Other Test Method 52A (OTM-52A) Method for Determination of Combustion Efficiency from Enclosed Combustion Devices Located at Oil and Natural Gas Facilities Using Method 25A

1.0 Scope and Application

Other Test Method (OTM)-52A is a test method for measuring combustion efficiency from enclosed combustion devices located at oil and natural gas production facilities and similar sources. OTM-52A requires specific installed testing infrastructure, instrumentation types, and execution procedures. Quality assurance and quality control (QA/QC) requirements are included to assure that you, the tester, collect data of known and acceptable quality for each testing program. OTM-52A does not completely describe all equipment, supplies, and sampling and analytical procedures you will need, but instead refers to supporting test methods for some of the details. Use of OTM-52A requires a thorough knowledge of the additional test methods referenced below, which are found in 40 CFR Part 60, Appendices A-1, A-2, A-3, A-4 and A-7:

(a) Method 1 – Sample and Velocity Traverses for Stationary Sources[1]

(b) Method 3A – Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources[2]

(c) Method 4 – Determination of Moisture Content in Stack Gases[3] (optional, not required when CO2, CO and HC are measured on consistent moisture basis)

(d) Method 7E – Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)[4]

(e) Method 10 – Determination of Carbon Monoxide Emissions from Stationary Sources[5]

(f) Method 25A – Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer[6]

1.1 Analytes.

This method measures the concentrations of carbon dioxide (CO_2), carbon monoxide (CO), and hydrocarbons (HC) as determined using promulgated reference methods.

Table 1-1 Analyte list

Analyte	CAS No	Sensitivity
Carbon Dioxide (CO_2)	124-38-9	< 2% of Calibration Span Gas Value
Carbon Monoxide (CO)	630-08-0	< 2% of Calibration Span Gas Value
Hydrocarbons (HC)	N/A	< 2% of Calibration Span Gas Value

1.2 Applicability.

This method is intended for the measurement of combustion efficiency using CO_2, CO and HC in enclosed combustors located at oil and natural gas production facilities for the purposes of conducting performance tests to demonstrate compliance with applicable performance standards. The use of this method for performance tests used to demonstrate compliance with federal emissions standards or monitoring requirements must be approved by the EPA Administrator. This method is available, with appropriate administrative oversight, for application without Federal oversight for other non-federal program uses including state permitting programs and engineering applications.

1.3 Data Quality Objectives (DQO).

This method is designed to provide high-quality data for the determinations described above. In these and other applications, the principal objective is to ensure data accuracy that the emission levels are at or below the emissions target. To meet this objective, the use of EPA traceability protocol calibration gases and measurement system performance tests are required.

2.0 Summary of Method

A gas sample is continuously extracted from the sampling port of the exhaust stack of an enclosed combustion device and conveyed to the specific gas analyzer(s) for determination of CO_2, CO, and HC gas concentrations for the calculation of combustion efficiency. You must meet the design specifications, analyzer performance requirements, and test procedures of this method and referenced methods to ensure reliable performance. The concentration measurement device may be referred to as a “analyzer” or an “instrument”, with these terms used interchangeably in this method. The analyte concentrations used in calculation of combustion efficiency (see Section 12.8) can be done on either a wet or dry basis, it just needs to be consistent across all analytes and as specified in the applicable regulation, permit or other requirement. If measurements of analytes are done on differing moisture basis, Method 4 must be completed to correct concentrations to a uniform moisture basis. Note, if all analytes are completed on a wet basis or dry, determination of moisture content is not required.

3.0 Definitions

3.1 Calibration Error means the percentage difference between the gas concentration measured by the gas analyzer and the known concentration of the Calibration Gas.

3.2 Calibration Gas means a gas mixture containing an analyte at a known concentration and produced and certified in accordance with “EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards,” September 1997, as amended May 2012, EPA-600/R-12/531[7] or more recent updates. The system verification tests require the use of Calibration Gas prepared according to this protocol. In the absence of reference materials to which a protocol gas may be made traceable, implementors of this method may follow Reference Method 205, as appropriate, to generate the Calibration Gases needed for use with this method.

3.2.1 High-Level Calibration Gas means a Calibration Gas with a concentration that is equal to the Calibration Span.

3.2.2 Mid-Level Calibration Gas means a Calibration Gas with a concentration equivalent of 40 to 60 percent of the Calibration Span.

3.2.3 Low-Level Calibration Gas means a Calibration Gas with a concentration equivalent to <20 percent of the Calibration Span.

3.2.4 Near-Zero Calibration Gas means a CO_2 Calibration Gas with a concentration between 2000-4000 ppm.

3.2.5 Zero Calibration Gas means a Calibration Gas with less than 0.1 part per million by volume (ppmv) of organic material (propane or carbon equivalent), 1 ppmv CO and 1 ppmv CO_2.

3.3 Calibration Span means the upper limit of the analyzer's calibration that is set by the choice of High-Level Calibration Gas. No valid run average concentration may exceed the calibration span. To the extent practicable, the measured emissions should be between 20 to 100 percent of the selected calibration span. This may not be practicable in cases where the target component's concentration is at or near the analyzer's detection limit for the target component for part of the test duration or testing for compliance with an emission limit when emissions are substantially less than the limit. In such cases, calibration spans should be chosen that are practicable to achieving the test DQOs without being excessively high.

3.4 Direct Calibration Mode means introducing the Calibration Gases directly into the analyzer (or into the assembled measurement system at a point downstream of all sample conditioning equipment) according to manufacturer's recommended calibration procedure. This mode of calibration applies to non-dilution-type measurement systems.

3.5 Drift means the difference between the pre- and post-run System Bias (or System Calibration Error) checks at a specific Calibration Gas concentration level (i.e., Low-, Mid-, or High-).

3.6 Hydrocarbons or HC means a total hydrocarbon concentration measurement determined using Method 25A as described in this method.

3.7 Measurement System means all equipment used to determine the HC, CO, and CO2 concentrations. The Measurement System comprises six major subsystems: sample acquisition, sample transport, sample conditioning, Calibration Gas manifold, gas analyzer(s), and data recorder(s).

3.8 Measurement System Response Time means the time it takes the Measurement System to respond to a change in gas concentration occurring at the sampling point when the system is operating normally at its target sample flow rate or dilution ratio.

3.9 System Bias means the difference between a Calibration Gas measured in Direct Calibration Mode and in System Calibration Mode. System Bias is determined before and after each run at the Low- and Mid- or High-Level Calibration Gas concentrations. For dilution-type systems, pre- and post-run System Calibration Error is measured rather than System Bias.

3.10 System Calibration Error applies to dilution-type systems and means the difference between the measured concentration of Low-, Mid-, or High-Level Calibration Gas and the certified concentration for each gas when introduced in system calibration mode. For dilution- type systems, a 3-point System Calibration Error test is conducted in lieu of the analyzer Calibration Error test, and 2-point System Calibration Error tests are conducted in lieu of System Bias tests.

3.11 System Calibration Mode means introducing the Calibration Gases into the Measurement System at the probe, upstream of the filter and all sample conditioning components.

3.12 Test Run means a series of gas samples taken successively from the sampling port of the ECD stack for a duration of 60 minutes, unless otherwise specified by a permitting authority.

4.0 Interferences

Note that interferences may vary among instruments and that instrument-specific interferences must be evaluated consistent with their respective method (*i.e.,* Methods 3A, 10, and 25A).

5.0 Safety

This method may require you to work with hazardous materials and in hazardous conditions. We encourage you to establish safety procedures before using the method. Among other precautions, you should become familiar with the safety recommendations in the gas analyzer user's manual. Occupational Safety and Health Administration (OSHA) regulations concerning cylinder and noxious gases may apply. All Calibration Gases must be handled with utmost care and with adequate ventilation.

6.0 Equipment and Supplies

Proper use of equipment designed for this application will meet or exceed the performance criteria in this method.

6.1 What do I need for the Measurement System? You may use any Measurement System that meets the performance and design standards within this method and the following equipment and supply specifications:

6.1.1 Sampling system components that are not evaluated in the System Bias or System Calibration Error test must be glass, Teflon, or stainless steel. Other materials are potentially acceptable, subject to approval by the EPA Administrator.

6.1.2 The instrumental analyzers must meet the analyzer performance requirements in Table 9-1.

6.2 Measurement System Components

6.2.1 Sample Probe. Glass, stainless steel, or other non-reactive material of sufficient length to sample from the centrally located 10 percent area of the stack cross-section.

6.2.2 Particulate Filters. An in-stack or out-of-stack filter. The filter must be made of material that is non-reactive to the gas being sampled. The out-of-stack filter media must be included in the System Bias test. The particulate filter requirement may be waived in applications where no significant particulate matter is expected (e.g., for emission testing of a combustion turbine firing natural gas).

6.2.3 Sample Line. The sample line from the probe to the conditioning system/sample pump should be made of Teflon or other material that does not absorb or otherwise alter the sample gas.

6.2.4 Conditioning Equipment. For dry basis measurements, a condenser, dryer, or other suitable device is required to remove moisture continuously from the sample gas. Any equipment needed to heat the probe or sample line to avoid condensation prior to the sample conditioning component is also required.

6.2.5 Sample Pump. A leak-free pump is needed to pull the sample gas through the system at a flow rate sufficient to minimize the Measurement System Response Time. The pump may be constructed of any material that is non- reactive to the gas being sampled. For dilution-type Measurement Systems, an ejector pump (eductor) is used to create a vacuum that draws the sample through a critical orifice at a constant rate.

6.2.6 Calibration Gas Manifold. Prepare a system to allow the introduction of Calibration Gases either directly to the gas analyzer(s) in Direct Calibration Mode or into the Measurement System, at the probe, in System Calibration Mode, or both, depending upon the type of system used. In system calibration mode, the system should be able to flood the sampling probe and vent excess gas. Alternatively, Calibration Gases may be introduced at the calibration valve following the probe. Maintain a constant pressure in the gas manifold. For in-stack dilution-type systems, a gas dilution subsystem is required to transport large volumes of purified air to the sample probe and a probe controller is needed to maintain the proper dilution ratio.

6.2.7 Sample Gas Manifold. For the type of system shown in Figure 7E-1[4], the sample gas manifold diverts a portion of the sample to the analyzer(s), delivering the remainder to the by-pass discharge vent. The manifold should also be able to introduce Calibration Gases directly to the analyzer(s) (except for dilution-type systems). The manifold must be made of material that is non-reactive to the gas sampled or the Calibration Gas and be configured to safely discharge the bypass gas.

6.2.8 Gas Analyzer(s).

6.2.8.1 CO_2 Concentration Analyzer (Method 3A)[2]. You must use an analyzer that continuously measures CO_2 in the gas stream and capable of meeting or exceeding the specifications of this method and the analyzer performance requirements in Table 9-1.

6.2.8.2 CO Concentration Analyzer (Method 10)[5]. You must use an instrument that continuously measures CO in the gas stream and capable of meeting or exceeding the specifications of this method and the analyzer performance requirements in Table 9-1.

6.2.8.3 Organic Concentration Analyzer (Method 25A)[6]. You must use a flame ionization analyzer (FIA) capable of meeting or exceeding the specifications of this method and the analyzer performance requirements in Table 9-1.

6.2.9 Data Recorder. A computerized data acquisition system, digital recorder, or data logger for recording measurement data may be used. The minimum data recording requirement is one measurement value per minute.

7.0 Reagents and Standards

7.1 Calibration Gases.

The Calibration Gases for the gas analyzer must be CO_2 in nitrogen (N_2) or CO_2 in air; CO in N_2 or CO in air; and methane (CH_4) in N_2 or CH_4 in air. Each Calibration Gas must be certified (or recertified) within an uncertainty of 2.0 percent in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards" September 1997, as amended May 2012, EPA-600/R-12/531[7]. In the absence of reference materials to which a protocol gas may be made traceable, implementors of this method may follow Reference Method 205, as appropriate, to generate the Calibration Gases needed for use with this method. Zero gas must meet the requirements under the definition in 3.2.5 of this method. The Calibration Gas must be used before its expiration date and the cylinder gas pressure must be greater than the minimum pressure of use. It is acceptable to prepare Calibration Gas mixtures from EPA Traceability Protocol gases in accordance with Method 205 in appendix M to 40 CFR Part 51. The following Calibration Gas concentrations are required:

7.1.1 High-Level Calibration Gas. This concentration is chosen to set the calibration span as defined in Section 3.4.

7.1.2 Mid-Level Calibration Gas. 40 to 60 percent of the calibration span.

7.1.3 Low-Level Calibration Gas. Less than 20 percent of the calibration span.

7.1.4 Near-Zero Calibration Gas. Between 2000 and 4000 ppm. (Only applicable to CO_2)

7.1.5 Zero Calibration Gas. High purity air with less than 0.1 part per million by volume (ppmv) of organic material (propane or carbon equivalent), 1 ppmv CO and 1 ppmv CO_2.

7.1.6 Fuel for Method 25A analyzer. A 40 percent hydrogen (H_2)/60 percent N_2 gas mixture is recommended to avoid an oxygen synergism effect that reportedly occurs when oxygen concentration varies significantly from a mean value. Use of pure hydrogen fuel is also acceptable.

8.0 Sample Collection, Preservation, and Storage Emission Test Procedure:

This following section includes all required sampling and analysis procedures required for measurements collected using Method 1, 3A, 4, 7E, 10 and 25A analyzers.

8.1 Sampling Location.

The sampling probe must be inserted into the stack via a sampling port with the probe centrally located in the stack and at least 0.5 duct diameters upstream of a flow disturbance and 2 duct diameters downstream of a flow disturbance.

8.2 Initial Measurement System Performance Tests.

Before measuring emissions, you must perform the procedures:

(a) Calibration Gas Verification (8.2.1)

(b) Measurement System Preparation (8.2.2)

(c) Calibration Error Test (8.2.3)

(d) Initial System Bias Check (8.2.4)

(e) Measurement System Response Time (8.2.5)

(f) Ambient Background Concentration (8.2.6)

8.2.1 Calibration Gas Verification.

Comply with Method 7E 8.2.1[4]

8.2.2 Measurement System Preparation.

Comply with Method 7E 8.2.2[4]

8.2.3 Calibration Error Test.

After you have assembled, prepared, and calibrated your sampling system and analyzer(s), you must conduct a 3-point analyzer Calibration Error test (or a 3-point System Calibration Error test for dilution systems) before the first run. Introduce the Low-, Mid-, and High-Level Calibration Gases sequentially. For non-dilution-type Measurement Systems, introduce the gases in Direct Calibration Mode. For dilution-type Measurement Systems, introduce the gases in system calibration mode.

(1) For non-dilution systems, you may adjust the system to maintain the correct flow rate at the analyzer(s) during the test, but you may not adjust for any other purpose. For dilution systems, you must operate the Measurement System at the appropriate dilution ratio during all System Calibration Error checks and may make only the adjustments necessary to maintain the proper ratio.

(2) Record the analyzer's response to each Calibration Gas on a form like Table OTM-52A-1. For each Calibration Gas, calculate the analyzer Calibration Error using Equation OTM-52A-1 in section 12.2 or the System Calibration Error using Equation OTM-52A-3 in section 12.4 (as applicable). The Calibration Error specification in section 13.1 must be met for the Low-, Mid-, and High-Level Calibration Gases. If the Calibration Error specification is not met, take corrective action and repeat the test until an acceptable 3-point calibration is achieved.

(3) This test remains valid for 5 days or until an analyzer has been replaced.

(4) Repeat section 8.2.4 (Calibration Error Test) for each target analyte (i.e., CO_2, CO, and HC.

8.2.4 Initial System Bias Check.

8.2.4.1 For CO, before sampling begins, determine whether the High or Mid-Level Calibration Gas best approximates the emissions and use it as the upscale gas. Introduce the upscale gas at the probe upstream of all sample conditioning components in System Calibration Mode. Record the time it takes for the measured concentration to increase to a value that is at least 95 percent or within 0.5 ppmv (whichever is less restrictive) of a stable response for the upscale gases. Continue to observe the gas concentration reading until it has reached a final, stable value. Record this value on a form like Table OTM-52A-2.

8.2.4.2 Next, introduce the Low-Level Calibration Gas in System Calibration Mode and record the time required for the concentration response to decrease to a value that is within 5.0 percent or 0.5 ppmv (whichever is less restrictive) of the certified Low-Level Calibration Gas concentration. If the Low-Level Calibration Gas is a Zero Calibration Gas, use the procedures described above and observe the change in concentration until the response is 0.5 ppmv or 5.0 percent of the upscale gas concentration (whichever is less restrictive).

8.2.4.3 Continue to observe the Low-Level Calibration Gas reading until it has reached a final, stable value and record the result on a form like Table OTM-52A-2. Operate the Measurement System at the normal sampling rate during all System Bias checks. Make only the adjustments necessary to achieve proper Calibration Gas flow rates at the analyzer.

8.2.4.4 From this data, calculate the Measurement System Response Time (see section 8.2.5) and then calculate the initial System Bias using Equation OTM-52A-2 in section 12.3. For dilution systems, calculate the System Calibration Error in lieu of System Bias using Equation OTM-52A-3 in section 12.4. See Section 9, Table 9-1 for acceptable performance criteria for System Bias. If the initial System Bias (or System Calibration Error) specification is not met, take corrective action. Then, you must repeat the applicable initial System Bias (or 2-point System Calibration Error) check until acceptable results are achieved, after which you may begin sampling.

(NOTE: For dilution-type systems, data from the 3-point System Calibration Error test described in section 8.2.3 may be used to meet the initial 2-point System Calibration Error test requirement of this section, if the Calibration Gases were injected as described in this section, and if response time data were recorded).

8.2.4.5 Repeat section 8.2.7.1-8.2.4.4 for HC.

8.2.4.6 For CO_2, before sampling begins, determine whether the High or Mid-Level Calibration Gas best approximates the emissions and use it as the upscale gas. Introduce the upscale gas at the probe upstream of all sample conditioning components in system calibration mode. Record the time it takes for the measured concentration to increase to a value that is at least 95 percent or within 0.5 ppmv (whichever is less restrictive) of a stable response for the upscale gases. Continue to observe the gas concentration reading until it has reached a final, stable value. Record this value on a form like Table OTM-52A-2.

8.2.4.7 Next, introduce the Near-Zero Calibration Gas in System Calibration Mode and record the time required for the concentration response to decrease to a value that is within 5.0 percent or 0.5 ppmv (whichever is less restrictive) of the certified Near-Zero Calibration Gas concentration. Continue to observe Near-Zero Calibration Gas reading until it has reached a final, stable value and record the result on a form like Table OTM-52A-2. Operate the measurement system at the normal sampling rate during all System Bias checks. Make only the adjustments necessary to achieve proper Calibration Gas flow rates at the analyzer.

8.2.4.8 Next, repeat section 8.2.4.6 and 8.2.4.7 using the Near-Zero Gas as the High/Mid-level Gas and Zero-Gas as Near-Zero Gas respectively.

8.2.4.9 From this data, calculate the Measurement System Response Time (see section 8.2.5) and then calculate the initial System Biases (including both high-range and low-range biases for CO_2) using Equation OTM-52A-2 in section 12.3. For dilution systems, calculate the Calibration Errors (including both high-range and low-range Calibration Errors for CO_2) in lieu of System Biases using Equation OTM-52A-3 in section 12.4. See Section 9, Table 9-1 for acceptable performance criteria for the System Biases. If the initial System Biases (or System Calibration Errors) specification are not met, take corrective action. Then, you must repeat the applicable initial System Bias (or 2-point System Calibration Error) check until acceptable results are achieved, after which you may begin sampling.

(NOTE: For dilution-type systems, data from the 3-point System Calibration Error test described in section 8.2.3 may be used to meet the initial 2-point System Calibration Error test requirement of this section, if the Calibration Gases were injected as described in this section, and if response time data were recorded).

8.2.5 Measurement System Response Times.

Comply with Method 7E 8.2.6[4]

8.2.6 Ambient Background Concentration

Ambient background concentration can be either determined by direct sampling (See 8.2.6.1-8.2.6.3) or using conservatively assumed fixed values of 1 ppmv for HC, 0.05% CO_2 and 0 ppmv CO.

8.2.6.1 Conduct a pre-test run ambient background concentration determination of each analyte (CO, CO_2 and HC). Place the sampling probe within 1 meter of the air inlet to the enclosed combustion device. Collect the ambient background concentrations of all analytes for at least four times the Measurement System Response Time or until the values of each target analyte have stabilized (whichever is longer). Record the measured concentration of each target analyte. Determination of ambient background concentration must be done by introducing the background sample directly into the analyzer and cannot be conducted while utilizing a dilution system.

8.2.6.2 Conduct a post-test run ambient background concentration determination of each analyte (CO, CO_2 and HC). Place the sampling probe within 1 meter of the air inlet to the enclosed combustion device. Collect the ambient background concentrations of all analytes for at least four times the Measurement System Response Time or until the values of each target analyte have stabilized (whichever is longer). Record the measured concentration of each target analyte. Note, for multiple successive test runs the post-run ambient background determination can be used as the pre-test run ambient background concentration determination for the following test run. Determination of ambient background concentration must be done by introducing the background sample directly into the analyzer and cannot be conducted while utilizing a dilution system.

8.2.6.3 Average the pre-test and post-test ambient background concentrations for each analyte and use these values for the ambient background concentrations (C_{back}) in the Section 12 calculations of this method.

8.3 Dilution-Type Systems—Special Considerations.

Comply with Method 7E 8.3[4]

8.4 Sample Collection Method.

8.4.1 Using a preinstalled sampling port, position the sampling probe at the centroid of the stack and begin sampling. Purge the system for a duration of at least two times the Measurement System Response Time before recording any data. Maintain the appropriate sample flow rate or dilution ratio (as applicable). You must record at least one data point per minute during the test run.

8.4.2 A Test Run must be at least 60 minutes in duration.

8.5 Post-Run System Bias Check and Drift Assessment

8.5.1 After each run, repeat the System Bias checks or 2-point System Calibration Error checks (See 8.2.4) to validate the run. Do not adjust the measurement system (other than to maintain the target sampling rate or dilution ratio) between the end of the run and the completion of the post-run System Bias or System Calibration Error check. Note that for all post-run System Bias or 2-point System Calibration Error checks, you may inject the low-level gas first and the upscale gas last, or vice-versa. You must perform a post-run System Bias or System Calibration Error check after each individual test run.

8.5.2 If you do not pass the post-run System Bias (or System Calibration Error) check, then the Test Run is invalid. You must diagnose and fix the problem and pass another System Bias (or 2-point System Calibration Error) check (Section 8.2.7) before repeating the test run. Record the System Bias (or System Calibration Error) results on a form like Table OTM-52A-2.

8.5.3 After each test run, calculate the low-level and upscale Drift, using Equation OTM-52A-4 in section 12.5. If the post-run low- and upscale bias (or 2-point System Calibration Error) and CO_2 Zero and Near-Zero bias checks are passed, but the low-or upscale Drift exceeds the specification in section 9.0, the Test Run data are valid, but a 3-point Calibration Error test and a System Bias (or 2-point System Calibration Error) check must be performed and passed before any more test runs are performed.

8.5.4 For dilution systems, data from a 3-point System Calibration Error test may be used to meet the pre-run 2-point System Calibration Error requirement for the first Test Run in a test sequence. Also, the post-run bias (or 2-point Calibration Error) check data may be used as the pre-run data for the next run in the test sequence at the discretion of the tester.

8.6 Post-Run Duty Cycle Assessment

After each run, an assessment of duty cycle must be completed to determine if the enclosed combustion device was operating for a sufficient period during the run to have valid results. Each data point (≤1 minute average) will need to be evaluated to determine if the combustion device was operational. For each data point, if the measured CO_2 (corrected to remove background and bias) exceeds 0.1%, the control device is deemed to be operational for that data point.

9.0 Quality Assurance and Quality Control

Table 9-1 summarizes the QA/QC performance criteria. The Status column indicates if the criteria is either Suggested (S), Mandatory (M), or is an Alternative (A).

Regarding Section 8.6 “Post-Run Duty Cycle Assessment”, see Table OTM-52A-3 for the duty cycle requirement. Also, the entire run is invalid if any Test Run that does not meet the required duty cycle from Table OTM-52A-3.

Table 9-1. Quality Assurance/Quality Control Criteria

Status	**Process or Element**	**QA/QC Specification**	**Acceptance Criteria**	**Checking Frequency**
S	Analyzer design	Analyzer resolution or sensitivity	<2.0% of full-scale range	Manufacturer design
M	Analyzer design	Analyzer minimum resolution	Carbon dioxide (Method 3a) – 0.01 %; Carbon monoxide (Method 10) – 1 ppm; Hydrocarbon Concentration (Method 25a) – 1 ppm;	Manufacturer design
M	Calibration gases	Traceability protocol	Valid certificate required uncertainty <2.0% of tag value	Each test
M		High-Level Gas	Equal to calibration span	
M		Mid-Level Gas	40-60% of calibration span	
M		Low-Level Gas	<20% of calibration span	
M		Near-Zero Gas	CO_2 2000-4000 ppmv	
M		Zero Gas.	<0.1 ppmv of organic material, <1 ppm CO and <1 ppm CO_2	
S	Data Recorder Design	Data resolution	Must be able to match the analyzer minimum resolution above	Manufacturer design
S	Sample Extraction	Probe material	Stainless steel or quartz	Each test
M	Sample Extraction	Probe, filter, and sample line temperature	1) For dry-basis analyzers, keep sample above the dew point by heating, prior to sample conditioning	Each test

			2) For wet-basis analyzers, always keep sample above dew point, by heating or dilution	Each test
S	Sample Extraction	Calibration valve material	Stainless steel	Each test
S	Sample Extraction	Sample pump material	Inert to sample constituents	Each test
S	Sample Extraction	Manifolding material	Inert to sample constituents	Each test
S	Moisture Removal	Equipment efficiency	<5% target compound removal	Verified through System Bias check
S	Particulate Removal	Filter inertness	Pass System Bias check	Each bias check
M	Analyzer & Calibration Gas Performance	Analyzer calibration error test (or 3-point system Calibration Error for dilution systems)	Within ±2.5 percent of the calibration span of the analyzer for the Low-, Mid- and High-level Calibration Gases	Before initial run and after a failed System Bias test or Drift test
A			Alternative specification: ≤0.5 ppmv absolute difference	
M	System Performance	System Bias (or pre- and post-run 2- point System Calibration Error for dilution systems)	Within ±5.0% of the analyzer calibration span for low-scale and upscale Calibration Gases. Within ±10.0% of the Near-Zero Calibration Gas for low-range CO_2 System Bias or Calibration Error tests for Zero and Near-Zero Calibration Gases.	Before and after each run
A	System Performance	Measurement System Response Time	Alternative specification: ≤0.5 ppmv absolute difference	During initial sampling system bias test
M			Determines purge time and ambient background sampling time	

M	System Performance	Drift	≤3.0% of calibration span for Low-level and Mid-level/High-level Gases ≤10.0% of Near-Zero Calibration Gas for Zero and Near-Zero Calibration Gases.	After each test run
A			Alternative specification: ≤0.5 ppmv absolute difference	
M	System Performance	Purge time	≥2 times system response time	Before starting the first run and when probe is removed from and re-inserted into the stack
M	System Performance	Stable sample flow rate (surrogate for maintaining system response time)	Within 10% of flow rate established during System Response Time check	Each run
M	Data Recording	Frequency	≤1 minute average	During each test run
S	Data Parameters	Sample concentration range	All 1-minute averages within 125% of calibration span	Each test run
M	Data Parameters	Average concentration for the run	Test Run average ≤calibration span	Each test run
M	Data Parameters	Duty Cycle	Requirements for Duty Cycle are found in Table OTM-52A-3	Each test run

10.0 Calibration and Standardization

10.1 The initial 3-point Calibration Error test as described in section 8.2.3 and the System Bias (or System Calibration Error) checks described in section 8.2.4 are required and must meet the specifications in Section 9 before you start the Test. Make all necessary adjustments to calibrate the gas analyzer and data recorder. Then, after the test commences, the System Bias or System Calibration Error checks described in section 8.5 are required before and after each run.

10.2 Comply with Method 7E Section 10.0.(2)[4]

11.0 Analytical Procedures

Comply with Method 7E Section 11.0[4]

12.0 Calculations and Data Analysis

You must follow the procedures for calculations and data analysis listed in this section.

12.1 Nomenclature.

The terms used in the equations are defined as follows:

ACE = Analyzer Calibration Error, percent of calibration span.

C_{Avg} = Average unadjusted gas concentration indicated by data recorder for the test run, ppmv.

C_{Back} = Average ambient background concentration, ppmv.

C_{Dir} = Measured concentration of a Calibration Gas (Zero, Near-Zero, Low, Mid, or High) when introduced in Direct Calibration Mode, ppmv.

C_{Gas} = Average effluent gas concentration adjusted for bias, ppmv.
C_{CO2} = Average carbon dioxide gas concentration adjusted for bias, ppmv.
C_{CO} = Average carbon monoxide gas concentration adjusted for bias, ppmv.
C_{HCC} = Average hydrocarbon gas concentration adjusted for bias, ppmv as methane.

C_M = Average of initial and final system calibration bias (or 2-point System Calibration Error) check responses for the upscale Calibration Gas, ppmv.

C_{MA} = Actual concentration of the upscale Calibration Gas, ppmv.

C_O = Average of the initial and final system calibration bias (or 2-point System Calibration Error) check responses from the Low-Level (or Zero) Calibration Gas, ppmv.

C_{OA} = Actual concentration of the Low-Level Calibration Gas, ppmv.

C_S = Measured concentration of a Calibration Gas (Zero, Near-Zero, Low, Mid, or High) when introduced in system calibration mode, ppmv.

C_V = Manufacturer/vendor certified concentration of a Calibration Gas (Zero, Near-Zero, Low, Mid, or High), ppmv.

CE% = Combustion efficiency percentage

CS = Calibration span, ppmv. For low-range CO_2 System Bias checks use the Near-Zero gas concentration. ppmv.

D = Drift assessment, percent of calibration span.

DC = Duty cycle of ECD operation during test period

DF = Dilution system dilution factor or spike gas dilution factor, dimensionless.

N_{DC} = is the number of data points that meets the definition of ECD operation (See Sections 8.6 and 12.9).

N_{SP} = is the number of data points in the entire test period.

SB = System Bias, percent of calibration span.

SB_i = Pre-run System Bias, percent of calibration span.

SB_{final} = Post-run System Bias, percent of calibration span.

SCE = System Calibration Error, percent of calibration span.

SCE_i = Pre-run System Calibration Error, percent of calibration span.

SCE_{Final} = Post-run System Calibration Error, percent of calibration span.

12.2 Analyzer Calibration Error.

For non-dilution systems, use Equation OTM-52A-1 to calculate the analyzer Calibration Error for the Low-, Mid-, and High-level Calibration Gases.

$$\mathrm{ACE} = \frac{\mathrm{C_{Dir}} - \mathrm{C_v}}{\mathrm{CS}} \text{ x } 100 \qquad \text{Eq. OTM-52A-1}$$

12.3 System Bias.

For non-dilution systems, use Equation OTM-52A-2 to calculate the System Bias separately for the low-level and upscale Calibration Gases. When determining the CO_2 low-range System Biases use the Near-Zero gas concentration (ppmv) for “CS”.

$$\mathrm{SB} = \frac{\mathrm{C_S} - \mathrm{C_{Dir}}}{\mathrm{CS}} \text{ x } 100 \qquad \text{Eq. OTM-52A-2}$$

12.4 System Calibration Error.

Use Equation OTM-52A-3 to calculate the System Calibration Error for dilution systems. Equation OTM-52A-3 applies to both the initial 3-point System Calibration Error test and the subsequent 2-point Calibration Error checks between test runs. In this equation, the term “Cs” refers to the diluted Calibration Gas concentration measured by the analyzer. When determining the CO_2 low-range System Calibration Error use the Near-Zero gas concentration (ppmv) for “CS”.

$$\mathrm{SCE} = \frac{(\mathrm{C_S} \text{ x } \mathrm{DF}) - \mathrm{C_V}}{\mathrm{CS}} \text{ x } 100 \qquad \text{Eq. OTM-52A-3}$$

12.5 Drift Assessment.

Use Equation OTM-52A-4 to separately calculate the low-level and upscale drift over each test run. For dilution systems, replace "SB_{final}" and "SB_i" with "SCE_{final}" and "SCE_i", respectively, to calculate and evaluate drift.

$$D = |SB_{final} - SB_i| \qquad \text{Eq. OTM-52A-4}$$

12.6 Effluent Gas Concentration (Methods 3A, 10 and 25A).

For each test run, calculate C_{avg}, the arithmetic average of all valid CO and HC concentration values (ppmv). Then adjust the value of C_{avg} (ppmv) for bias using Equation OTM-52A-5a if you use a non-zero gas as your Low-Level Calibration Gas, or Equation OTM-52A-5b if you use a Zero Gas as your Low-Level Calibration Gas.

$$C_{Gas} = \left(C_{avg} - C_{Back} - C_M\right)\frac{C_{MA}-C_{OA}}{C_M-C_O} + C_{MA} \qquad \text{Eq. OTM-52A-5a}$$

$$C_{Gas} = \left(C_{avg} - C_{Back} - C_O\right)\frac{C_{MA}}{C_M-C_O} \qquad \text{Eq. OTM-52A-5b}$$

For each test run, calculate a bias corrected value for each individual CO_2 concentration data point (C_{CO2_i}, where i is the i^{th} data point during the test run). For CO_{2_i} values that are greater than the Near-Zero Gas concentration use Equation OTM-52A-6a and use C_{MA}, C_M, C_{OA} and C_O from the high-range CO_2 bias check. For CO_{2_i} values that are equal or less than the Near-Zero gas concentration use Equation OTM-52A-6b and use C_{MA}, C_M and C_O from the low-range CO_2 bias check. If any $C_{CO2\_i\_corrected}$ value is less than zero, change that value to zero before proceeding to Equation OTM-52A-6c.

$$C_{CO2\_i\_corrected} = \left(C_{CO2\_i} - C_{Back} - C_M\right)\frac{C_{MA}-C_{OA}}{C_M-C_O} + C_{MA} \qquad \text{Eq. OTM-52A-6a}$$

$$C_{CO2\_i\_corrected} = \left(C_{CO2\_i} - C_{Back} - C_O\right)\frac{C_{MA}}{C_M-C_O} \qquad \text{Eq. OTM-52A-6b}$$

Average all bias corrected CO_2 concentration data points to get the Test Run average CO_2 ($C_{Gas(CO2)}$). Again, if any $C_{CO2\_i\_corrected}$ value is less than zero, change that value to zero before proceeding to Equation OTM-52A-6c.

$$C_{Gas(CO2)} = \sum_{i=1}^{N_{SP}} C_{CO2\_i\_corrected}/N_{SP} \qquad \text{Eq. OTM-52A-6c}$$

$$C_{CO_2} = C_{Gas(CO2)} \qquad C_{CO} = C_{Gas(CO)} \qquad C_{HCC} = C_{Gas(HCC)}$$

12.7 Method 25A Response Factor Correction

An FID response factor correction needs to be applied. The generic response factor (RF) is equal to 1.20[1]. In lieu of using the generic response factor, an analyzer specific response factor can be developed by following the procedure in Appendix A of this method and can be used in place of 1.20.

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[1] This response factor was developed by applying documented FID analyzer response factors to process simulated tank vapor flash gas compositions at oil and gas production facilities.

$$C_{HCC\_RF} = 1.20 * C_{Gas(HCC)}$$ Eq. OTM-52A-7

12.8 Combustion Efficiency.

Use Equation OTM-52A-8 to calculate the combustion efficiency of the enclosed combustor.

$$CE\% = \frac{C_{CO2}}{(C_{CO2}+C_{CO}+C_{HCC\_RF})} * 100$$ Eq. OTM-52A-8

Note: The analyte concentrations used in calculation of combustion efficiency can be done on either a wet or dry basis, it just needs to be consistent across all analytes.

12.9 Duty Cycle

Use Equation OTM-52A-9 to calculate the apparent duty cycle of the enclosed combustion device. Where N_{SP} is the total number of data points in the entire test period and N_{DC} is the number of data points that meets the following definition:

Number of data points where the measured CO_2 (corrected to remove background and bias) exceeds 0.1%.

$$DC = \frac{N_{DC}}{N_{SP}} * 100$$ Eq. OTM-52A-9

13.0 Method Performance

13.1 Calculation of Combustion Efficiency from Intermittent Operating Sources

For ECDs with intermittent operation the calculation of combustion efficiency can be done in one of two ways 1) calculate combustion efficiency using data only from periods of operation or 2) calculate combustion efficiency using the entire 60-minute test period. Because of how combustion efficiency is calculated both approaches generate substantially close results, however, slight differences can occur. The differences between the two calculation approaches are driven by the HC analyzer minimum resolution and how ECD operation is defined using outlet only concentrations. Using the Duty Cycle Assessment outlined in Section 8.6 and the Duty Cycle Requirements in Table OTM-52A-3 ensure that the differences between combustion efficiency calculation approaches are less than 1% in the worst-case scenario.

13.2 Method 25A Response Factor Correction

The generic Method 25A response factor correction applied in Section 12.8 was generated based on flame ionization detector responses and waste gas compositions measured during the development of this method. Appendix A to this method describes the waste gas composition used to generate this generic Method 25A response factor as well as an approach to determine analyzer specific response factors based on this assumed waste gas composition. By determining a Method 25A analyzer specific response factor as outlined in Appendix A and using that analyzer specific response factor will increase the accuracy of test average combustion efficiency.

14.0 Pollution Prevention [Reserved]

15.0 Waste Management [Reserved]

16.0 Alternative Procedures [Reserved]

17.0 References

1. *Method 1 – Sample and Velocity Traverses for Stationary Sources*
2. *Method 3A – Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)*
3. *Method 4 – Determination of Moisture Content in Stack Gases*
4. *Method 7E – Determination of Nitrogen Oxides Emissions from Stationary Sources (Instrumental Analyzer Procedure)*
5. *Method 10 – Determination of Carbon Monoxide Emissions from Stationary Source*
6. *Method 25A—Determination of Total Gaseous Organic Concentration Using a Flame Ionization Analyzer*
7. *"EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards" September 1997 as amended May 2012, EPA-600/R-12/531.*

18.0 Tables, Diagrams Flowcharts, and Validation Data

Table OTM-52A-1

Analyte	Range	Calibration Gas Conc. (ppmv)	Analyzer Response ppmv CH_4	Analyzer Response ppmv CO_2	Analyzer Response ppmv CO	Percent of Span
CH_4	Low/Zero			■	■	
	Mid			■	■	
	Span			■	■	
CO_2	Low/Zero		■		■	
	Mid		■		■	
	Span		■		■	
CO	Low/Zero		■	■		
	Mid		■	■		
	Span		■	■		

Table OTM-52A-2

		Pre-test		Post-test		
Calibration Gas Level	Certified Gas Concentration	System Response	System Bias (% of span)	System Response	System Bias (% of span)	Drift (% of span)
Low-Level Gas						

Upscale level gas						
Zero Gas (CO2 only)						
Near-Zero Gas (CO2 only)						

Table OTM-52A-3

Duty Cycle Requirements	
HC Analyzer Minimum Resolution	Required Duty Cycle (%)
≤1 ppm	≥ 5%

OTM-52A Appendix A: Procedure for Determination of Analyzer Specific Response Factor

1.0 Scope and Applicability

This procedure is used to determine an analyzer specific response factor for use with OTM-52A. The analyzer specific response factor converts the analyzer response to that of hydrocarbon measurements on a single carbon basis. This procedure is used with Method 25A analyzers.

2.0 Summary of Procedure

A Method 25A analyzer samples a gas mixture, that is typical of oil and natural gas production facility waste stream, to determine the unique analyzer specific response factor. You must meet the design specifications, analyzer performance requirements, and test procedures of this procedure to ensure reliable determination of analyzer specific response factors. The concentration measurement device may be referred to as a “analyzer” or an “instrument”, with these terms used interchangeably in this method.

3.0 Definitions

3.1 *Calibration Gas* means a gas mixture containing an analyte or analytes at a known concentration and produced and certified in accordance with “EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards,” September 1997, as amended May, 2012, EPA-600/R-12/531[7] or more recent updates. The system verification tests in OTM 52A require the use of Calibration Gas prepared according to this protocol. In the absence of reference materials to which a protocol gas may be made traceable, implementors of this method may follow Reference Method 205, as appropriate, to generate the Calibration Gases needed for use with this method.

3.1.1 *Methane Calibration Span (See Section A7.1.1)*

3.1.2 *Response Factor Gas Mixture (See Section A7.1.2)*

4.0 Interferences [Reserved]

5.0 Safety

This procedure may require you to work with hazardous materials and equipment in hazardous conditions. This test procedure may not address all the safety problems associated with its use. It is the responsibility of the user of this procedure to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to performing this procedure. We encourage you to establish safety measures before using the procedure. Among other precautions, you should become familiar with the safety recommendations in the gas analyzer user's manual. Occupational Safety and Health Administration (OSHA) regulations concerning pressurized gas cylinders and noxious gases may apply. All Calibration Gases must be handled with utmost care and with adequate ventilation.

6.0 Equipment

The performance criteria in this method will be met or exceeded if you are properly using equipment designed for this application.

6.1 Measurement System Components

6.1.1 *Calibration Gas Manifold*. Prepare an apparatus to allow the introduction of Calibration Gases directly to the gas analyzer(s). The apparatus should be able to vent excess Calibration Gas.

6.1.2 *Organic Concentration Analyzer* (Method 25A)[6]. You may use a flame ionization analyzer (FIA) capable of meeting or exceeding the specifications of this method and the analyzer performance requirements in Appendix A, Table A9-1.

6.1.4 *Data Recorder.* A computerized data acquisition system, digital recorder, or data logger for recording measurement data may be used. The minimum data recording requirement is one measurement value every 10 seconds.

7.0 Reagents and Standards

7.1 Calibration Gases

7.1.1 Methane Calibration Span.

The Calibration Gas for the gas analyzer must be methane (CH_4) in N_2 or CH_4 in air. The Calibration Gas must be certified (or recertified) within an uncertainty of 2.0 percent in accordance with "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards" September 1997, as amended May 2012, EPA-600/R-12/531[7]. In the absence of reference materials to which a protocol gas may be made traceable, implementors of this method may follow Reference Method 205, as appropriate, to generate the Calibration Gases needed for use with this method.

For this procedure a Calibration Gas mole concentration of about 2,000 ppm methane is recommended. However, the methane Calibration Gas used to meet Section 7.1.1 of OTM-52A is also acceptable.

7.1.2 Response Factor Gas Mixture.

7.1.2.1 The gas mixture used to determine analyzer specific response factor is dependent on the type of waste gas emission sources being combusted by enclosed combustion device (ECD) using OTM-52A. You may use one of the two most common mixtures representing emission sources at oil and natural gas production facilities include tank vapors and dehydration unit vapors.

7.1.2.2 For analyzers used to test ECDs combusting oil tank vapor streams the analyte and concentrations listed under "Tank Vapors - Molar Conc. (ppm)" in Table A7-1 must be used as an approximate gas mixture for the determination of the analyzer specific response factor. This composition must also be used for analyzers testing ECDs combusting comingled oil tank and dehydration unit vapor streams.

7.1.2.3 For analyzers that will be used to test ECDs combusting dehydration unit vapor streams the analyte and concentrations listed under "Dehydration Unit Vapors - Molar Conc. (ppm)" in Table A7-1 must be used as an approximate gas mixture for the determination of the analyzer specific response factor.

Table A7-1 Example Total Single Carbon Concentration Mixture

	Tank Vapors		Dehydration Unit Vapors	
Analyte	Molar Conc. (ppm)	Single Carbon Conc. (ppm)	Molar Conc. (ppm)	Single Carbon Conc. (ppm)
Methane	1,250	1,250	1,600	1,600
Ethane	250	500	150	300
Propane	200	600	100	300
Butane	150	600	50	200
Pentane	50	250	30	150
Hexane	50	300	30	180
Heptane	5	35	2.5	18
Total =	-	**3,535**	-	**2,748**

Note: Table A7-1 above is an example of how to determine "total single carbon concentration."

7.1.2.4 For each specific response factor determination an exact "total single carbon concentration" must be determined using the exact concentrations of the gas mixture provided by the gas provider. See Section 12.3 for the calculation of "total single carbon concentration."

7.1.3 Zero Gas. High purity nitrogen with less than 0.1 part per million by volume (ppmv) of organic material (propane or carbon equivalent) or less than 0.1 percent of the span value, whichever is greater.

8.0 Test Procedure

8.1 Initial Measurement System Preparation

8.1.1 Assemble, prepare, and precondition the measurement system according to your standard operating procedure.

8.1.2 Conduct an initial calibration of the analyzer per the manufacturer(s) directed calibration procedures using the methane Calibration Gas identified in section A7.1.1.

8.1.3 Adjust the system to achieve the correct sampling rate or dilution ratio (as applicable).

8.2 Leak Check.

8.2.1 After you have assembled, prepared, and calibrated your measurement system and analyzer, you must conduct a leak check by injecting Zero Gas oxygen free gas through the measurement system.

8.2.2 You must record the result of the check and verify that the O_2 reading meets the leak check performance criteria in Section A9.0, Table A9-1.

8.3 Initial Calibration Bias Check

8.3.1 Operate the measurement system at the normal sampling rate during all calibration bias checks. Make only the adjustments necessary to achieve proper Calibration Gas flow rates at the analyzer.

8.3.2 Introduce the methane Calibration Gas to the measurement system. Continue to observe the gas concentration reading until it has reached a final, stable value. Record this value.

8.3.3 Introduce the Zero Gas to the measurement system. Continue to observe the Zero Gas reading until it has reached a final, stable value and record the result. Operate the measurement system at the normal sampling rate during all calibration bias checks. Make only the adjustments necessary to achieve proper Calibration Gas flow rates at the analyzer.

8.3.4 Systems must meet the calibration bias check performance criteria in Section A9.0, Table A9-1.

8.4 Analyzer Response Factor Testing

8.4.1 Introduce the appropriate gas mixture from Section A7.1.2 to the measurement system.

8.4.2 Continue to observe the gas concentration reading until it has reached a final, stable value for at least 2 minutes.

8.4.3 Record this value.

8.5 Post System Bias Check

8.5.1 Introduce the methane Calibration Gas to the measurement system.

8.5.2 Continue to observe the gas concentration reading until it has reached a final, stable value.

8.5.3 Record this value.

8.5.4 Introduce the Zero Gas to the measurement system. Continue to observe the Zero Gas reading until it has reached a final, stable value and record the result.

8.5.5 Operate the measurement system at the normal sampling rate during all System Bias checks. Make only the adjustments necessary to achieve proper Calibration Gas flow rates at the analyzer.

9.0 Quality Assurance and Quality Control

Table 9-1 summarizes the QA/QC performance criteria. The Status column indicates if the criteria is either Suggested (S), Mandatory (M), or is an Alternative (A).

Table A9-1. Quality Assurance/Quality Control Criteria

Status	**Process or Element**	**QA/QC Specification**	**Acceptance Criteria**	**Checking Frequency**
M	Analyzer design	Analyzer minimum resolution	Hydrocarbon Concentration (Method 25A) – 0.01 %;	Manufacturer design.
M	Calibration Gases	Traceability protocol	Valid certificate required uncertainty <2.0% of tag value	Each test
M	System Performance	Leak check	O_2 reading is less than or equal to 0.2 percent	Each test
M	System Performance	Calibration bias check	Within ±5.0% of the analyzer calibration span for span and zero Calibration Gases	Before and after each test
S	Data Recorder Design	Data resolution	≤0.5% of full-scale range	Manufacturer design
M	Data Recording	Frequency	≤10 second average	During test

10.0 Calibration and Standardization

10.1 The initial System Bias check described in section A8.3 are required and must meet the specifications in section 9 before you start analyzer response factor testing.

10.1.1 Make all necessary adjustments to calibrate the gas analyzer and data recorder.
A10.1.2 After the test commences, the System Bias check described in section A8.5 is required after each test run.

10.2 You must maintain a copy of the manufacturer's certification of the Calibration Gases used in the analyzer response factor testing.

10.2.1 This certification must include the documentation requirements in the EPA Traceability Protocol For Assay and Certification of Gaseous Calibration Standards, September 1997, as amended May, 2012[1].
A10.2.2 When Method 205 is used to produce diluted Calibration Gases, you must document that the specifications for the gas dilution system are met for the test. You must also maintain the date of the most recent dilution system calibration against flow standards and the name of the person or manufacturer who carried out the calibration.

11.0 Analytical Procedures

11.1 Because sample collection and analysis are performed together (see Section 8), additional discussion of the analytical procedure is not necessary.

12.0 Calculations and Data Analysis

You must follow the procedures for calculations and data analysis listed in this section.

12.1 Nomenclature.

The terms used in the equations are defined as follows:

C_{Avg} = Average unadjusted gas concentration indicated by data recorder during the analyzer response factor testing (Section A8.4), ppmv.

C_{Gas} = Average gas concentration adjusted for bias, ppmv.

C_M = Average of initial and final system calibration bias (or 2-point System Calibration Error) check responses for the Methane Calibration Gas, ppmv.

C_{MA} = Actual concentration of the Methane Calibration Gas, ppmv.

C_O = Average of the initial and final system calibration bias (or 2-point System Calibration Error) check responses from the Zero Gas, ppmv.

SCC_{Tanks} = Total single carbon concentration using the tank vapor composition profile.

SCC_{Dehy} = Total single carbon concentration using the dehydration unit vapor composition profile.

12.2 Effluent Gas Concentration

Adjust the value of C_{Avg} (ppmv) for bias using Equation OTM-52A-App.A-1

$$C_{Gas} = \left(C_{avg} - C_O\right)\frac{C_{MA}}{C_M - C_O} \qquad \text{Eq. OTM-52A-App.A-1}$$

A12.3 Calculation of Total Single Carbon Concentration

12.3.1 Multiply the molar concentration of each analyte by its carbon number to get each analyte's single carbon concentration (i.e. multiply methane concentration by 1, multiply ethane concentration by 2, multiply propane concentration by 3, etc). An example of analyte specific single carbon concentrations can be seen in Table A7-1.

12.3.2 Sum the analyte specific single carbon concentrations to get a "total single carbon concentration" or SCC. If the Response Factor Gas Mixture composition is based on the tank vapor concentration profile from Table A7-1 the total single carbon concentration is defined as SCC_{Tanks} and if the Response Factor Gas Mixture composition is based on the dehydration unit vapor concentration profile from Table A7-1 the total single carbon concentration is defined as SCC_{Dehy}.

12.3.3 Use the calculated SCC_{Tanks} value in equation OTM-52A-App.A-2 and SCC_{dehy} value in equation OTM-52A-App.A-3.

12.4 Response Factor Determination

Determine the analyzer specific response factor using the following equations below. For tests using the tank vapor gas mixture use Equation OTM-52A-App.A-2 and the "total single carbon concentration" calculation methodology in section A12.3 for the exact concentrations listed on the gas mixture cylinder used for testing (SCC_{Tanks}). For tests using dehydration unit vapor gas mixture use Equation OTM-52A-App.A-3 and the "total single carbon concentration" calculation methodology in section A12.3 for the exact concentrations listed on the gas mixture cylinder used for testing (SCC_{Dehy}).

$$RF_{TOC-Tanks} = {}^{SCC_{Tanks}}\!/_{C_{Gas}} \qquad \text{Eq. OTM-52A-App.A-2}$$

$$RF_{TOC-Dehy} = {}^{SCC_{Dehy}}\!/_{C_{Gas}} \qquad \text{Eq. OTM-52A-App.A-3}$$

When testing using OTM-52A use the analyzer specific response factor calculated above in lieu of the generic response factor values listed in OTM-52A, Section 12.8 (RF = 1.28) for Method 25A analyzers and OTM-52A.

13.0 References

1. "EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards" September 1997 as amended May 2012, EPA-600/R-12/531.