California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP-201.2

Efficiency and Emission Factor for Phase II Systems

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Adopted: April 12, 1996
Amended: February 1, 2001
Amended: July 25, 2001
Amended: October 8, 2003
Amended: May 2, 2008
Amended October XX, 2010

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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 State of California Air Resources Board, and the term "ARB Executive Officer" refers to the Executive Officer of the ARB or his or her authorized representative or designate.

1. PURPOSE AND APPLICABILITY

The purpose of this procedure is to quantify the representative Phase II vapor recovery mass efficiency and/or mass emission factor, during the ~~C~~ARB Certification Process for Phase II vapor recovery systems at gasoline dispensing facilities (GDF). It is applicable to the determination of compliance with the Phase II performance standards for the maximum allowable mass emission factor and the minimum required vapor recovery mass efficiency as defined in the Certification Procedure (CP-201).

2. PRINCIPLE AND SUMMARY OF TEST PROCEDURE

While fueling 100~~200~~ vehicles, the vapor recovery mass efficiency and/or mass emission factor is determined by direct measurement of the mass of hydrocarbons at the following test point locations: (1) emitted at nozzle/vehicle interface, (2) returned through the vapor passage of the hose, (3) emitted from the pressure/vacuum (P/V) valve(s) on the underground storage tank (UST) vent pipe(s), (4) emitted from the assist processor (4_{inlet} and 4_{outlet}), if applicable, and (5) emitted as pressure related fugitives, as determined using TP-201.2F (see Figure 1). Using the results of the direct hydrocarbon measurements, both the Phase II mass efficiency (in units of percent by weight) and mass emission factor (in units of pounds of hydrocarbon emissions per 1,000 gallons dispensed) may be calculated.

3. BIASES AND INTERFERENCES

3.1 Failure to test a vehicle matrix representing the vehicle population in the State of California may bias the test toward either compliance or noncompliance. This bias is removed by requiring that the testing be based on the most recent representative vehicle matrix, as determined by TP-201.2A.

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3.2 Vehicles which do not conform to ~~C~~ARB specifications for fillpipes and openings of motor vehicle fuel tanks, title 13, CCR, section 2235 shall be excluded from the test matrix.

3.3 Vehicle fuel tanks that demonstrate a leak rate greater than 0.01 cfm at 0.5"WC shall be excluded. ORVR vehicles are exempt from this requirement. Other exceptions may be approved by the Executive Officer if the vehicle matrix required by TP-201.2A cannot otherwise be filled.

3.4 Vehicles failing the sleeve leak check requirement shall be excluded.

3.5 Vehicle fueling episodes during which less than six gallons of gasoline are dispensed shall be excluded.

3.6 Vehicle fueling episodes in which the nozzle sleeve is contaminated with liquid gasoline as a result of inappropriate action such as topping off or depressing the nozzle trigger when the nozzle is not properly inserted in the vehicle fill-pipe shall be excluded.

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 and efficiencies in the range of 0% to 100%.

4.2 The maximum emission factor error is calculated to be 13%. The maximum efficiency error is calculated to be 1.0%.

5. EQUIPMENT

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

5.1 Hydrocarbon (HC) Analyzer(s). Depending on the test point location of the HC measurement, the HC analyzer shall be capable of continuously measuring HC concentrations as follows:

5.1.1 100 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 Analyzers at test points 1, 3 and 4_{outlet} shall use **either** a destructive detection principle, such as a flame ionization detector (FID) **or a non-destructive detection principle, such as non-dispersive infrared (NDIR).** The analyzer at test points 2 and 4_{inlet} shall use a non-destructive detection principle, such as non-dispersive infrared (NDIR). A sufficient number of hydrocarbon analyzers shall be used to provide for simultaneous, and continuous, measurements at all applicable test

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points. The Executive Officer may allow other measurement methods if it is determined that equivalent results can be obtained.

5.1.3 Hydrocarbon Calibration Gases. Cylinders of certified, or NIST traceable, calibration gases using propane (or butane) in nitrogen capable of providing calibration for the analyzer ranges recommended in Table 5-1.

Table 5-1
Recommended Continuous Analyzer Concentration Ranges

Test Point (Fig.1)	HC Measurement	Ranges	Usable Concentration Range
1	FID	0 to1,000 ppm 0 to 5,000 ppm 0 to 1.0% 0 to 5.0%	100 to 950 ppm 500 to 4,750 ppm 1,000 ppm to 9,500 ppm 5,000 ppm to 4.75%
2	NDIR	0 to 10.0% 0 to 50.0%	1.0% to 9.5% 5.0% to 47.5%
3	FID	0 to 1,000 ppm 0 to 5,000 ppm 0 to 1.0% 0 to 5.0% 0 to 10.0% 0 to 50.0%	100 to 950 ppm 500 to 4,750 ppm 1,000 to 9,500 ppm 5,000 ppm to 4.75% 1.0% to 9.5% 5% to 48%
4_{inlet}	NDIR	0 to 10.0% 0 to 50.0%	1% to 9.5% 5% to 47.5%
4_{outlet}	FID	0 to10 ppm 0 to 100 ppm 0 to 1,000 ppm 0 to 5,000 ppm 0 to 1.0% 0 to 5.0%	1.0 to 9.5ppm 10 to 95 ppm 100 to 950 ppm 500 to 4,750 ppm 1,000 to 9,500 ppm 5,000 ppm to 4.75%
	Destructive Processor	Ranges	Usable Concentration Range
4_{outlet}	CO	0 to 500 ppm	50 to 475 ppm
4_{outlet}	CO_2	0 to 5.0% 0 to 10.0%	5,000 ppm to 4.75% 1.0% to 9.5%

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.

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5.1.4 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, 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 EPA Protocol gas. A gas dilution system which meets the requirements of 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).

5.1.5 Sample lines. Constructed of Teflon or other material that does not absorb or otherwise alter the sample gas.

5.1.6 Additional Analyzers for Systems with Vapor Processors: If processor exhaust flowrate is to be determined by USEPA Method 2B 40 CFR, Part 60, App.A, then the following additional analyzers are needed for Test Point 4_{outlet}.

5.1.6.1 Carbon Monoxide (CO) analyzer: As specified in ARB Method 100, title 17, CCR, section 94114, or USEPA Method 10, "Determination of Carbon Monoxide Emissions From Stationary Sources", 40 CFR Part 60, App. A.

5.1.6.2 Carbon Dioxide (CO_2) analyzer: As specified in ARB Method 100 or USEPA Method 3A, "Determination of Oxygen and Carbon Dioxide Concentrations in Emissions from Stationary Sources (Instrumental Analyzer Procedure)", 40 CFR Part 60, App. A.

5.2 Data Acquisition System/Data Recorder: Provide a permanent record of hydrocarbon analyzer data using a strip chart recorder. A datalogger or another electronic data acquisition is also recommended. Data shall be collected at intervals not to exceed one second. Any electronic data acquisition system must be capable of integration at a ten-second interval. The strip chart, as well as the data acquisition system, must 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.

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Table 5-2
Volume Meter Specifications

Test Point	Typical Range Measured (cfm)	Recommended Meter Range (cfh)
1	2 to 5	0 to 800
2	0.5 to 1.4	0 to 800
3	Vent sleeve sweep: 2 to 20 Vent : 0 to 5	0 to 800 0 to 800
4_{inlet}	System specific	Determined during evaluation
4_{outlet}	System specific	Determined during evaluation

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 The meter shall be equipped with taps to accommodate the following as applicable for the specific Test Point:

(a) Inlet side: thermocouple with a range of 0 to 200 deg F.

(b) Inlet side: concentration sampling and pressure measurement

(c) Inlet and outlet sides: differential pressure gauge with a full-scale range of less than or equal to four times the backpressure limit.

5.3.4 Pressure Measurement Devices for Volume Meters

Transducers, liquid manometers, Magnahelic gauges or equivalent with a design range suitable for the pressure being measured (see Section 5.3.1). The error of the pressure measuring device shall not

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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 suitable for the temperature being measured (see Section 5.3.3(a)). The error in the temperature measurement shall not exceed 4 degrees Fahrenheit.

5.4 Vehicle Leak Check Equipment (see Figure 2)

5.4.1 Fill pipe Interface: A plug which provides a seal at the fill pipe outlet equipped with two taps. One tap for pressurizing the fill pipe and vehicle tank with nitrogen, the second tap for connection to a pressure measurement device.

5.4.2 Flow meter: Appropriately sized for measuring 0.01 cfm (283 ml/min).

5.4.3 Pressure Measurement Device: Transducer, liquid manometer, Magnehelic gauge or equivalent with range of 0.0 to 1.0 inch WC.

5.4.4 Pressurizing System: Nitrogen cylinder (commercial grade), two stage pressure regulator with gauges indicating cylinder pressure and supply line pressure, a coarse control valve for regulating the pressure in the supply line to the flow meter, a fine control valve for adjusting the flow through the flow meter and a hose for supplying nitrogen to the vehicle tank.

5.4.5 Fillpipe with Closed End: A stand-alone vehicle fill-pipe, at least 18 inches in length, which has been closed off at one end. This fill-pipe is used to check for leaks in the pressurizing apparatus.

5.5 Nozzle Sleeve and Nozzle Sleeve Leak Check Equipment (see Figures 3 through 7)

5.5.1 Nozzle Sleeve: A sleeve fabricated using a material compatible with California gasolines which captures the entire mass of gasoline vapors emitted at the nozzle/vehicle interface. An example design for the sleeve is shown in Figures 3 through 5.

Other designs may be used if demonstrated to produce less than 0.01 inches WC vacuum inside the sleeve at a sleeve sweep rate of five cubic feet per minute (cfm) and receive prior approval by the Executive Officer.

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5.5.2 Sleeve Tubing: The sample tubing shall be Teflon, or equivalent, and as lightweight as practical so that the behavior of the nozzle operator is minimally affected by testing activities. 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 design which does not provide a source of or sink for hydrocarbon vapors, capable of 5 cfm.

5.5.4 Leak check portable analyzer: A combustible gas detector that complies with the requirements of USEPA Method 21, "Determination of Volatile Organic Compounds Leaks", 40 CFR Ch.1, Part 60, App. A or TP-204.3.

5.6 Vapor Return Line (Test Point 2): See Figures 8 to 11.

5.6.1 Liquid trap for volume meter: **When the configuration of the vapor return line allows it, a** ~~A~~ transparent liquid trap shall be installed at the lowest point in the plumbing installed on the inlet side of the meter. The liquid trap shall be designed and installed to allow for the removal of any liquid gasoline after each refueling event. The quantity of liquid gasoline shall be measured and recorded after each vehicle fueling. The trap shall be designed to allow liquid removal with minimal effort or tools. Ball valves shall be installed at the inlet to the liquid trap and at the exhaust of the vapor return in order to isolate the meter if servicing is required during the test. **In cases where the configuration of the vapor return line does not allow for the installation of a transparent liquid trap as described in this section, transparent tubing shall be used to connect the volume meter to the test dispenser.**

5.6.2 Test Manifold: Piping inserted between liquid trap and volume meter with taps to allow measurement of temperature, pressure and hydrocarbon concentration.

5.6.3 Isolation valves: Non-restrictive ball valve of appropriate size to allow removal of test apparatus at Test Point 2 during non-test intervals.

5.6.4 In-line plumbing: Test apparatus piping shall be compatible with gasoline and adaptable to various vapor line configurations to allow total measurement of the vapor return line volume as well as routing and return of a portion of the vapor to the non-destructive hydrocarbon analyzer.

5.6.5 Vapor return line sample pump: Carbon vane, metal bellows or other pump design which does not provide a source or sink for HC vapors, capable of 0.5 to 2 cfm.

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5.6.6 Vehicle Fuel Tank Temperature Probe. Apparatus for measuring temperature of vapors in vehicle fuel tank, which consists of an intrinsically safe thermocouple or thermometer on a nozzle spout so that the temperature sensor is near the tip of the spout.

5.7 Vent Sleeve Sampling Apparatus (Test Point 3): See Figure 12

5.7.1 A sleeve that captures the entire mass of gasoline emitted at the storage tank vent pipe(s). Other designs may be used if demonstrated to produce less than 0.01"WC inside the sleeve and within one inch of the outer surface of the tank vent or tank vent PV valve at a sleeve rate of 20 cfm and receive prior approval by the Executive Officer. 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 at two flow rates as described 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.

5.7.1.1 High flow rate (3-7 cfm). Bubble nitrogen through gasoline filled impingers and then through a roots meter (equipped with meter temperature and pressure monitoring) at inlet of simulated vent pipe discharging to the vent sleeve sample apparatus equipped with vent sleeve hydrocarbon analyzers. Quantify HC concentration of flow from simulated vent line by sampling at outlet of gasoline impingers with NDIR analyzer with 0 to 80% range. Determine volume of flow into the simulated vent pipe and vent sleeve using a volume meter installed at the simulated vent line inlet. The mass of HC entering the vent sleeve must be ±5% of the mass of HC collected from the vent sleeve as determined by the vent sleeve sampling apparatus volume, temperature, pressure and HC concentration measurements and data recording system and mass calculation algorithms.

5.7.1.2 Low flow rate (@200 ml/min). Run propane calibration gas with a concentration of 10 to 20% by volume through a mass flow controller (a bubble meter or precision rotameter with sufficient accuracy is acceptable) 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

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apparatus volume, temperature, pressure and HC concentration measurements and the data recording system and mass calculation algorithms.

5.7.2 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.

5.7.3 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 2 to 20 cfm.

5.7.4 Ball Valve: Installed upstream of volume meter to allow closing off vent pipe for testing purposes.

5.8 Vapor Processor (Test Point 4)

5.8.1 Processor inlet sample pump: Carbon vane, metal bellows or other pump design which do not provide a source or sink for hydrocarbon vapors, capable of 2 cfm during sampling. **This equipment is only required for vapor processors employing a destructive principle such as thermal oxidation.**

5.8.2 Processor outlet sample probe: Use equipment specified in TP-201.1A.

5.9 Pressure Related Fugitive Emissions (Test Point 5). Use equipment specified in TP-201.2F.

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

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

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

5.13 Stopwatch: Use a stopwatch accurate to within 0.2 seconds to measure the dispensing rate.

5.14 Vehicle Fillpipe Check Equipment: A rod, level, protractor and clearance gauge to determine compliance with the “Specifications for Fill Pipes and Openings of Motor Vehicle Fuel Tanks”, title 13, CCR, section 2235.

6. CALIBRATIONS

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

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6.1 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". Field calibrations during testing shall be conducted as described in Section 8.1.1.

6.2 Calibration Gases:

6.2.1 Certification. The calibration gases must 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 (40 CFR Part 75, App. H), 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 meter calibrations shall be NIST traceable. 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 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 meter. The transfer meter 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: Calibrate pressure measurement devices prior to and immediately following the test period with a static pressure calibrator for five points over a range of – 10 to +10 inches water or appropriate range of operation. The accuracy of the device shall be 5%. Alternatively, pressure measurement devices may be calibrated in accordance with manufacturer's specifications with a documentation of the specifications and the calibrations in the certification test report. Pressure measurement devices used to determine fugitive emissions shall meet the requirements of TP-201.2F.

6.5 Temperature Measurement Devices: Temperature measurement devices shall be checked semi-annually using an ice bath, ambient air, and boiling

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water. This accuracy check shall be conducted by comparison to a NIST traceable measurement device.

7. PRE-TEST REQUIREMENTS

7.1 Vehicle Test Matrix. The matrix of vehicles to be tested is defined by TP-201.2A. The test matrix must be approved by the ARB Executive Officer before testing begins.

7.2 Certified Phase I System and Phase II System Documentation. Verify that the test site has a certified Phase I system. Document the Phase I and Phase II system information on a form such as provided in Figure 13.

7.3 Pre-test Pressure Integrity Test. TP-201.3 shall be conducted preceding test equipment installation. ~~First, check UST pressure. If at a vacuum, add N2 to bring UST pressure up to zero gauge pressure, then proceed with TP-201.3. Document test results.~~

7.4 Equipment Set-up at Test Site. Select dispenser(s) to be tested and ensure dispenser has valid Weights and Measures approval seal (sticker). Set-up equipment as described below. Use safety cones to divert vehicle traffic during set-up, however, place sampling equipment so that test can be conducted while fueling vehicles normally. Testing activities should be conducted so that alterations to the system and facility are minimized.

7.4.1 Vehicle Leak Check Apparatus: Assemble the vehicle leak check equipment as shown in Figure 2. Conduct a leak check of the sampling arrangement by pressurizing the apparatus to 1.0 inch WC using the closed-off fillpipe. Apparatus shall maintain 1.0 inch WC for 20 seconds.

7.4.2 Test Point 1 – Nozzle/Vehicle Interface: See Figure 1. Assemble the nozzle sleeve sampling apparatus as shown in Figure 3.

7.4.3 Test Point 2 – Vapor Return Line: See Figure 1. Install the sampling equipment as shown in Figures 8 through 10. The volume meter is inserted into the vapor return line at the vapor hose or dispenser vapor manifold connection to the vapor riser. Plumbing in the vapor return line should:

(1) Minimize the length of the vapor return line between the nozzle and the sampling point to reduce biases related to entry of condensation from the vapor return line into the volume meter.

(2) Minimize the pressure drop for flow through added plumbing and the volume meter.

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(3) Return the entire volume of any sample extracted from the vapor return line.

7.4.3.1 Pressure Drop Check: Measure the backpressure from the nozzle to the sampling apparatus using TP-201.4. Then connect the sampling apparatus and measure the backpressure again. The backpressure added by the test equipment shall not increase the backpressure by more than 10%. Record the actual backpressure measurements.

7.4.3.2 Verify that the flowrate through the analyzer (using rotameter at analyzer inlet) and the pressure of the sampled vapors or calibration gas in the analyzer (pressure gauge at analyzer outlet) are identical both during sampling and calibration.

7.4.4 Test Point 3 – Vent Pipe: See Figure 1. Assemble the vent sleeve and sampling equipment as shown in Figures 12 through 13. All test sites are required to manifold their vent pipes to one P/V valve. Before replacing the P/V valve, determine the positive and negative cracking pressures as described in TP-201.2B.

7.4.5 Test Point 4_{inlet} and 4_{outlet} - Vapor Processor: See Figure 1. Install sampling equipment upstream and downstream of vapor processor.

7.4.5.1 Inlet to Vapor Processor: The vapor processor inlet sample and temperature and pressure measurements must be taken from a sample manifold attached to the inlet side of the volume meter which has been inserted in the inlet line. The installation of test equipment shall not interfere with the normal operation of the vapor incinerator. 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. **Processor inlet sampling is only required for vapor processors employing a destructive principle such as thermal oxidation.**

7.4.5.1 Outlet of 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 diameter upstream of any flow disturbance may be used. Sampling locations that do not meet these minimum criteria must be approved in advance of testing by the ARB Executive Officer. Hydrocarbon concentrations are measured at this test point for all vapor processors. CO and CO_2 concentrations are also measured for destructive processors if using USEPA Method 2B,

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"Determination of Exhaust Gas Volume Flow Rate from Gasoline Vapor Incinerators", 40 CFR Part 60, App. A.

7.5 The certification engineering evaluation may have identified additional parameters beyond those listed in TP-201.2 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.

7.6 Post-Installation Facility Leak Test: After all test equipment is installed, conduct a pressure decay test in accordance with TP-201.3. **The leak test shall occur at least 24 hours prior, and no longer than 7-days before testing.** Corrective action shall be taken as necessary until facility meets TP-201.3 requirements.

7.7 Test Point 5 - Fugitive Emissions: See Figure 1. Determine fugitive emissions as specified in TP-201.2F.

7.8 System Equilibration. After completing 7.~~7~~6, 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 (high-range, mid-range and zero gas) 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 flowrate. 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.

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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 10%, 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 Determination of Nozzle Sleeve Response Time. This determination can be conducted once for Test Point 1. If the sampling apparatus ~~or dispenser location~~ for Test Point 1 is changed, the response time determination shall be repeated.

8.2.1 Set the sample flow rate at 5 cfm. Lower flowrates may be used if sleeve leak check requirements are met (see 9.4.4.2).

8.2.2 Introduce ambient air from a location removed from any potential gasoline vapor source into the sleeve until the analyzer reading has stabilized at a level at or near zero.

8.2.3 Move the sleeve over an open **hydrocarbon gas calibration standard** ~~gasoline container or other HC source~~ that has been demonstrated to produce vapor concentrations within the range of the nozzle sleeve hydrocarbon analyzers. Measure the time interval from the time the sleeve was moved to the **hydrocarbon gas calibration standard** ~~vapor source~~ to the time that 90% of the **selected analyzer range or** final stable analyzer reading is observed. Perform this test sequence 3 times, calculate the average and define the result as the "nozzle sleeve response time".

8.3 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 8.3. All sampling points must pass the bias check before the test can proceed.

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

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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

8.4 Initiate Test Documentation:

8.4.1 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. A video demonstrating emission measurement during a vehicle fueling as described in sections 9.1 to 9.4 is recommended.

8.4.2 Testers shall maintain a test log which shall consist of a narrative documenting activities at the test site, such as Phase I fuelings, modifications to equipment and the reasons for testing decisions. The tester shall update the test log at least twice a day.

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

9. TEST PROCEDURE

Collect data during refueling of vehicles as defined in the vehicle test matrix as described below. An example data sheet is given in Figure 15. The Executive Officer shall conduct the fueling. Hydrocarbon emissions at test points 3 (vent) and 4 (processor), if applicable, are to be monitored continuously (24 hours/day) throughout the duration of the test.

9.1 When a vehicle corresponding to a vacancy in the vehicle test matrix arrives at the instrumented dispenser, the tester shall explain that a test is underway and request that the consumer participate. If approval is obtained, proceed as follows:

9.1.1 Determine if the vehicle is equipped with onboard refueling vapor recovery (ORVR) by checking the emission label attached to the vehicle's hood (title 13, CCR, section 1965). Look for the "Evap Family" code. If the fifth digit is an "R", then the vehicle has ORVR. If the fifth digit is an "E" or "V", it does not have ORVR. Record on data sheet.

9.2 Install the nozzle sleeve on the nozzle at the instrumented dispenser as shown in Figure 5. Check liquid trap and remove any liquid collected. Record amount of liquid collected.

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9.3 The vehicle fuel tank is checked for leaks using the apparatus shown in Figure 2. ORVR vehicles are exempt from the leak check.

9.3.1 Connect the fill-pipe interface to the vehicle fill pipe.

9.3.2 Open the main valve on the nitrogen cylinder. Use the two stage regulator to adjust the supply line pressure and the coarse flow control valve and the rotameter fine flow control valve to maintain a stable pressure reading of 0.5 inches WC in the vehicle fill-pipe. If 0.5 inches WC cannot be maintained for 10 seconds, record an unacceptable vehicle leak for the subject vehicle.

9.3.3 If the 0.5 inches WC can be maintained, determine the leak rate by observing the rotameter reading for 10 seconds. Record the rotameter reading. If a flow rate greater than 0.01 cfm (283 ml/min) was observed on the rotameter, record an unacceptable vehicle leak for the subject vehicle.

9.3.4 Disconnect the equipment from the vehicle fillpipe. Continue with the test procedure only if the vehicle passed the leak check.

9.3.5 Measure vehicle fuel tank temperature using apparatus described in 5.6.6.

9.4 Vehicle Fueling with Nozzle Sleeve

9.4.1 If necessary, move sleeve to nozzle grade desired by customer. Turn on the nozzle sleeve sampling pump. Record the initial volume meter reading. Hydrocarbon concentration data collection for a dispensing episode begins with the insertion of the nozzle into the vehicle.

9.4.2 The Executive Officer shall conduct the fueling. The fueling shall be conducted “hands off” at the high clip rate with no top-offs. Fuel is dispensed until the first nozzle shutoff after a minimum of six gallons is dispensed.

9.4.2.1 Start the stopwatch when the dispenser volume meter begins to move.

9.4.2.2 During the fueling, check that the sleeve is capturing emissions effectively using the portable hydrocarbon analyzer (see Figure 7). The sleeve flow rate must be high enough to prevent the presence of hydrocarbon vapors at concentrations greater than 10% of the LEL (2,100 ppm as propane as determined by USEPA Method 21, “Determination of Volatile Organic Compounds Leaks”, 40 CFR Ch.1, Part 60, App. A or TP-204.3) at the air inlet ports

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near the top of the vent sleeve. If this concentration is exceeded, the data collected is invalid.

9.4.2.3 Stop the stopwatch when the dispenser volume meter stops moving. Record the volume dispensed and time elapsed during dispensing. Invalidate data if volume dispensed is less than six gallons and the dispensing flow rate is outside the range of 6.0 to 10.0 gallons/minute. Invalidate data if more than one premature shutoff occurs before a minimum of six gallons is dispensed.

9.4.3 After termination of product dispensing, the Executive Officer shall turn off the dispenser and remove the nozzle from the vehicle fill pipe to minimize the chance of contaminating the nozzle sampling sleeve with liquid gasoline. Document whether or not liquid gasoline is present in the sleeve. Invalidate the results if liquid is present. The nozzle **sleeve shall be removed and the nozzle** ~~with the sleeve~~ shall be hung on the dispenser. Data shall continue to be collected from the termination of dispensing **until the nozzle sleeve hydrocarbon analyzer concentration is less than 100 ppmv as propane, or** for **a time period of at least** the nozzle sleeve response time determined in Section 8.2**, whichever is longer**. Then the nozzle sleeve sample pump is turned off, constituting the end of the dispensing episode. Record the final volume meter reading.

9.5 Vehicle Fillpipe Check: Verify that the vehicle meets the vehicle fillpipe specifications using the apparatus described in Section 5.14. Invalidate the data if fillpipe specifications are not met.

9.6 Repeat test sequence in Sections 9.1 through 9.5 until vehicle matrix is filled or until end of test day.

9.7 Phase I Deliveries: All Phase I deliveries occurring after Section 7.2 shall be observed by the Executive Officer.

9.7.1 All Phase I deliveries must be conducted by cargo tanks which have been certified by ARB. ARB certification shall be verified by obtaining a copy of the cargo tank vapor recovery application.

9.7.2 The Phase I vapor recovery system shall be operated during product deliveries so as to minimize the loss of vapors from the facility storage tank which may be under pressure. Provided it is not in conflict with established safety procedures, this shall be accomplished in the following manner:

9.7.2.1 The Phase I vapor return hose is connected to the delivery tank and to the delivery elbow before the elbow is connected to the facility storage tank;

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9.7.2.2 The delivery tank is opened only after all vapor connections have been made, and is closed before disconnection of any vapor return hoses; and

9.7.2.3 The vapor return hose is disconnected from the facility storage tank before it is disconnected from the delivery tank.

9.7.2.4 Phase I deliveries shall be accomplished so as to ensure that there is at least one vapor connection between the cargo tank compartment headspace and the storage tank associated with the product delivery. There shall be no more than two product hoses used with one vapor hose connected, and no more than three product hoses used with two vapor hoses connected.

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

9.8.1 Ambient Temperature: Hourly

9.8.2 Ambient Barometric Pressure: Hourly

9.8.3 Station throughput (gallons dispensed to vehicles):

9.8.3.1 Daily

9.8.3.2 Between start and stop of testing intervals

10. END OF TEST DAY PROCEDURES

Several test days are normally necessary to complete the vehicle test matrix. 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 at the probe. 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 zero or calibration gas measured for the bias check in section 10.1 and the zero or calibration gas bias check measured in section 8.3 exceeds ±5% of the range, as determined by equation 10.1.

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

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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 bias check in section 10.1 and the zero or calibration gas bias check measured in section 8.3 exceeds ±3% of the range as determined by equation 10.2 below.

$$\text{Drift} = \frac{(C_{ib} - C_{fb})}{R} \text{x}100$$

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.

11. POST-TEST PROCEDURES

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

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11.1 Prior to dismantling test equipment, conduct a pressure decay test as specified in TP-201.3. **This test pressure decay test shall be conducted as soon as possible, but not more than 48-hours, after completion of the TP 201.2 test. Failure of this pressure decay test shall invalidate the TP-201.2 test unless the Executive Officer determines that the integrity failure did not result in any significant unmeasured emissions.**

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

11.3 Pressure Decay Test. Conduct a pressure integrity test using TP-201.3. Initiate corrective action until meet TP-201.3 requirements.

12. CALCULATING RESULTS

Data from each test point is used to determine a mass emission factor in lbs/1000 gallons. Efficiency is calculated using the mass emission factors and the mass of vapor returned per 1000 gallons dispensed.

12.1 Test Point 1 - Nozzle Sleeve

An emission factor in lbs hydrocarbon/1000 gallons dispensed is calculated for each fueling. Overall emission factors are also calculated for ~~ORVR vehicles, non-ORVR vehicles and~~ the entire vehicle matrix.

12.1.1 The sample volumes shall be corrected to standard conditions for each dispensing episode as shown in Equation 12.1.1.

$$V = V_m \times \left(\frac{528}{T}\right) \times \left[\frac{P_{bar}\left(\frac{P}{13.6}\right)}{29.92}\right] \qquad \text{Equation 12.1.1}$$

where:

V	=	volume corrected to standard conditions (ft^3).
V_m	=	measured volume (ft^3).
P_{bar}	=	barometric pressure (in. Hg).
P	=	meter pressure (inches water column).
T	=	meter temperature (^oR).

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12.1.2 The mass emission factor for each dispensing episode shall be calculated as follows:

$$M_{rate} = \frac{(V_i)(C_i)(MW)(1{,}000)}{(385)(G_i)} \qquad \text{Equation 12.1.2}$$

where:

M_{rate} = emission factor for dispensing episode *i* (lb HC/1,000 gallons)

V_i = volume for dispensing episode *i* corrected to standard conditions (ft^3).

C_I = hydrocarbon concentration for dispensing episode *i* (volume fraction, i.e. ppm_v / 10^6 or Volume % / 10^2)

MW = molecular weight of HC analyzer calibration gas (lb/lb-mole) e.g., 44 for propane

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

G_i = gallons dispensed for dispensing episode i.

1,000 = Conversion factor to 1,000 gallons

12.2 Test Point 2. Vapor Return Line

The vapor return line data is not needed to calculate the emission factor, but is necessary to calculate the system efficiency.

12.2.1 Calculate the standard volume of vapor returned for each dispensing episode as shown in Equation 12.1.1.

12.2.2 Calculate the vapor returned in lbs/1000 gallons dispensed as shown in Equation 12.1.2.

12.3 Test Point 3. Vent Sleeve

The vent emissions shall be calculated over the time periods specified by the ARB Executive Officer. Knowledge of the total station gasoline throughput for the specified time period is necessary to calculate the emission factor.

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12.3.1 Calculate the standard volume sampled over the time interval using Equation 12.1.1.

12.3.2 Calculate the emission factor in lbs/1000 gallons dispensed over the time interval selected using Equation 12.1.2.

12.4 Test Point 4 Processor

12.4.1 If a volume meter is used at Test Point 4_{outlet}, calculate the standard volume sampled of the time interval using Equation 12.1.1.

12.4.2 If a volume meter is used at Test Point 4_{inlet}, calculate the exhaust volume flow rate using USEPA Method 2B.

12.5 Test Point 5 Pressure-Related Fugitives: Calculate the emission factor as specified in TP-201.2F.

12.6 Phase II System Emission Factor: Calculate the Phase II system emission factor using Equation 12-6.

$$M_{total} = M_1 + M_3 + M_4 + M_5$$

Where: M_{total} = Phase II emission factor, lbs/1000 gallons
M_1 = Mass emission factor at Test Point 1, lbs/1000 gallons
M_3 = Mass emission factor at Test Point 3, lbs/1000 gallons
M_4 = Mass emission factor at Test Point 4, lbs/1000 gallons
M_5 = Mass emission factor at Test Point 5, lbs/1000 gallons

12.7 Phase II System Efficiency: Calculate the Phase II system efficiency using Equation 12-7.

$$EFF = 1 - \frac{(M_1 + M_3 + M_4 + M_5)}{(M_1 + M_2)} \times 100$$

Where: M_2 = Mass emission factor at Test Point 2, lbs/1000 gallons

13. REPORTING RESULTS

All data, forms, calculations and other test documentation shall be included in a test report.

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 ARB Executive Officer, pursuant to Section 14 of Certification Procedure CP-201.

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