California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP-206.2

Determination of Emission Factor for Standing Loss Control Vapor Recovery Systems Using Processors at Gasoline Dispensing Facilities with Aboveground Storage Tanks

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Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

For the purpose of this procedure, the term "ARB" refers to the California Air Resources Board, and the term "Executive Officer" refers to the ARB Executive Officer or his or her authorized representative or designee.

1. PURPOSE AND APPLICABILITY

The purpose of this procedure is to quantify the Standing Loss Control emission factor for a processor and pressure vacuum (P/V) vent valve used to control gasoline vapors from an aboveground storage tank (AST). This procedure is applicable to the determination of compliance with the Standing Loss Control (SLC) performance standards specified in Vapor Recovery Certification Procedure, CP-206, “Certification Procedure~~s~~ for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Aboveground Storage Tanks.”

Any modifications to the equipment and/or procedures used in execution of this test procedure are only permissible with prior written approval by the Executive Officer.

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

During episodes of no Phase I or Phase II activity, the SLC emission factor is determined by calculating the mass of hydrocarbons emitted (in units of pounds of hydrocarbon emissions per 1,000 gallons ullage per day) at the following test points:

1. Test Point 1_{outlet} is the hydrocarbon concentration at the exhaust or outlet of a non-destructive or destructive processor.
2. Test Point 1_{inlet} is the hydrocarbon concentration at the inlet of a destructive processor
3. Test Point 2 is the hydrocarbon concentration from the P/V valve on

the AST vent pipe(s).

3. BIASES AND INTERFERENCES

3.1 Failure to test a Standing Loss Control system that does not meet the Static Pressure Performance test requirements (TP-206.3) may bias the test toward either compliance or noncompliance, and shall invalidate the Standing Loss Control emission factor test results.

3.2 Phase I and Phase II transfers shall not be permitted during the 24-hour testing episode.

4. RANGE AND MEASUREMENT ERROR

4.1 This procedure can generate emission factors in the range of 0.00 to greater than 15.0 lbs/1000 gallons.

4.2 The maximum emission factor error is calculated to be 13%.

5. EQUIPMENT

Alternatives to the required equipment shall only be used subject to prior written approval by the Executive Officer.

5.1 Continuous Gas Analyzers. Continuous Gas analyzers shall have the following characteristics and capabilities:

5.1.1 Depending on the test point location of the hydrocarbon (HC) measurement, the HC analyzer shall be capable of continuously measuring HC concentrations from 100 ppm to 80 percent by volume using propane as a calibration gas, or 75 ppm to 60 percent by volume using butane as a calibration gas.

5.1.2 Hydrocarbon analyzers at test point~~s~~ 1 and 2 shall use a flame ionization detector (FID) or non-destructive infrared (NDIR) detection principle. Hydrocarbon analyzers at test point 1_{inlet} shall use a non-destructive detection principle, specifically, non-dispersive infrared (NDIR). Hydrocarbon analyzers at test point 1_{outlet} may use either FID or NDIR depending on the expected range of the hydrocarbon concentration at this test point. A sufficient number of hydrocarbon analyzers shall be used to provide for simultaneous and continuous measurements at all applicable test points. The Executive Officer may allow alternative measurement methods if the equivalency of the alternative method is established using the procedures in US EPA Method 301 – "*Field Validation of Pollutant Measurement Methods From Various Waste* Media."

5.1.3 Additional analyzers for ASTs with destructive vapor processors: If processor exhaust flow rate is to be determined by US EPA Method 2B, 40 CFR, Part 60, Appendix A, then the following additional analyzers are needed for Test Point 1_{outlet}.

5.1.3.1 Carbon Monoxide (CO) analyzer: As specified in ARB Method 100, title 17, CCR, section 94114, or US EPA Method 10, “Determination of Carbon Monoxide Emissions From Stationary Sources”, 40 CFR Part 60, Appendix A. The CO analyzer shall be capable of continuously measuring CO concentrations from zero to 1000 ppm by volume.

5.1.3.2 Carbon Dioxide (CO_2) analyzer: As specified in ARB Method 100 or US EPA Method 3A, “Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)”, 40 CFR Part 60, Appendix A. The CO_2 analyzer shall be capable of continuously measuring CO_2 concentrations from zero to 10% by volume.

5.1.4 Continuous analyzer calibration gas standards: Cylinders of certified, or National Institute of Standards and Technology (NIST) traceable, calibration gases containing the compound of interest in nitrogen, capable of providing calibration for the analyzer ranges recommended in Table 5-1.

5.1.5 Gas Dilution System: A gas dilution system which meets the requirements of EPA Method 205, Verification of Gas Dilution Systems for Field Instrument Calibrations, CFR 40, Part 51, Appendix M (62 FR 32502, June 16, 1997) may be used to provide low-level calibration gases from a high-level calibration gas. The calibration gas used with a gas dilution system shall be an United States Environmental Protection Agency (US EPA) Protocol gas. A gas dilution system which meets the requirements of US EPA Method 205 may be used for all analyzer calibrations and sampling system bias checks. If a diluter is used, it must be included in the calibration of the analyzer(s).

Table 5-1
Recommended Continuous Analyzer Concentration Ranges

Test Point	Pollutant	Operating Principle	Ranges	Usable Concentration Range
Non-Destructive Processors				
1_{outlet}	HC	FID or NDIR	0 to 5.0% 0 to 10%	5,000 ppm to 4.75% 10,000 ppm to 9.5%
2	HC	FID or NDIR	0 to 500 ppm 0 to 5,000 ppm 0 to 5.0%	50 to 475 ppm 500 to 4,750 ppm 5,000 ppm to 4.75%
Destructive Processors				
1_{inlet}*	CO	NDIR	0 to 500 ppm	50 to 475 ppm
1_{inlet}*	CO_2	NDIR	0 to 5.0% 0 to 10.0%	5,000 ppm to 4.75% 1.0% to 9.5%
1_{inlet}*	HC	NDIR	0 to 10% 0 to 100%	1.0 to 9.5% 10 to 95%
1_{outlet}	HC	FID	0 to 500 ppm 0 to 5,000 ppm	50 to 475 ppm 500 to 4,750 ppm
2	HC	FID or NDIR	0 to 500 ppm 0 to 5,000 ppm	50 to 475 ppm 500 to 4,750 ppm 5,000 ppm to 4.75%

* destructive processor only

Each range requires three calibration gases:

(1) High-Range Gas: Concentration between 80 and 100% of range.
(2) Mid-Range Gas: Concentration between 40 and 60% of range.
(3) Zero Gas: Nitrogen with a hydrocarbon concentration less than 0.25% of range.

5.1.6 Sample lines shall be constructed of Teflon or other material that does not absorb or otherwise alter the sample gas.

5.2 Data Acquisition System/Data Recorder: Provide a permanent record of continuous analyzer concentration, temperature and pressure data using a strip chart recorder, a data logger or another electronic data acquisition system. Data shall be collected at intervals not to exceed one second and averaged at intervals not to exceed one-minute. The strip chart, or the data logger or data acquisition system shall have a resolution of 0.5 percent of the analyzer range.

5.3 Volumetric Flow Rate Meters: Recommended volume meter ranges for each test point are shown in Table 5-2.

Table 5-2
Volume Meter Specifications

Test Point	Typical Range Measured (cfm)	Recommended Meter Range (cfh)
1_{inlet} 1_{outlet}	System specific	Determined during evaluation
2	Vent sleeve sweep: 1 to 2	0 to 800

The volume meters are positive displacement or turbine meters that meet the following requirements:

5.3.1 Backpressure limits (BPL):

(a) Meters with a manufacturer specified maximum flow rating of greater than 1000 CFH shall demonstrate BPL < 1.10 inches WC at a flow rate of 3,000 CFH or the maximum flow rating specified by the manufacturer, whichever is less, and BPL < 0.05 inches WC at a flow rate of 30 CFH.

(b) Meters with a manufacturer specified maximum flow rating of less than 1000 CFH shall demonstrate BPL < 0.70 inches water column at a flow rate of 800 CFH and BPL < 0.04 inches WC at a flowrate of 16 CFH.

5.3.2 The error of the meter shall be less than 2% of the true volume over the entire range of flow rates for which it will be used.

5.3.3 Depending on the Test Point of the processor, install a manifold at either the meter inlet or meter outlet. The manifold shall be equipped with a taps to accommodate the following:

(a) Collection of sample for analyzer and sample return.

(b) Installation of pressure measurement device.

(c) Installation of thermocouple with a range of 0 to 200 deg F or suitable for the temperature being measured.

5.3.4 Pressure Measurement Devices for Volume Meters.

Transducers, liquid manometers, Magnahelic gauges, electronic manometers, or equivalent with a design range suitable for the pressure being measured. The error of the pressure measuring device shall not exceed 3% of the true pressure over the range of pressures to be quantified.

5.3.5 Temperature Measurement Device for Volume Meters.

Thermocouple or thermometer with a design range of 0 to 200 ^{0}F or suitable for the temperature being measured. The error in the temperature measurement shall not exceed 4 degrees Fahrenheit.

5.4 Vapor Processor (Test Point 1).

5.4.1 Processor inlet and outlet sample pumps: Carbon vane, metal bellows or other pump design which do not provide a source or sink for hydrocarbon vapors, capable of at least 1 cfm during sampling.

5.4.2 Processor outlet sample probe (destructive processors): The probe shall have an inside diameter of 6 mm or larger and shall be constructed of quartz, borosilicate glass, stainless steel, aluminum oxide or porcelain. An internal or external probe filter may be used. As necessary, provisions should be made for back flushing the filter to remove particulate build-up.

5.4.3 Processor outlet sample conditioner (destructive processors): The sample conditioner shall be capable of reducing the sample gas temperature to 15 °C (60 °F), or to 11 °C (20 °F) lower than the ambient temperature, whichever is lower. All parts of the conditioner exposed to the sample shall be glass, stainless steel or teflon. The sample gas shall not be bubbled or dispersed through the condensate such that minimum contact shall be maintained between any condensate and the sample gas. A temperature gauge shall be used to determine the temperature of the condenser outlet.

5.5 P/V Vent Sleeve Sampling Apparatus (Test Point 2).

5.5.1 A sleeve (Figure 1) that captures the entire mass of gasoline vapor emitted at the storage tank vent pipe(s). The Executive Officer may approve in writing other designs if demonstrated to produce a pressure drop of less than 0.01 inch WC inside the sleeve and within one inch WC of the outer surface of the tank vent or tank vent P/V valve at a sleeve rate of 1 - 2 cfm. Sleeves must be tested before use in the field to validate the collection efficiency of the sleeve and accuracy of the hydrocarbon mass calculation. Testing shall occur as described in Section 5.5.1.1 below. **CAUTION: Ensure that the exhaust from the vent sleeve pump and vent sleeve analyzers are directed to a safe location and that hazards associated with exposure to gasoline and gasoline vapors are addressed.**

5.5.1.1 Meter propane calibration gas with a concentration of 40 to 60% by volume through a mass flow controller (a bubble meter or precision rotameter with sufficient accuracy is acceptable) at approximately 200 ml/min and into the inlet of the simulated vent pipe discharging to the vent sleeve sample apparatus equipped with vent sleeve HC analyzers. Determine the time that calibration gas was allowed to enter the sleeve and calculate the mass of propane entering the sleeve from the flow rate determined from the mass flow controller and the known calibration gas concentration. The mass of HC entering the vent sleeve must be +5% of the mass of HC collected from the vent sleeve sampling apparatus volume, temperature, pressure and HC concentration measurements and the data recording system and mass calculation algorithms.

5.5.2 Sleeve Tubing: Teflon. Care should be taken that a representative sample of the sleeve flow is routed to the analyzer. The unanalyzed portion of sample flow shall be safely discharged to the atmosphere.

5.5.3 Sleeve Sample Pump: Carbon vane, metal bellows or other pump designs which do not provide a source of or sink for hydrocarbon vapors, capable of 1 to 2 cfm.

5.6 Ambient Temperature Measurement: Use a temperature measurement device capable of measuring ambient temperature with a resolution of 2 deg F.

5.7 Ambient Pressure Measurement: Use a pressure measurement device capable of measuring atmospheric pressure to within 2.5 mm Hg.

5.8 Gasoline Containers for RVP Samples: As specified in Section 2296 of title 13, CCR.

6. CALIBRATIONS

All measurement devices shall be calibrated as described below. A record of all calibrations shall be maintained.

6.1 Continuous Gas Analyzers: Calibration curves shall be produced no longer than six months before testing using ARB’s SOP 054, “Standard Operating Procedure for the Multilevel Calibrations of Pollutant Gas Analyzers” (September 1997). Field calibrations during testing shall be conducted as described in Section 8 and Section 10.

6.2 Calibration Gases:

6.2.1 Certification. The calibration gases shall be certified according to one of the following options:

6.2.1.1 The EPA Traceability Protocol for Assay and Certification of Gaseous Calibration Standards (EPA-600/R-97/121, September 1997), or

6.2.1.2 To an analytical accuracy of ± 2% percent, traceable to a reference material approved by the National Institute of Standards and Technology (NIST) and recertified annually.

6.2.2 Documentation: Information on calibration gas cylinders shall be entered into a log identifying each cylinder by serial number. Sufficient information shall be maintained to allow a determination of the certification status of each calibration gas and shall include: (1) the data put in service, (2) assay result, (3) the dates the assay was performed, (4) the organization and specific personnel who performed the assay, and (5) the date taken out of service.

6.3 Volume Meters: All volume meters shall be calibrated on an annual basis against a bell type spirometer at flow rates representing 1, 10, 30, 60, and 90% of the meter capacity. The bell type spirometer shall be calibrated against a NIST traceable standard or a transfer standard traceable to NIST. The accuracy of the meter shall be 2% of the true volume measured over the range of flow rates encountered in application of this test procedure. Alternatively, the field volume meter may be calibrated against a transfer standard traceable to NIST. The transfer standard shall be calibrated against the bell type spirometer or wet test meter and may not be used in the field as a working meter.

6.4 Pressure Measurement Devices: All pressure measurement devices shall be tested for accuracy using a reference gauge, incline manometer, NIST traceable standard, or static pressure calibrator, for five points (e.g. 10, 25, 50, 75, and 90% of full scale) to verify that the accuracy is within 5 percent. This test for accuracy shall be conducted prior and immediately following the test period. Alternatively, pressure measurement devices may be calibrated in accordance with manufacturer’s specifications. The test report shall provide documentation on the calibration of pressure measurement devices.

6.5 Temperature Measurement Devices: Temperature measurement devices shall be checked annually using an ice bath, ambient air, and boiling water. This accuracy check shall be conducted by comparison to a NIST traceable measurement device.

7. PRE-TEST REQUIREMENTS

7.1 Pre-test Static Pressure Performance Test: TP-206.3 shall be conducted preceding test equipment installation. First, check UST pressure. If at a vacuum, add N_2 gas to bring AST pressure up to zero gauge pressure then proceed with TP-206.3. Document test results.

7.2 Test Point 1_{inlet} and 1_{outlet} - Vapor Processor: Install sampling equipment upstream and downstream of the vapor processor.

7.2.1 Upstream or Inlet to Destructive Vapor Processor: The vapor processor inlet sample and temperature and pressure measurements shall be collected in accordance with US EPA Method 2B, “Determination of Exhaust Gas Volume Flow Rate from Gasoline Vapor Incinerators”, 40 CFR Part 60, Appendix. A-1 (36 FR 24877, December 23, 1971). The sample shall be taken from a manifold attached to the inlet or outlet side of the volume meter which has been inserted in the processor inlet line. The installation of test equipment shall not interfere with the normal operation of the vapor processor. The total volume of sample taken from the processor inlet for the purpose of hydrocarbon concentration measurement must be returned, unaltered to the sample manifold.

7.2.2 Downstream or Outlet of Destructive Vapor Processor: Sampling points at the processor ideally should be at least eight stack diameters downstream and two stack diameters upstream of any flow disturbance. If these criteria cannot be met without altering the stack, a sampling point which is at least two stack diameters downstream and one-half diameter upstream of any flow disturbance may be used. Sampling locations that do not meet these minimum criteria shall be approved in writing by the Executive Officer prior to testing. HC, CO and CO_2 concentrations are measured at the outlet of destructive processors using US EPA Method 2B, “Determination of Exhaust Gas Volume Flow Rate from Gasoline Vapor Incinerators,” 40 CFR Part 60, Appendix A-1 (36 FR 24877, December 23, 1971).

7.2.3 Outlet of Non-Destructive Vapor Processor: The vapor processor outlet sample HC concentration, temperature and pressure measurements shall be collected in a sample manifold attached to the outlet side of the volume meter which has been inserted in the processor outlet line. The installation of test equipment shall not interfere with the normal operation of the vapor processor. If the HC analyzer sampling rate at this Test Point exceeds one-half the processor exhaust flow rate, the total volume of sample taken from the processor outlet must be returned, unaltered to the sample manifold.

7.3 Test Point 2 – P/V Vent Sleeve: Assemble the P/V vent sleeve and sampling equipment as shown in Figure 1. All test sites are required to manifold their vent pipes to one P/V valve. The P/V vent HC concentration, temperature and pressure measurements shall be collected with a sample manifold attached to the outlet side of the volume meter, which is located downstream of the pump used to seep the P/V vent sleeve. Determine the positive and negative cracking pressures, positive leak rate, and negative leak rate in accordance with TP-201.1E CERT, prior to performing TP-206.3, to verify that the P/V valve complies with specifications listed in CP-206, or with specifications requested by the applicant and approved by the Executive Officer.

7.4 The certification engineering evaluation may identify additional parameters beyond those listed in TP-206.2 to be monitored during the test. Verify that all equipment needed to monitor any additional parameters is calibrated and installed. Prepare additional data forms if necessary.

7.5 Post-Installation Facility Leak Test: After all test equipment is installed, conduct a pressure decay test in accordance with TP-206.3. Corrective action shall be taken as necessary until facility meets TP-206.3 requirements.

7.6 System Equilibration: After completing the pre-installation and post-installation facility leak tests, wait at least 16 hours before data collection. Take steps to ensure facility and system operations are minimally disturbed by the test equipment in the period between equipment installation and the start of the test.

8. DAILY PRE-TEST PROCEDURES

8.1 Field Calibration.

8.1.1 Hydrocarbon Analyzers: Follow manufacturer's instructions concerning warm-up time and adjustments. On each test day, prior to data collection, zero the analyzer with a zero gas and span with known concentrations of calibration gases at levels which are 40 to 60% and 80 to 100% of the concentration ranges to be used for the test.

Conduct the analyzer calibration error check by sequentially introducing the three calibration gases (zero gas, high-range and mid-range) and recording the analyzer response to each calibration gas. Make no adjustments to the sampling/analysis system except those necessary to achieve the proper calibration gas flow rate. The analyzer calibration error for any calibration gas shall not exceed ± 2 percent of the range. If needed, take corrective action until acceptable performance is achieved.

Perform a leak check on the vacuum side of the assembly at the maximum pump vacuum. Correct any leaks found and repeat the leak check and correction procedure until no leak is detected.

8.1.2 CO and CO_2 Analyzers: Repeat instructions in 8.1.1 for CO and CO_2 analyzers if applicable.

8.1.3 Pressure Measurement Device: Prior to and immediately following each day of testing, record the pressure measuring device(s) response to the pressure generated by a static pressure calibrator at 0, 40, and 80% of the specified range of operation. If pressure differs more than

5%, recalibrate the device. Document instrument response before and after adjustment.

8.1.4 Temperature Measurement Device: Check the accuracy of the temperature measurement device(s) against an NIST traceable mercury-glass thermometer at ambient temperature prior to and immediately following each day of testing. If necessary, adjust the temperature read-out in accordance with manufacturer's instructions. Provide a copy of these instructions and document the instrument response before and after adjustment in the test report.

8.2 Sampling System Bias Checks: Check sampling set-up by introducing a known hydrocarbon concentration as close to the sample point as possible. If the difference between the analyzer field calibration and the sample system bias check exceeds + 5% of the range for the high-level calibration gas, the system fails the bias check and corrective action must be taken. Calculate bias using Equation 8.1. All sampling points must pass the bias check before the test can proceed.

Equation 8.1

$$\text{Bias} = \left[\frac{(C_a - C_b)}{R} \right] x100$$

where:

C_a = analyzer response for calibration gas for field calibration

C_b = analyzer response for calibration gas for sampling system bias check

R = analyzer range

8.3 Initiate Test Documentation:

8.3.1 Photographs shall be taken at each test point to document the equipment set-up. Any changes in configuration during the test shall also be documented by photographs, along with the date and time of the modification.

8.3.2 Testers shall maintain a test log which shall document activities at the test site, such as modifications to equipment and the reasons for testing decisions. The tester shall update the test log at least twice a day.

8.4 RVP Sample: If required by the Executive Officer, collect gasoline samples of each grade as described in title 13, CCR, Section 2296.

8.5 Determine the ullage in gallons of gasoline in the test tank through the gauging port, measurement stick, or other means approved by the Executive Officer.

9. TEST PROCEDURE

Phase I and/or Phase II transfers are not permitted during the test period. Should any occur, the test results shall be voided~~)~~. Hydrocarbon concentration and volume measurements at Test Point~~s~~ 1 (processor) and Test Point 2 (P/V vent) are to be monitored continuously for a minimum 24 hours during the testing episode.

9.1 Testing requirements:

9.1.1 Testing shall be conducted in accordance with the time period and temperature range specified by Sections 3.3.2 and 3.4.2 of CP-206.

9.1.2 The testing episode shall be a minimum 24 hours in duration. Record the start date and time.

9.1.3 No Phase I or Phase II transfers are permitted during the testing episode.

9.2 Data Recording: In addition to the data collection described above, the tester shall record the following parameters at the minimum frequency set forth below:

9.2.1 Ambient Temperature: Hourly

9.2.2 Ambient Barometric Pressure: Hourly

10. END OF TEST DAY PROCEDURES

These procedures are required at the end of each test day.

10.1 System Bias Checks: Conduct for all analyzers used that test day. Perform the sampling system bias check by alternately introducing zero gas and the calibration gas as close to the sample point as possible. Operate the system at the normal sampling rate and make no adjustments to the measurement system other than those necessary to achieve proper calibration gas flow rates through the sampling system to the gas analyzer.

The test run shall be considered invalid if the difference of the zero or calibration gas measured for the initial analyzer calibration in section 8.1 and the zero or calibration gas measured for the final bias check in section 10.1 exceeds ±5% of the range, as determined by equation 10.1.

Equation 10.1

$$\text{Bias} = \frac{(C_a - C_{fb})}{R} x100$$

Where:

C_{fb} = analyzer response for the zero or upscale calibration gas for post run sampling system bias check

C_a = analyzer response for the zero or upscale calibration for initial analyzer calibration

R = analyzer range

10.2 Zero and Calibration Drift: The test run shall be considered invalid if the difference of zero or calibration gas measured for the initial bias check in section 8.2 and the zero or calibration gas bias check measured for the final bias check in section 10.1 exceeds ± 3% of the range as determined by equation 10.2 below.

Equation 10.2

$$\text{Drift} = \frac{(C_{ib} - C_{fb})}{R} x100$$

Where:

C_{fb} = analyzer response for the zero or upscale calibration gas for post run sampling system bias check

C_{ib} = analyzer response for the zero or upscale calibration for initial system bias check

R = analyzer range

10.3 Pressure Measurement Devices: Following each day of testing, record the pressure measuring device(s) response to the pressure generated by a static pressure calibrator at 0, 40, and 80% of the specified range of operation. If necessary, adjust the instrument response in accordance with the manufacturer's instructions. Provide a copy of these instructions and document the instrument response before and after adjustment in the Certification Test Report.

10.4 RVP Samples. If required by the Executive Officer, take samples of each gasoline grade in accordance with section 2296 of title 13, CCR.

10.5 Log. Summarize the day's testing activities and document any problems encountered during testing in the testing log.

10.6 Record end date and time.

11. POST-TEST PROCEDURES

The test is completed when valid measurements have been recorded for each 24-hour test episode. After completing the daily post-test activities in Section 10, continue as follows:

11.1 Dismantle equipment. Remove testing apparatus and carefully reconnect system plumbing to original configuration.

11.2 Static Pressure Performance Test. Conduct a static pressure performance test using TP-206.3. Failure of static pressure performance test will invalidate section 9 test results.

12. CALCULATING RESULTS

Data from each test point is used to determine an emission factor in lbs/1000 gallons ullage/day.

12.1 Test Point 1_{outlet}: Processor Outlet (Non-Destructive Processors)

An emission factor in lbs hydrocarbon/1000 gallons ullage/day is calculated for the processor outlet Test Point for each 24 hour testing episode.

12.1.1 The sample volume for Test Point 1_{outlet} shall be corrected to standard conditions as shown in Equation 12.1.1.

Equation 12.1.1

$$Q_i = \frac{V_m}{t} \times \left(\frac{528}{T}\right) \times \left[\frac{P_{bar} + \left(\frac{P}{13.6}\right)}{29.92}\right]$$

where:

Q_i = volumetric flow rate at Test Point *i* corrected to standard conditions (ft^3/day @ 68 °F and 1 atm.).

V_m = meter volume (ft^3).

P_{bar} = barometric pressure (in. Hg).

P = meter pressure (inches water column).

T = meter temperature (^oR).

t = time period of testing in days (e.g. 32 hours / 24 hours/day = 1.33 days)

528 = standard temperature (^oR)

13.6 = conversion factor from inches water column to in. Hg

29.92 = standard pressure (in. Hg)

12.1.2 The mass emission factor for Test Point 1_{outlet} (M_1) shall be calculated as shown in Equation 12.1.2:

Equation 12.1.2

$$M_i = \frac{(Q_i)(C_i)(MW)(1{,}000)}{(385)(G_i)}$$

where:

M_i = emission factor for Test Point *i* (lb HC/1,000 gallons ullage/day)

Q_i = volumetric flow rate for Test Point *i* corrected to standard conditions (ft^3/day) from Equation 12.1.1.

C_i = hydrocarbon concentration for Test Point *i* (volume fraction, i.e. ppm_v / 10^6 or Volume % / 10^2)

MW = molecular weight of HC analyzer calibration gas (lb/lb-mole). For example, if propane is used as a calibration gas, the molecular weight is 44 lb/lb-mole.

385 = standard volume (ft^3) of one lb-mole of ideal gas at standard temperature and pressure (528^{o}R and 29.92 in. Hg)

G_i = ullage of test tank for testing episode *i* (gallons).

1,000 = Conversion factor to 1,000 gallons

12.2 Test Point 1_{inlet} and Test Point 1_{outlet}: Processor Inlet and Processor Outlet (Destructive Processors)

An emission factor in lbs hydrocarbon/1000 gallons ullage/day is calculated for the processor outlet Test Point for each 24 hour testing episode.

12.2.1 Calculate the standard volumetric flow rate for Test Point 1_{inlet} (Q_{in}) for the testing episode using Equation 12.1.1.

12.2.2 Calculate the standard volumetric flow rate for Test Point 1_{outlet} (Q_{out}) for the testing episode as shown in Equation 12.2.1

Equation 12.2.1

$$Q_{out} = Q_{in}\left(\frac{N[HC]_{in}}{N[HC]_{out} + [CO_2] + [CO] - 300}\right)$$

where:

Q_{out} = vapor incinerator outlet volumetric flow rate at standard conditions (ft^3/day @ 68 ^{o}F and 1 atm.)

Q_{in} = vapor incinerator inlet volumetric flow rate corrected to standard conditions (ft^3/day @ 68 ^{o}F and 1 atm.)

N = number of carbon atoms in each molecule of calibration gas

$[HC]_{out}$= vapor incinerator outlet hydrocarbon concentration (ppm)

$[CO_2]$ = vapor incinerator outlet carbon dioxide concentration (ppm)

$[CO]$ = vapor incinerator outlet carbon monoxide concentration (ppm)

300 = assumed background concentration (ppm) of CO_2

12.2.3 Calculate the processor exhaust emission factor (M_1) in lbs/1000 gallons ullage/day over the testing episode using Equations 12.1.2 and 12.2.1.

12.3 Test Point 2: P/V Vent Sleeve

An emission factor in lbs hydrocarbon/1000 gallons ullage/day is calculated for the P/V vent sleeve, Test Point 2, for each 24 hour testing episode.

12.3.1 Calculate the standard volumetric flow rate at Test Point 2 for the testing episode using Equation 12.1.1.

12.3.2 Calculate the P/V vent sleeve emission factor for Test Point 2 (M_2) in lbs/1000 gallons ullage/day for the testing episode using Equation 12.1.2.

12.4 Standing Loss Control System Emission Factor: Calculate the Phase II system emission factor using Equation 12.4.

Equation 12.4

$$EF_{HC} = M_1 + M_2$$

Where:

EF_{HC} = Standing Loss Emission Factor in lbs/1000 gallons ullage/day

M_1 = Mass emission factor at Test Point 1 (processor), lbs/1000 gallons ullage/day

M_2 = Mass emission factor at Test Point 2 (P/V vent valve), lbs/1000 gallons ullage/day

13. REPORTING RESULTS

Data are collected by ARB. All data forms, equipment calibrations, completed forms, results, and other test documentation shall be included in a test report.

In cases of conflict between hard copy and electronic format, the hard copy shall be presumed correct, unless the ARB Executive Officer specifies otherwise in writing.

14. ALTERNATIVE PROCEDURES

14.1 This procedure shall be conducted as specified. Any modifications to this test procedure shall not be used for certification unless prior written approval has been obtained from the Executive Officer, pursuant to Section 15 of Certification Procedure CP-206.

Figure 1
Vent Pipe Sleeve