teflon® probe brush and use only Teflon® or glass wash bottles.
- Use only amber glass sample bottles with Teflon®-lined closures.
- The probe liner, impingers, connecting glassware, wash bottles, sample bottles and all laboratory glassware used to handle samples must be scrupulously cleaned prior to use. Either bake the glassware or perform a final rinse with acetonitrile. Do **not** rinse with acetone.

- Do not use any silicone grease in the train.
- If a flexible line is needed to connect the probe to the first impinger, use Teflon® or equivalent tubing and heat the line to 120 ± 14 °C (248 ± 25 °F).
- Use only A.C.S. reagent grade chemicals.
- Although the method states that the acidic DNPH absorbing solution can be prepared in the field, this presents both safety and quality issues. Prepare the solution in the lab or purchase pre-mixed and purified from the laboratory contracted to do the analysis. Method 0011 requires that the DNPH be used within 5 days after making and 2 days after opening the container in the field.

Sampling and Analysis

- Choose a nozzle so that the isokinetic sampling rate is in the range of 0.5 to 0.75 cfm.
- The ICR requires a minimum sample volume of 1.7 m^3 (60 ft^3) collected over a minimum sample time of 2 hours.
- Check the impingers periodically during the run. Watch for orange or red crystals forming at the interface of the reagent and the glass in the first impinger. This indicates DNPH consumption or that the train has been contaminated with acetone.
- After the run, the impingers will normally contain a two-phase emulsion that does not pour well, and a significant amount of the impinger catch will be left on the walls after the contents are poured out. Use water as a rinse first to recover as much of this material as possible. Follow the water rinse of the impingers with three or more rinses with methylene chloride. Rinse the impingers until all yellow color is gone from the surfaces.
- The quality assurance program for this method includes collection and analysis of field reagent blanks (optional but highly recommended), laboratory method blanks, a field spike and a matrix field spike. A complete field train blank is not required but is also recommended.
- The matrix field spike is an additional field run spiked with a known amount of formaldehyde after collection. Either perform the matrix spike as a fourth run immediately after the normal runs, or preferably, operate it simultaneously (collocated if possible) with one of the normal sample trains so that the baseline concentration is the same in both trains.
- Keep the samples stored at wet ice temperature (4 °C ± 2 °C) until they are analyzed.
- The analysis should be performed only by a laboratory with a demonstrated proficiency in this method.
- Analyze the samples within 30 days after testing.

Reporting

Test results should be reported in ppmvd @ 7% O_2 and lb/MMBtu, following the procedures outlined in Section 3.2.1 of Enclosure 1 of the ICR.

Unlisted Alternative Methods

EPA Method 25A is probably the best alternative available for determining emissions of THC from utility stacks. It is in common usage and is familiar to most stack testers.

Methane can also be measured using EPA Method 320, a spectroscopic method that has the advantage that it can be used to simultaneously measure many of the other ICR HAPs and potential surrogates. Method 320 is discussed in more detail in another paper in this series: *Acid Gases and Hydrogen Cyanide*.

Past testing has indicated that formaldehyde concentrations in power plant emissions are very low to non-detectable. Detecting formaldehyde may not be feasible with either of the method alternatives listed in the ICR document. Other formaldehyde methods that were not listed in the ICR document could possibly give better sensitivity at these low concentrations if properly applied. EPA has indicated that they are receptive to proposed alternative formaldehyde methods. Potential options for alternative methods that the tester may consider include:

ASTM D6348-03

ASTM D6348-03, 'Standard Test Method for Determination of Gaseous Compounds by Extractive Direct Interface Fourier Transform Infrared (FTIR) Spectroscopy,' is an EPA-acceptable alternative to Method 320 for formaldehyde measurement (reference EPA guidance document GD-051A from the 2009 ICR for Boiler and CISWI). Like Method 320, this method uses extractive FTIR but differs in some of the specific analytical and QA/QC details. Although the performance of the two methods is similar, the ASTM method eliminates some ambiguity of Method 320 and the minimum detection limit calculations are much simpler. This method may be purchased from www.astm.org.

EPA Method 316

EPA approved the use of EPA Method 316 (40 CFR 63, Appendix A) as an alternative method to measure formaldehyde, provided that the tester follows modifications to the analytical method to address potential interferences. This approval and citation for the analytical modifications are provided on the ICR website (http://utilitymacticr.rti.org/FAQ.aspx) under the FAQ section.

Method 316 is performed isokinetically, similar to Method 5, and uses water to collect formaldehyde, with a modified pararosaniline spectrophotometric method for analysis. It can be used for sources with entrained moisture droplets. Sulfites and cyanide are interferences with the standard analysis and are addressed by the required analytical modifications.

EPA has indicated previously that the tester will need to conduct a breakthrough evaluation of the impingers when using this method (see GD-051A and GD-051D from the 2009 ICR for Boiler and CISWI). A similar requirement would seem applicable to the EGU ICR as well.

This method has the advantage over Method 0011 in that it is considerably simpler from sampling and analytical perspectives, and it avoids the hazards and hold-time restrictions associated with the DNPH reagent used in Method 0011. The method is available from: www.epa.gov/ttn/emc/promgate.html.

EPA Method 323

EPA approved Method 323 (40 CFR 63, Appendix A) as an alternative for formaldehyde in guidance for the 2009 Boiler MACT ICR. Method 323 is a constant rate, midget impinger method which collects formaldehyde in high purity water with a colorimetric analysis of the sample. EPA also approved in that ICR the combined approach of using this method for sampling, with Method 316 for analysis. A breakthrough analysis is required for approval. It cannot be used if entrained water droplets are present in the flue gas.

CARB 430

California Air Resources Board (CARB) Method 430, 'Determination of Formaldehyde and Acetaldehyde in Emissions From Stationary Sources' is a DNPH absorption method similar to EPA Method 0011, with the major difference being the use of midget impingers in the CARB method instead of the full-size impingers required in the EPA method. EPA approved this method as an alternative in their guidance for the 2009 ICR for Boiler and CISWI (see

GD-051A from the 2009 ICR for Boiler and CISWI). The method is available here: http://www.arb.ca.gov/testmeth/vol3/M_430.pdf.

This method does not require the "fourth-run" field matrix spike that is required in Method 0011. Since it is a non-isokinetic method, it would not be acceptable if the flue gas contains entrained water droplets, such as downstream of a wet scrubber. It offers the advantage of the tester being able to use lab-sealed midget impingers for the sampling (and thus not having to handle the DNPH reagent in the field). Although the performance of CARB 430 has been demonstrated with some success on gas-fired units, it has not been validated for gas streams with high particulate or moisture loading.

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