STATE OF CALIFORNIA

AIR RESOURCES BOARD

STATIONARY SOURCE TEST METHODS

Volume 2

Certification and Test Procedures for Gasoline Vapor Recovery Systems

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STATIONARY SOURCE CONTROL DIVISION

INTRODUCTION

The contents of this volume are the certification and test procedures used by the Air Resources Board to approve gasoline vapor recovery systems for gasoline marketing operations.

TABLE OF CONTENTS

METHOD	TITLE
2-1	Test Procedures for Determining the Efficiency of Gasoline Vapor Recovery Systems at Service Stations Adopted December 9, 1975, Amended March 30, 1976, Amended August 9, 1978. Amended Sept. 1, 1982
2-2	Certification Procedures for Gasoline Vapor Recovery Systems at Service Stations Adopted March 30, 1976 Amended August 25, 1977, Amended August 9, 1978
2-3	Certification and Test Procedures for Vapor Recovery Systems at Gasoline Bulk Plants Adopted April 18, 1977, Amended August 9, 1978
2-4	Certification and Test Procedures for Vapor Recovery Systems at Gasoline Terminals Adopted April 18, 1977
2-5	Certification and Test Procedures for Vapor Recovery Systems of Gasoline Delivery Tanks Adopted April 18, 1977 Amended Sept. 1, 1982

METHOD 2-1

State of California

AIR RESOURCES BOARD

Test Procedures for Determining the Efficiency of Gasoline Vapor Recovery Systems at Service Stations

Adopted: December 9, 1975

Amended: March 30, 1976

Amended: August 9, 1978

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Note: To assist the user, the most recent amendments to these procedures are set forth in italics and deletions are shown as struck through.

State of California

AIR RESOURCES BOARD

Test Procedures for Determining the Efficiency of Gasoline Vapor Recovery Systems at Service Stations

1. Introduction

The following test procedures are for determining the efficiency of vapor recovery systems (Sections 2 and 3) for controlling gasoline vapors emitted during the filling of storage tanks and vehicle fuel tanks.

The test procedures for determining the efficiency of systems for controlling gasoline vapors displaced during filling of underground storage tanks requires determination of the weight of gasoline vapors vented through the storage tank vent and the volume of gasoline dispensed. The percentage effectiveness of control is then calculated from these values.

The test procedures for determining the efficiency of systems to control gasoline vapors displaced during vehicle fueling requires that the weight of vapors collected at the vehicle, corrected for vent losses, be compared to the potential mass emission calculated for that vehicle. A standard test sample of the vehicle population is to be tested and an average efficiency calculated.

The potential mass emissions are determined during the fueling of vehicles by measuring the mass of hydrocarbons collected from vehicles from which no leak occurred. Potential emissions are expressed as a function of the vapor pressures of the dispensed fuel, the temperature of the dispensed fuel and the temperature of the gasoline in the test vehicle tank. The relationship is used as the baseline or reference from which the efficiency of a vehicle fueling vapor control system is evaluated.

The sample of vehicles to be used for testing control systems shall be comprised of vehicles representative of the on-the-road vehicle population in terms of vehicle miles travelled.

The test will be conducted during the normal operation of the service station. For vehicle fueling at a self-servce station, the customers shall fuel the vehicles; at a full-service station, the service station attendant shall fuel the vehicles during the test period. No more than 30 days prior to the 100 vehicle efficiency test, the entire vapor recovery system is to be tested for leaks. ~~in accordance with the criteria specified in Title 19 Chapter 1 Subchapter 11.5 Section 1918.35 (j) and 1918.56 (j), in the State Fire Marshall's regulations.~~ *The vapor piping system, including the storage tanks, dispensing nozzles and hoses, shall be pneumatically tested to 150% of the maximum working pressure of the system, or to 10 inches of water column pressure, whichever is greatest. Test pressure shall be maintained for not less than 5 minutes, with the system sealed, with a pressure drop not to exceed 10% of the test pressure. An inert gas,* *e.g., nitrogen, shall be used. At no time shall air be used <u>from an external power source</u> to pressurize the system.*

In addition, the total ullage space shall not be more than 6,000 gallons. During the performance test, maintenance, adjustment, replacement of components or other such alteration of the control system is not allowed unless such action is specifically called for in the system's maintenance manual. Any such alteration shall be recorded on the day on which the alteration was performed. During the testing, the control system will be sealed in such a manner that unauthorized maintenance may be detected. Maintenance is to be performed only after notification of the person in charge of the testing except in case of an emergency. Unauthorized maintenance may be reason for immediate failure of the test.

For systems which are identical in design and include the same components as systems tested and found to comply with the test procedures, but differ, primarily in size, the owner or vendor may demonstrate compliance capability and obtain approval by submitting engineering and/or test data demonstrating the relationship between capacity and throughput of each component whose performance is a function of throughput. Examples of such components include: blowers, catalyst, carbon or other adsorbant, compressors, heat exchangers, combustors, piping, etc.

2. Underground Tank Fueling Test Procedure (Phase I Systems)

2.1 Principle and Applicability

(a) Principle. During a fuel delivery, the volume of gasoline delivered from the tank truck to the underground tank is recorded and the concentration of gasoline vapor returning to the tank truck is measured. The weight of gasoline vapor discharged from the vent of the underground tank and, if applicable, from the vent of the vacuum assisted secondary processing unit during the same period is determined. The efficiency of control is calculated from these determinations.

(b) Applicability. The method is applicable to all control systems which have a vapor line connecting the underground tank to the tank truck.

2.2 Apparatus

(a) For each vent, including restricted vents and vents of any processing units, a positive displacement meter, with a capacity of 3,000 SCFH, a pressure drop of no more than 0.05 inches of water at an air flow of 30 SCFH, and equipped with an automatic data gathering system that can differentiate direction of flow and records volume vented in such a manner that this data can be correlated with simultaneously-recorded hydrocarbon concentration data. A manifold for meter outlet with taps for an HC analyzer, a thermocouple*; and a pressure sensor is to be used with the positive displacement meter.

(b) Coupling for the vent vapor line to connect the gas meter. Coupling to be sized for a minimum pressure drop.

(c) Coupling for the vent of the vacuum assisted secondary processing unit to connect the gas meter. Coupling to be sized so as to create no significant additional pressure drop on the system.

(d) Coupling for tank truck vapor return line with thermocouple, manometer‡ and HC analyzer taps. Coupling to be the same diameter as the vapor return line.

(e) Coupling for tank truck fuel drop line with thermocouple tap. Coupling to be the same diameter as the fuel line.

(f) Two (2) hydrocarbon analyzers (FID or ARB approved equivalent) with recorders and with a capability of measuring total gasoline vapor concentration of 100 percent as propane. Both analyzers to be of same make and model.

* ~~The use of the word thermocouple is to imply temperature sensing device throughout this procedure.~~
Wherever in this procedure the use of a "thermocouple" is specified, another equally effective temperature sensing device may alternatively be used.

‡ ~~The use of the word manometer is to imply pressure sensing device throughout this procedure.~~
Wherever in this procedure the use of a "manometer" is specified, another equally effective pressure sensing device may alternatively be used.

(g) Three (3) flexible thermocouples or thermistors (0-150°F) with a recorder system.

(h) Explosimeter

(i) Barometer

(j) Three manometers or other pressure sensing devices capable of measuring zero to ten inches of water.

(k) Thermometer

2.3 Procedure

(a) The test for underground fueling will be conducted under, as closely as feasible, normal conditions for the station. Normal conditions will include delivery time and station operating conditions.

(b) Connect manifold to outlet of positive displacement meter and resulting to system vent of underground tank using the coupler or if the vent has a restriction, remove the restriction and connect the coupler, manifold and the meter system to the vent and connect restrictor to manifold outlet. If appropriate, connect another manifold and meter to the vent of the vacuum assisted secondary processing unit, or, if appropriate, use E.P.A. stack sampling techniques. If the system uses an incinerator to control emissions, use the test procedures set forth in Section 3.6.

(c) Connect the HC analyzer with recorder, thermocouple and manometer to the vent manifold. Calibrate the equipment in accordance with Section 3.3.

(d) Connect the couplers to the tank truck fuel and vapor return lines.

(e) Connect an HC analyzer with a recorder, a manometer and a thermocouple to the taps on the coupler on the vapor return line. Connect thermocouple to the tap on the coupler on the fuel line.

(f) Connect tank truck fuel and vapor return lines to appropriate underground tank lines in accordance with written procedure for the system.

(g) Check the tank truck and all vapor return line connections for a tight seal before and during the test with the explosimeter.

(h) Record the initial reading of gas meter(s).

(i) Start fueling of the underground tank in accordance with manufacturers' established normal procedure.

(j) Hydrocarbon concentrations, temperature and pressure measurements should be recorded using stripchart recorders within the first 15 seconds of the unloading period. The gas meter reading is to be taken at 120 second intervals.

(k) Record at the start and the end of the test barometric pressure and ambient temperature.

(l) At the end of the drop, disconnect the tank truck from the underground tank in accordance with manufacturers' instructions (normal procedure). Leave the underground tank vent instrumentation in place.

(m) Continue recording hydrocarbon concentrations, temperatures, pressure and gas meter readings at the underground tank vent and/or the exhaust of any processing unit at 20-minute intervals. Do this for one hour for balance systems and until the system returns to normal conditions as specified by the manufacturer for secondary systems.

(n) Disconnect instrumentation from the vent(s).

(o) Record volume of gasoline that is delivered.

(p) Record final reading of gas meter.

2.4 Calculations

(a) Volume of gas discharged through "i th" vent. This includes underground tank vent and any control system vent.

$$V_{vsi} = \frac{V_{vi} \times 520 \times P_b}{T_{vi} \times 29.92}$$

Where:

V_{vsi} = Volume of gas discharged through "i th" vent, corrected to 60°F and 29.92 in. Hg; Ft^3.

P_b = Barometric Pressure, in. Hg.

V_{vi} = Volume of gas recorded by meter on "i th" vent, corrected for amount of vapor removed for the hydrocarbon analysis, Ft^3.

T_{vi} = Average temperature in "i th" vent line, °R.

i = The vent under consideration.

(b) Volume of gas returned to the tank truck.

$$V_t = \frac{0.1337G_t\ (520 \times [P_b + \Delta H])}{T_t \times 29.92}$$

Where:

V_t = Volume of gas returned to the tank truck at 60°F and 29.92 in. Hg; Ft^3.

G_t = Volume of gasoline delivered, gal.

ΔH = Final gauge pressure of tank truck; in. Hg.

T_t = Average temperature of gas returned to tank truck, °R.

$$V_{vsi} = \frac{V_{vi} \times 520 \times P_b}{T_{vi} \times 29.92}$$

Where:

V_{vsi} = Volume of gas discharged through "i th" vent, corrected to 60°F and 29.92 in. Hg; Ft^3.

P_b = Barometric Pressure, in. Hg.

V_{vi} = Volume of gas recorded by meter on "i th" vent, corrected for amount of vapor removed for the hydrocarbon analysis, Ft^3.

T_{vi} = Average temperature in "i th" vent line, °R.

i = The vent under consideration.

(b) Volume of gas returned to the tank truck.

$$V_t = \frac{0.1337 G_t \, (520 \times [P_b + \Delta H])}{T_t \times 29.92}$$

Where:

V_t = Volume of gas returned to the tank truck at 60°F and 29.92 in. Hg; Ft^3.

G_t = Volume of gasoline delivered, gal.

ΔH = Final gauge pressure of tank truck; in. Hg.

T_t = Average temperature of gas returned to tank truck, °R.

P_b = Barometric pressure, in. Hg.

0.1337 = Conversion factor gallons to Ft^3.

(c) Collection efficiency

$$E = \frac{V_t \times C_t \times 100}{(V_t \times C_t) + \Sigma[C_{vi} \times V_{vsi}]}$$

Where E is the efficiency of control in percent.

V_t = Form (b) above.

C_t = The average fractional volume concentration of gasoline vapor in the return line to the truck as determined by the hydrocarbon analyzer, decimal fraction.

C_{vi} = The average fractional volume concentration of gasoline vapors in the "i th" vent as determined by the hydrocarbon analyzer, decimal fraction.

V_{vsi} = From (a) above.

3. Vehicle Fueling Test Procedure

3.1 Principle and Applicability

3.1.1 Principle. Tests are conducted on a sample of vehicles representative of the vehicle population to determine the weight of gasoline vapor returned to the underground tank and the weight of vapor lost through any vents in the system. Baseline data (the weight of gasoline vapor displaced per gallon of gasoline dispensed for given temperatures of the gasoline in the vehicle tank and the dispensed gasoline, and given vapor pressure of the dispensed gasoline) are determined from vehicles from which no significant leaks occurred during fueling. The efficiency of the vapor recovery system is then calculated by comparing the amount of vapor returned during fueling, corrected for vent losses, to the baseline data.

3.1.2 Applicability. The method is applicable to all control systems in which vapors are returned from the vehicle tank to the underground tank or disposal system through a vapor line.

3.2 Determination of Gasoline Vapor Transferred to Underground Tank and Discharged through Vent of Underground Tank and Control System During Vehicle Fueling.

3.2.1 Apparatus

(a) Positive displacement meter with a capacity of 3000 SCFH and a pressure drop of no more than 0.05 inches water at 30 SCFH. If testing is to be conducted concurrently at more than one pump, an additional positive-displacement meter will be required for each additional pump. The positive displacement meter must be calibrated at 10, 30, 50, 60, 90, 120, 180, 300, and 3000 SCFH.

(b) A manifold, for connection to the nozzle vapor line at the nozzle, with ports for a thermocouple, a pressure sensor, and HC analyzer sample line. A manifold, for connection to the nozzle gasoline line at the nozzle, with a tap for a thermocouple. A set of these manifold will be required for each pump to be included in the test.

(c) A modified nozzle (of the type to be tested) with a 1/8 inch copper tube as a pressure tap. The tube enters through the nozzle body into the dispensing spout and exits through the wall of the dispensing spout about two inches from the end of the spout. The pressure tap is connected to the pressure transducer with 1/8 inch teflon tubing.

(d) A manifold for the inlet to the positive displacement meter with taps for a thermocouple and a pressure transducer.

(e) A manifold for the outlet of the positive displacement meter. The manifold will have a one inch I.D. valve for closing off flow to the vapor return line. Between the valve and positive displacement meter will be a 1/4 inch or 3/8 inch tap for connecting the flow system for pressurizing the vehicle fill neck for the leak rate check.

(f) The pressure system for conducting the pre-fueling leak rate check consists of a nitrogen bottle (2000 psig), commercial grade), a control valve for regulating the bottle pressure to 1 psig, a needle valve, two Magnehelic gauges (0 - 30 and 0 - 10 inches water) for determining the pressure upstream and downstream of the needle valve, and a dry gas meter (175 SCFH), alternately an adequate flowmeter), a device for ensuring a tight seal with the vehicle fill-pipe, and a hose for supplying pressure to the vehicle tank. The device (see Figure 3) is to have a tap for allowing monitoring of the pressure in the fill-pipe during the leak check.

(g) The pressure system for conducting the post-fueling leak rate check consists of a nitrogen bottle (2000 psig), commercial grade, a control valve for regulating the bottle pressure to 1 psig, a needle valve, two Magnehelic gauges (0 - 30 and 0 - 10 inches water, for determining pressure upstream and downstream of the needle valve, and a dry gas meter (175 SCFH), alternately an adequate flowmeter.

(h) A positive displacement meter, with a capacity of 3000 SCFH, a pressure drop of no more than 0.05 inches at 30 SCFH, and equipped with automatic data gathering system that can differentiate direction of flow and records volume vented in such a manner that this data can be correlated with simultaneously recorded HC data. A manifold with taps for an HC analyzer, a thermocouple, and a pressure sensor is to be used with the positive displacement meter.

Such a system is required for each vent of the station unless the vents can be manifolded together without affecting the vapor recovery system operation. If the underground tanks are vented separately then only the vent(s) of the underground tank for the grade of gasoline used during the test is (are) required to be instrumented.

(i) Four flexible thermocouples or thermistors (0 - 150°F) with recorders.

(j) Two pressure transducers (± .5 psi) with recorder.

(k) Two HC analyzers (FID or ARB approved equivalent) with recorders and with a capability of measuring gasoline vapor concentrations of 100 percent as propane.

It is suggested that the recorder for the HC analyzer to be used at the vent manifold be equipped with an event marker that will record when out-breathing occurs on the HC strip chart. If not, then periodic readings of the dry gas meter will be required and the time of the readings must be noted on the HC strip chart.

(l) Barometer.

(m) Thermometer.

(n) Explosimeter.

(o) Containers for RVP samples.

(p) Apparatus for determining RVP by ASTM test method D323-72, and/or apparatus for determining RVP by the Chevron Research Corporation's micro-technique.

(q) Flexible thermocouple (0 - 150°F) or type for determining vehicle tank temperatures with system to ensure contact with liquid.

3.2.2 Procedure for Determination of Gasoline Vapor Transferred to Underground Tank and Discharged Through Vent of Underground Tank During Vehicle Fueling.

(a) Connect the appropriate manifolds to the nozzle. Connect a thermocouple, and an HC analyzer to the manifold on the vapor return side of the nozzle. Connect a thermocouple and the gasoline delivery line to the manifold on the gasoline inlet side of the nozzle. Connect pressure transducer line to the nozzle pressure tube.

(b) Connect the appropriate inlet manifold to the inlet of the positive-displacement meter and connect a thermocouple and pressure transducer to the inlet manifold. Connect the appropriate outlet manifold to the outlet of the positive-displacement meter and connect the leak-rate pressure line to the outlet manifold. For a balance system, connect a one-inch polypropylene line from the outlet manifold on the vapor return side of the nozzle to the inlet manifold of the positive-displacement meter, and connect a one-inch polypropylene line from the outlet of the one-inch valve downstream of the meter to the underground vapor recovery line. (System should be arranged so that pressure drop through the system is approximately the same with measuring devices connected as when system is operated normally.)

(c) Connect the manifold with dry gas meter, thermocouple, and HC analyzer to the vent of the underground tank. If the vents cannot be manifolded together, when a vacuum-assisted system is being tested, connect similar instrumentation to the vent of the gasoline vapor control system. When an incinerator is used to process gasoline vapors, install the positive displacement meter and manifold into the line to the incinerator. Connect HC analyzer, thermocouple, and pressure sensor to manifold taps.

(d) Assemble apparatus for conducting leak check of vehicle fuel tank. Connect 3/8 inch pressure supply hose and pressure sensor to leak check device. Connect supply hose to needle valve and pressure sensors upstream and downstream of needle valve. Connect regulator to bottle of nitrogen and exhaust of regulator by 3/8 inch line to the needle valve.

(e) Calibrate all instruments according to their manufacturers operating manuals for spans appropriate to the test requirements (Section 3.3). Calibrate the instruments at least at the start and end of the day's testing.

(f) Record the ambient barometric pressure and temperature after each vehicle test.

(g) Take five samples of gasoline from the underground tank in accordance with ASTM Method D270-65 and determine their RVP by ASTM test Method D323-72 or the Chevron micro-technique. Repeat after each fuel delivery to the underground tank.

(h) At the start and end of the test day, record the liquid volume readings on each gasoline pump at the service station. For systems using an incinerator, record the meter reading of the positive-displacement meter installed in the vapor line to the incinerator.

(i) At the start and end of the test period, record the positive-displacement vapor meter readings of the meters in the vents. Monitoring of vent emissions shall be 24 hours per day.

3.2.2.1 Leak check of vehicle fuel tanks to be done prior to vehicle tests is described below.

(a) Connect device for determining vehicle tank leak rate to vehicle fill-pipe.

(b) Open main valve on the nitrogen supply bottle and adjust the needle valve until the pressure in the fill neck reaches one half (1/2) inch water (gauge) and is stable.

(c) Determine the rate at which vapor is leaking by either timing a volume of 0.1 $ft.^3$ or by selecting a time period of 15 seconds, whichever results in a smaller volume being transferred to the vehicle tank. Record readings. If a stable pressure cannot be maintained due to too large a leak, note this.

(d) Remove device from the vehicle fill-pipe and proceed with the procedures as described in Section 3.2.2.2.

(e) If a leak-rate greater than 0.01 cfm is determined the vehicle may not be a base-line vehicle and the post-fueling leak check need not be conducted.

3.2.2.2 The following steps are for performing the individual vehicle tests.

(a) All dispensing from any nozzle not being tested, but connected to the same vapor return line as the test nozzle, must be done carefully by a service station attendant and not by a self-service customer. This procedure applies regardless of the mode of operation used during the 90-day reliability period. Even if certification is being sought for a totally manifolded system that is to be used in the self-service mode, all dispensing during the 100-car test, except dispensing which is done with the test nozzle, must be done very carefully by an attendant.

(b) For each vehicle tested insert a thermocouple into the vehicle tank, ensure thermocouple comes in contact with the liquid, allow sufficient time for the instrument to stabilize, and record the initial temperature of gasoline in its fuel tank.

(c) Instruct station attendant or self-service customer to connect nozzle. Note the type of fit obtained and note the make, model and year of vehicle being tested. The note on the type of fit obtained should include:

1) whether or not the nozzle could be latched,
2) problems encountered when inserting the nozzle, and
3) whether or not the nozzle was hand-held.

(d) Record the initial positive-displacement meter reading, turn chart recorders on, and verify operation of sensors. Set HC sample flowrate to approximately 500 cubic centimeters per minute.

(e) Instruct station attendant or self-service customer to start fueling vehicle at the maximum desired automatic flow-rate. Record the setting.

(f) Indicate on charts and/or other data print-outs the point at which fueling commences.

(g) Record the dispensed liquid and returned vapor temperatures and record the positive-displacement meter readings at five gallon intervals. Indicate on the chart recordings the point at which each five gallon increment is passed. Take background explosimeter reading.

Use explosimeter to detect any leaks at the nozzle-fillneck interface. (Warn person dispensing gasoline that an explosimeter will be used and this is not to affect the person's normal mode of operation.)

(h) Indicate on the chart recordings the point at which fueling is terminated. Need a minimum of four gallons of fuel dispensed for an acceptable test. This is to allow for instrumentation responses to stabilize.

Record the total gallons dispensed and the final positive-displacement meter readings. Note any incidents of "spitbacks" or spills. Note the combustible gas detector readings. Instruct station attendant or self-service customer not to disturb the nozzle.

3.2.2.3 The post-fueling leak rate check is not to be conducted for vacuum assisted systems. Steps (a) through (e) are for leak rate check for displacement systems.

(a) Close the valve in the vapor return line under test so that the vapor return line is closed to gas flow. (Be sure HC analyzer sample pump has been turned off.)

(b) Open the main valve on the nitrogen supply bottle and adjust the needle-valve until the pressure in the fill-neck is at the desired level and is stable. It is suggested that the leak rate be determined at three fillneck pressures, one point below the average pressure experienced during fueling, one at average pressure and one above average pressure.

(c) Determine the rate at which vapor is leaking by timing a convenient volume (suggest a minimum of 0.1 ft.^{3} or 15 seconds). Mark the chart pressure trace at the start and finish of each timed interval. Record the time and volume. Repeat for each pressure setting. If a stable pressure cannot be maintained due to too small a leak (probably through vehicle's evaporative emission control system) so note. If the pressure experienced during the fueling cannot be obtained because the leak is too large, note this also.

(d) Remove the nozzle from the vehicle fill-neck and replace on the gasoline pump. Purge HC analyzer system and zero pressure transducers. Open the valve in the vapor return line.

(e) Measure the final temperature of the gasoline in the vehicle tank and record.

3.2.2.4 Continue tests for the test sample. The sample shall be statistically representative of the vehicle population, weighted according to vehicle miles travelled (Section 3.4 5).

(a) The vehicle population is to meet the specified vehicle matrix within three vehicles. The test vehicles are to be selected on a first-in-first tested basis. The exception to this is when a vehicle is rejected for one of the reasons in (b) below.

(b) The only acceptable reasons for rejection of a vehicle are: (1) incomplete test data; (2) vehicle has been modified in the vicinity of the fill-pipe opening or vehicle fill-pipe has been modified or damaged, (3) vehicle test matrix category already full, (4) less than required minimum fuel dispensed, (5) vehicle did not have fill-pipe cap upon arrival at station.

3.2.2.5 At the end of the testing determine the number of baseline vehicles (those vehicles which met the conditions of 3.2.3 (g)) if this number is not 40 or more, continue testing until this number is obtained. These additional vehicles will only be used in estimating actual vehicle emissions and will not be used in calculating the system efficiency. (Any additional baseline vehicles have to meet the conditions in 3.2.3 (g).

3.2.2.6 Any test vehicle which had an initial vehicle tank temperature more than 10°F outside the range of temperatures for the baseline vehicles will be discarded from the test fleet.

3.2.2.7 Record pressure of the vehicle tank and the underground tank during various rates of fueling and determine the pressure drop in the line from the nozzle to the underground tank.

3.2.3 Calculations

(a) Volume of gas transferred to underground tank during vehicle fueling.

$$V_{rs} = \frac{V_r \times 520 \times (P_b + \Delta H_r/13.6)}{T_r \times 29.92}$$

Where:

V_{rs} = Volume of gas corrected to 60°F and 29.92 in. Hg. passing through dry gas meter in nozzle vapor line for each vehicle, Ft.^{3}.

V_r = Actual volume of gas passing through the dry gas meter in the nozzle vapor line for each vehicle. Corrected for amount of vapor removed for the hydrocarbon analysis, $Ft.^3$.

P_b = Average barometric pressure, in. Hg.

ΔH_r = Average manometer pressure, in. H_2O.

T_r = Average temperature in the nozzle vapor line, °R taken at meter inlet.

(b) Weight of gasoline vapor transferred to underground tank during vehicle fueling.

$$W_r = \frac{C_r \times V_{rs} \times M_r \times 454}{379}$$

Where:

W_r = Weight of gasoline vapor transferred to underground tank for each vehicle, Gm.

C_r = Average fractional concentration of hydrocarbons, decimal fraction.

V_{rs} = From (a) above.

M_r = Molecular weight of hydrocarbon used to calibrate hydrocarbon analyzer, lbs/lb. Mole.

(c) Volume of gas discharged from vent of underground tank during vehicle fueling.

$$V_{as} = \frac{V_a \times 520 \times P_b}{T_a \times 29.92}$$

Where:

V_{as} = Total volume of gas discharged from vent of the underground tank plus from vent of control system if a vacuum-assisted system, corrected to 60°F and 29.92 in. Hg, $Ft.^3$.

V_a = Actual volume of gas passing through dry gas meter, or meters, corrected for amount of vapor removed for the hydrocarbon analysis, $Ft.^3$.

P_b = Average barometric pressure, in. Hg.

T_a = Average temperature of gas discharging from vent, or vents, °R.

(d) Weight of gasoline vapor discharged from vent of underground tank during vehicle fueling.

$$W_a = \frac{C_a \times V_{as} \times M_a \times 454\ G_d}{379\ G_s}$$

Where:

W_a = Weight of gasoline vapor discharged from the vent of the underground tank, plus from vent of control system if a vacuum-assisted system, weighted for the gallons of gasoline sold through the pump where vehicle testing occurs, Gm.

C_a = Average fractional concentration of hydrocarbons at vent, decimal fraction.

V_{as} = From (c) above.

M_a = Molecular weight of hydrocarbons compound used to calibrate hydrocarbon analyzer, lbs/lb. Mole.

Note: If an incinerator is used to process vapors, see Section 3.6 for calculation of incinerator emissions.

G_d = Total volume of gasoline dispensed to the test vehicles, gal.

G_s = Total volume of gasoline dispensed from all the station pumps, gal.

Note: If the rate of volume emissions and the hydrocarbon concentrations of the vent emissions are not constant with time, the product of $C_a \times V_{as}$ must be integrated with respect to time. Numerical integration techniques are recommended.

(e) Weight of gasoline vapor displaced during vehicle fueling of the test fleet.

$$W_x = \sum_{i=1}^{n} [\frac{U}{L}]_i \ (G)_i$$

Where:

W_x = Baseline weight of total gasoline vapor displaced during vehicle fueling, Gm.

$[\frac{U}{L}]_i$ = From regression equations developed from baseline vehicle data. Gm/gal.

$(G)_i$ = Number of gallons transferred during "i th" fueling.

i = Individual fueling.

Note: For calculating W_x for baseline vehicles, use W_{ri} instead of $[\frac{U}{L}]_i \ G_i$.

(f) Efficiency of fueling control system.

$$E_r = \frac{[\sum_{i=1}^{n} W_{ri} - W_{ai}] \times 100}{W_x}$$

Where:

E_r = Efficiency of vehicle fueling control system, percent.

W_r = From (b) above.

W_a = From (d) above.

W_x = From (e) above.

i = Individual fueling.

(g) Regression equations for estimating the actual weight of gasoline vapor displaced during vehicle fueling of the test fleet.

For a balance system, select those vehicles from the total list of vehicles tested which had: (1) complete test data, (2) a pre-fueling leak rate of equal to or less than 0.01 CFM, (3) a post-fueling leak rate of equal to or less than 0.01 CFM, (4) explosimeter readings for the fueling period equal to or less than 0.1 LEL (except for a monetary spike such as the end of fueling). It is desireable that baseline vehicles be those where "hands-off" fueling occurred; however, this may not be possible due to the nature or mode of operation of the system being tested. These vehicles and their measured data will be used to develop the regression equation to determine [$\frac{U}{L}$]; for a balance type vapor recovery system.

For a vacuum-assisted system, select those vehicles from the total list of vehicles tested which had: (1) a pre-fueling leak rate of equal to or less than 0.01 CFM, (2) a zero or negative pressure in the vehicle fillneck for the fueling period, (3) explosimeter readings for the fueling period equal to or less than 0.1 LEL (except for a monetary spike such as at the end of fueling), and (4) a complete set of data. These vehicles and their measured data will be used to develop the regression equation to determine [$\frac{U}{L}$]; for a vacuum-assisted type vapor recovery system. Using step-wise regression techniques, determine a multi-variable linear regression equation for the emissions from baseline vehicles (those vehicles selected by the above criteria) using as the dependent variable - grams HC vapor per gallon of gasoline dispensed.

$$\left(\frac{W_r}{\text{gallons of gasoline dispensed to vehicle}}\right)$$

and as the independent variables - the vapor pressure of the dispensed gasoline, the initial temperature of the gasoline in the vehicle tank (T_v), and the average temperature of the dispensed gasoline (T_d). An equation of a different form (such as a quadratic) or an equation using different independent variables may be used if the alternate equation gives a statistically better fit at the 0.01 level of confidence.

3.3 Calibrations

3.3.1 Flow meters. Standard methods and equipment shall be used to calibrate the flow meters. The calibration curves are to be traceable to National Bureau of Standards (NBS) standards.

3.3.2 Temperature recording instruments. Calibrate daily prior to test period and immediately following test period using ice water (32°F) and a known temperature source about 100°F.

3.3.3 Pressure recording instruments. Calibrate pressure transducers prior to the 100 vehicle Phase II test with a static pressure calibrator for a range of -3 to +3 inches water or appropriate range of operation. Zero the transducers after each individual vehicle test.

3.3.4 Total hydrocarbon analyzer. Follow the manufacturer's instructions concerning warm-up time and adjustments. On each test day prior to testing and at the end of the day's testing, zero the analyzer with a zero gas (<3 ppm C) and span with 30 percent and 70 percent concentrations of propane. Prior to the Phase I and Phase II testing perform a comprehensive calibration in the laboratory. Check the analyzer with several known concentrations of propane to determine linearity. The HC calibration cylinders must be checked against a reference cylinder maintained in the laboratory before each field test. This information must be entered into a log identifying each cylinder by serial number. The reference cylinder must be checked against a primary standard every six months and the results recorded. The reference cylinder is to be discarded when the assayed value changes more than one percent. Any cylinder is to be discarded when the cylinder pressure drops to 10 percent of the original pressure.

3.3.5 A record of all calibrations made is to be maintained.

3.4 Acceptance of Systems

When a system is accepted, it will have certain physical features such as piping sizes and configurations which may have to be modified to accomodate the requirements of each installation. Because the pressure drops and other characteristics of the system are influenced by these features and these in turn influence effectiveness, it may be necessary to condition acceptance upon certain criteria which account for physical parameters such as pressure drops and flow rates. When systems are tested for acceptance, these parameters will be ascertained.

Some of the conditions that may be imposed upon an acceptance are:

(a) Allowable pressure drop in the lines leading from the dispensing nozzle to the underground tank.

(b) The method of calculating the pressure drop.

(c) The model of dispensing nozzle which may be used.

(d) The manner in which vapor return lines may be manifolded.

(e) The type of restriction to be placed on the vent of the underground tank.

(f) The number of dispensing nozzles which may be serviced by a secondary system.

(g) Allowable delivery rates.

(h) Use of the system on full-service stations only.

3.5 Test Sample

A total of 100 vehicles are required to be tested for determining the efficiency of a Phase II system. The vehicle distribution based on model year, vehicle miles travelled and manufacturer for use until September 1976 is given in Table I. An up-date table will be issued in September of each subsequent year. Vehicles will be tested as they enter the station ("first in" basis) until a specific matrix block of the distribution is filled. Additional tested cars that fit into a completed matrix block can be used as baseline vehicles but may not be substituted for earlier complete tests. Exception to this is when more than two identical vehicles arrive to be tested, only the first two will be used. (An example of this would be if three 1975 Impala station wagons come in for testing, only the first two would be used unless one was rejected for other reasons such as missing data.) The only other reasons for excluding a vehicle from the test fleet are: (1) incomplete data for vehicle (missing vehicle temperature, HC concentration, volume returned); (2) less than require minimum fuel dispensed; (3) vehicle has been modified in the vicinity of the fillpipe opening or has significantly damaged or modified fuel tank fillpipe; (4) vehicle was agreed upon by applicant and ARB as being unacceptable; (5) vehicle did not have fill-pipe cap upon arrival at station.

3.6 Test Procedures for Determining Incineration Emissions

3.6.1 Principle and Applicability

3.6.1.1 Hydrocarbon and carbon dioxide concentrations in the exhaust gases, and gas volume and HC concentrations in the inlet vapor, and ambient carbon dioxide concentrations are measured. These values are used to calculate the incinerator HC control efficiency and mass emission rate based on a carbon balance.

3.6.1.2 Applicability: This method is applicable as a performance test method for gasoline vapor control incinerators used at service stations equipped for Phase I and II vapor control.

3.6.2 Test Scope and Conditions

3.6.2.1 Station Test Status: The procedure is designed to measure incinerator control efficiency under conditions that may be considered normal for the station under test. All dispensing pumps interconnected with or sharing the control system under test shall remain open as is normal for the station operation. Vehicles shall be fueled as is normal for the test period. As underground tank filling produces vapor volumes different from vehicle tank filling, no underground tank filling should be performed during the test period. A separate test is to be made to determine vapor control efficiency during Phase I operations.

3.6.2.2 Fuel RVP: The RVP of the fuel dispensed during the test shall be within the range normal for the geographic location and time of the year.

3.6.3 Test Equipment

3.6.3.1 HC Analyzers: HC analyzers using flame ionization detectors calibrated with known concentrations of propane in air are used to measure HC concentrations at both the incinerator inlet and exhaust. A suitable continuous recorder is required to record real-time output from the HC analyzer.

3.6.3.2 Sample System: The sample probe is to be of a material unaffected by combustion gases (S.S. 365). The sample pump should be oil-less and leak-tight. Sample lines are to be inert, teflon is recommended. A thermocouple (0-2000°F) shall be used to monitor temperature of exhaust gases at the inlet to sampling system.

3.6.3.3 Carbon Dioxide Analyzer: A nondispersive infrared analyzer calibrated with known quantities of CO_2 in air is used to measure CO_2 concentrations in the exhaust gas.

3.6.3.4 Other equipment is specified in Section 3.2.1.

3.6.4 Test Procedure

3.6.4.1 Visual Inspection: Any visual emissions except for steam, from vapor incinerators are an indication of poor combustion. An incinerator shall not emit air contaminants (not including moisture) in such a manner that the opacity of the emission is greater than 10 percent for a period or periods aggregating more than one minute in any 60 consecutive minutes; or greater than 40 percent opacity at any time. Should such visible emissions from the exhaust be detected, the control system is unacceptable and the problem must be corrected and an application made to the ARB for reconsideration for certification.

3.6.4.2 Sample Location: The sampling point should be located in the exhaust stack down-stream of the burner far enough to permit complete mixing of the combustion gases. For most sources, this point is at least eight stack diameters downstream of any interference and two diameters upstream of the stack exit. There are many cases where these conditions cannot be met. The sample point should be no less than one stack diameter from the stack exit and one stack diameter above the high point of the flame and be at a point of maximum velocity head as determined by the number of equal areas of cross-sectional area of the stack. The inlet sampling location is in the system inlet line routing vapors to the burner. A HC sample tap, a pressure sensor tap, and a thermocouple connection to monitor gas temperature must be installed on the inlet side of the volume meter.

3.6.4.3 Monitoring Equipment Set-Ups: Span and calibrate all monitors. Connect sampling probes, pumps and recorders to the monitors and mount sampling probes in the stack and at the inlet.

3.6.4.4 Measurements: Mark strip charts at the start of the test period and proceed with HC, CO_2, and volume measurements for at least three burning cycles of the system. The total sampling time should be at least three hours. Sampling for HC's and CO_2 must occur simultaneously. At the end of each cycle, disconnect CO_2 instrument and obtain an ambient air sample. This step requires that the CO_2 instrument be calibrated for the lower concentrations expected at ambient levels.

3.6.4.5 Gasoline Liquid Volume: Record the gasoline liquid dispensed during the test period.

3.6.5 Calculations

3.6.5.1 Symbols

CO_2	=	Carbon dioxide concentration in the exhaust gas (ppmv).
CO_{2a}	=	Average carbon dioxide concentration in the ambient air (ppmv).
HC_i	=	Hydrocarbon concentration in the inlet gas to the burner (ppmv as propane).
HC_e	=	Hydrocarbon concentration in the exhaust (ppmv as propane).
L_d	=	Gasoline liquid volume dispensed during test period (gallons).
P_i	=	Static pressure at inlet meter (in H_g).
T_i	=	Temperature of gas at inlet meter (°F).
V_i	=	Inlet gas volume (ft^3).
F	=	Dilution Factor
51.6×10^{-6}	=	Correction factor for grams of hydrocarbon per gas volume parts per million propane $\left(\frac{g}{(SCF)\ (ppmv)}\right)$
3	=	Number of carbon atoms per propane molecule.

3.6.5.2(a) Calculate the standard total gas volume (V_s) at the burner inlet for each test. (Standard temperature 60°F, standard pressure 29.92 in Hg).

$$V_s = V_i \frac{(P_i + 29.92)}{(T_i + 460)} \frac{520}{29.92} \quad (1)$$

(b) Calculate an average vapor volume to liquid volume (v/l) at the inlet for each test.

$$(v/l)_i = \frac{V_s}{L_d} \quad \frac{(SCF)}{gal} \quad (2)$$

(c) A carbon dilution factor, F, can be calculated for the incinerator using the inlet and outlet CO_2 concentrations, the inlet and outlet HC concentrations and the ambient CO_2 concentration. The important criterion for this calculation is that all the significant carbon sources be measured. The values used in the calculation should represent average values obtained from strip chart readings using integration techniques. Some systems have more than one burning mode of operation. For these it is desirable to have high and low emission levels calculated. This requires that corresponding dilution factors (v/L) values and $(m/L)_i$, values be calculated for each period in question.

$$F = \frac{HC_i}{HC_e + \frac{CO_{2e} - CO_{2a}}{3}} \qquad (3)$$

(d) The mass emission rate $(m/L)_e$ is calculated using the inlet $(m/L)_i$ from equation (3) and the carbon dilution factor from equation (4). The exhaust HC concentration will vary with time and operation of the system. It is likely that, in addition to an overall average mass emission rate using an average HC_i, several peak values of $(m/L)_e$ will be required as discussed above. If some correlations between HC_i and HC_e occurs over the burning cycle of the system, this calculation should be used to show the change in mass emission rate.

$$(m/L)_e = F \left(\frac{HC_e}{HC_i}\right) (m/L)_i \text{ (g/gal)} \qquad (5)$$

(e). Mass control efficiency (% E) can be calculated for an average value over each test interval. It represents the reduction of hydrocarbon mass achieved by the incinerator system and this efficiency can vary depending on the loading cycle or the inlet loading.

$$\%E = 100\left[1 - \frac{(F)(HC_e)}{(HC_i)}\right] \qquad (6)$$

3.6.6 Calibrations

3.6.6.1 Total Hydrocarbon Analyzers: Flame ionization detectors or equivalent total hydrocarbon analyzers are acceptable for measurement of exhaust hydrocarbon concentrations. Calibrations should be performed following the manufacturer's instructions for warm-up time and adjustments. Calibration gases should be propane in hydrocarbon-free air of known concentrations prepared gravimetrically with measured mass quantities of 100 percent propane. A calibration curve shall be produced using a minimum of five (5) prepared calibration gases in the range of concentrations expected during testing. The calibration curve shall be used in determining measured levels during testing. The calibration of the instrument need not be performed on site, but shall be performed prior to and immediately following the test program. During the test program, the HC analyzer shall be spanned on site with zero gas (<3 ppmv C) and with known concentrations of propane in hydrocarbon-free air at a level near the highest concentration expected. The spanning procedure shall be performed at least twice each test day.

3.6.6.2 Carbon Dioxide Analyzer: Nondispersive infrared analyzers are acceptable for measurement of exhaust CO_2 concentrations. Calibrations should be performed following the manufacturer's instructions. Calibration gases should be known concentrations of CO_2 in air. A calibration shall be prepared using a minimum of five prepared calibration gases in the range of concentrations expected. The calibration of the instrument need not be performed on site but shall be performed immediately prior to and immediately following the test program. During the testing the analyzer shall be spanned with a known concentration of CO_2 in air at a level near the highest concentration expected. The spanning procedure shall occur at least twice per test day.

3.7 Alternate equipment and techniques may be used if prior approval is obtained from the ARB.

STATE OF CALIFORNIA

AIR RESOURCES BOARD

STATIONARY SOURCE TEST METHODS

Volume 2

Certification and Test Procedures for Gasoline Vapor Recovery Systems

NOVEMBER 1978

STATIONARY SOURCE CONTROL DIVISION

INTRODUCTION

The contents of this volume are the certification and test procedures used by the Air Resources Board to approve gasoline vapor recovery systems for gasoline marketing operations.

TABLE OF CONTENTS

METHOD	TITLE
2-1	Test Procedures for Determining the Efficiency of Gasoline Vapor Recovery Systems at Service Stations Adopted December 9, 1975, Amended March 30, 1976, Amended August 9, 1978. Amended Sept. 1, 1982
2-2	Certification Procedures for Gasoline Vapor Recovery Systems at Service Stations Adopted March 30, 1976 Amended August 25, 1977, Amended August 9, 1978
2-3	Certification and Test Procedures for Vapor Recovery Systems at Gasoline Bulk Plants Adopted April 18, 1977, Amended August 9, 1978
2-4	Certification and Test Procedures for Vapor Recovery Systems at Gasoline Terminals Adopted April 18, 1977
2-5	Certification and Test Procedures for Vapor Recovery Systems of Gasoline Delivery Tanks Adopted April 18, 1977 Amended Sept. 1, 1982

METHOD 2-2

State of California

AIR RESOURCES BOARD

Certification Procedures for Gasoline Vapor Recovery Systems at Service Stations

Adopted: March 30, 1976

Amended: August 25, 1977

Amended: August 9, 1978

TABLE OF CONTENTS

		Page
I.	General Applicability	1
II.	Definitions	2
III.	General Standards	3
IV.	Performance Standards	3
V.	General Requirements Applicable to Certification of all Control Systems	6
VI.	Application of Certification	10
VII.	Fees and Testing	12
VIII.	Certification	13

State of California

AIR RESOURCES BOARD

Certification Procedures for Gasoline Vapor Recovery Systems at Service Stations

I. General Applicability

These certification procedures are adopted pursuant to Section 41954 of the Health and Safety Code and are applicable to vapor recovery systems installed at gasoline service stations for controlling gasoline vapors emitted during the filling of storage tanks (Phase I) and vehicle fuel tanks (Phase II). Vapor recovery systems are complete systems and shall include all necessary piping, nozzles, couplers, processing units, underground tanks and any other equipment necessary for the control of gasoline vapors during fueling operations at service stations.

The certification procedures are not intended to be used to certify individual system components. For systems which are identical in design and include the same components as systems tested and certified, but differ, primarily in size, the manufacturer may demonstrate compliance capability and obtain certification by submitting engineering and test data demonstrating the relationship between capacity and throughput of each component whose performance is a function of throughput.

II. Definitions

A. Vapor-balance or displacement vapor recovery system - A gasoline vapor control system which uses direct displacement to force vapors into the underground tank (or bulk delivery tank) to prevent the emission of displaced vapors to the atmosphere during Phase I and/or Phase II operations.

B. Vacuum-assisted or vacuum-assisted secondary system. A gasoline vapor control system, which employs a pump, blower, or other vacuum inducing devices, to collect and/or process vapors generated during vehicle fueling (Phase II) operations.

C. Phase I - Control of vapors from underground tank fueling operations.

D. Phase II - Control of vapors from vehicle fueling operations.

E. Automatic Nozzle - A nozzle which will dispense fuel without being hand-held.

F. On-stream efficiency factor - That factor which indicates the fraction of time that the vapor recovery system is operating as the system was designed to operate.

$$\text{On-Stream Efficiency Factor} = \frac{t_s - t_d}{t_s}$$

Where t_s = System Time, Hours

t_d = System Down-Time, Hours

G. System Time - Hours that the system needs to be capable of controlling vapor emissions. For the 90-day reliability test period, this would be 2160 hours (24 hours per day x 90 days).

H. System Down-Time - The time (in hours) that the vapor recovery system is not operating as designed.

III. General Standards

A. Certification of a system by the California Air Resources Board does not exempt the system from compliance with other applicable codes and regulations such as fire, weights and measures, and safety codes.

B. Phase II systems must be capable of fueling, without the use of nozzle spout extenders, any motor vehicle that may be fueled at service stations not equipped with vapor recovery systems.

IV. Performance Standards

A. The system shall complete an operational test of at least 90 days. During the test, replacement of components or alteration of the control system is not allowed, except that the Executive Officer may allow replacement or alteration of a component if the component has been damaged due to an accident or vandalism and if he/she determines that the replacement or alteration would not affect the operational test results. No maintenance or adjustment to the system will be allowed during the certification test unless such action is specifically called for in the system's maintenance manual. The control system will be sealed in such a manner that unauthorized maintenance or adjustment may be detected. Maintenance or adjustment is to be performed only after notification of the person in charge of the testing, except in case of an emergency. Unauthorized maintenance or adjustment may be reason for immediate failure of the test.

A system component submitted to the Executive Officer for evaluation subsequent to July 1, 1977, may be subjected to a shorter operational test, if the Executive Officer determines that the reliability of the component may be adequately demonstrated in a period shorter than 90 days.

B. The system shall prevent emission to the atmosphere of at least 90 percent or that percentage by weight of the gasoline vapors displaced during the filling of the stationary storage tank as required by applicable air pollution control district rules and regulations. The percentages of control shall be determined as described in Section 2.0 of the "Test Procedures for Determining the Efficiency of Gasoline Vapor Recovery Systems at Service Stations" as incorporated in Title 17, subchapter 8, Section 94000, California Administrative Code.

C. The system shall prevent emission to the atmosphere of an average of at least 90 percent or that percentage by weight of the gasoline vapors displaced during the filling of the vehicle fuel tanks as required by applicable air pollution control district rules and regulations. The specified percentage of control shall be determined by multiplying the on-stream efficiency factor (definition F, Section II) by the efficiency of the system as determined by testing in accordance with the procedures in Section 3.0 of the "Test Procedures for Determining the "Efficiency of Gasoline Vapor Recovery Systems at Service Stations" as incorporated in Title 17, Chapter I, subchapter 8, Section 94000 of the California Administrative Code.

D. Prior to Air Resources Board certification of the vapor recovery system, plans and specifications for the intended generic system shall be submitted to the State Fire Marshal's Office for review to determine whether the system creates a hazardous condition or is contrary to adopted fire safety regulations. Final determination by the State Fire Marshal may be contingent upon a review of each pilot installation of the proposed system. Compliance with the State Fire Marshal's requirements shall be a precondition to certification by the Air Resources Board.

E. Prior to Air Resources Board certification, the system shall be submitted for type approval to the California Department of Food Agriculture, Division of Measurement Standards and certified by such Division. Only those systems meeting the requirements of the California Business and Professions Code and the California Administrative Code will be issued certificates of approval by the Division of Measurement Standards; such certification shall be a precondition to certification by the Air Resources Board. Certification testing by Measurement Standards and the Air Resources Board may be conducted concurrently.

F. Prior to certification of the system, the manufacturer of the system shall submit the system to the California Occupational Safety and Health Administration (Cal OSHA) for determining compliance with appropriate safety regulations. This may be conducted concurrently with certification testing by the Air Resources Board Compliance with Cal OSHA requirements shall be a precondition to certification by the Air Resources Board.

V. General Requirements Applicable to Certification of all Control Systems

A. An operating and required maintenance manual shall be submitted to the Executive Officer for each gasoline vapor control system submitted for certification. The operating manual shall, as a minimum, contain:

1. Identification of critical operating parameters affecting system operation, e.g., maximum dispensing rates; liquid to vapor flow rate ratios; pressures; etc. The operating range of these parameters associated with normal, in-compliance operation of the control system shall be identified. These operating data shall be determined and/or verified during the performance test of the system.

2. Identification of specific maintenance requirements and maintenance schedules necessary to ensure on-going operation in compliance with the applicable standards. Maintenance requirements shall be clearly identified as being capable of performance by the operator, or as requiring authorized

service only. Operating manuals shall provide clear instruction on operator maintenance and shall provide clear warnings against unauthorized service. Maintenance schedules shall, at a minimum, reflect the life of individual components such as regulators, compressors, nozzles, pressure vacuum valves, catalysts, combustor components, etc. Systems requiring maintenance which the Executive Officer finds unreasonable will be disapproved.

3. Identification of system components for each control system certified. Components shall, as applicable, be identified by brand name, part number, and/or performance characteristics. The identification shall be sufficiently clear so as to allow determination of comparability between tested and untested models, and/or to allow determination of the adequacy of replacement parts.

4. A warranty statement which complies with the requirements of Paragraph V. C. herein.

B. Indicating gauges, or alarms, or detection devices, or combination thereof, shall be included in each control system as required to enable monitoring of the critical system operation parameters. The gauges and alarms shall serve to alert and warn the gasoline service station owner or operator with an audible signal or warning light when the gasoline vapor control system is malfunctioning. Such gauges and alarms shall, as applicable, include temperature and pressure indicators, pass/fail hydrocarbon detectors, etc. These shall indicate the performance of critical components such as compressors, carbon canisters, etc. Specific examples of necessary devices are: temperature indicators installed in control systems which utilize refrigeration as a control technique; pressure indicators installed in control systems which utilize compression as a control technique; hydrocarbon breakthrough detectors installed in control systems which utilize carbon absorption or flexible bladders or seals as a control technique, and pressure differential indicators on vapor return lines to detect liquid blockage of the lines.

C. The manufacturer of the vapor recovery system shall provide a three-year warranty for the system. An exception to the warranty may be for those components of the system which the maintenance manual identifies as having expected useful lives of less than three years; the warranty in these cases may specify the expected life.

The manufacturer of each vapor recovery system shall warrant in writing to the ultimate purchaser and each subsequent purchaser that such vapor recovery system is:

1. Designed, built, and equipped so as to conform at the time of sale with the applicable regulations; and
2. Free from defects in materials and workmanship which cause such vapor recovery system to fail to conform with applicable regulations for three years.

D. The adequacy of methods of distribution, replacement parts program, the financial responsibility of the applicant, and other factors affecting the economic interests of the system purchaser shall be evaluated by the Executive Officer and determined by him or her to be satisfactory to protect the purchaser. A determination of financial responsibility by the Executive Officer shall not be deemed to be a guarantee or endorsement of the applicant.

E. The Executive Officer shall certify only those systems which, on the basis of an engineering evaluation of the system design and component quality, can be expected to perform with reasonable durability and reliability over the three-year warranty period specified in Paragraph V. C. herein.

VI. Application for Certification

A. An application for certification of a vapor recovery system (Phase I or Phase II) may be made to the Air Resources Board by any manufacturer. Certification will be granted to any applicant meeting the applicable standards and criteria.

B. The application shall be in writing, signed by an authorized representative of the manufacturer, and shall include the following:

1. A detailed description of the configuration of the vapor recovery system including but not limited to the following:

a. The underground piping configuration and specifications (pipe sizes, lengths, fittings, material(s), etc.);

b. Gasoline dispensing nozzle to be used for Phase II;

c. Engineering parameters for pumps and vapor processing units to be used as part of the vapor recovery system; and

d. Allowable pressure drops through the systems.

2. Evidence demonstrating the vapor recovery reliability of the system or device for 90 days;

3. A description of tests performed to ascertain compliance with the general standards, and the results of such tests;

4. A statement of recommended maintenance procedures, equipment performance checkout procedures, and equipment necessary to assure that the vapor recovery system, in operation, conforms to the regulations, plus a description of the program for training personnel for such maintenance, and the proposed replacement parts program;

5. Six copies of the service and operating manuals that will be supplied to the purchaser;

6. A statement that a vapor recovery system, installed at an operating facility, will be available for certification testing no later than one month after submission of the application for certification. The facility submitted for certification testing shall have a minimum throughput of 100,000 gallons per month and shall include at least six nozzles of each type submitted for approval. There shall

not be more than two types of nozzles at any one test facility.

7. The retail price of the system and an estimate of the installation and yearly maintenance costs;

8. A copy of the warranty or warranties provided with the system;

9. If the application is for a system previously tested, but not certified, the application shall include identification of the system components which have been changed; including all new physical and operational characteristics; together with any new test results obtained by the applicant; and

10. Such other information as the Executive Officer may reasonably require.

VII. Fees and Testing

A. A fee not to exceed the actual cost of certification will be charged by the Air Resources Board to each applicant submitting system(s) for certification. The applicant is required to demonstrate ability to pay the cost of testing prior to certification testing. This may take the form of posting a bond of not less than $20,000. A resolution of certification of the system will not be issued until the test fee has been paid in full to the Air Resources Board.

B. Testing may be conducted by an independent contractor under contract to the Air Resources Board. The contractor will be responsible solely to the Air Resources Board for the conduct of the certification test and the test results.

VIII. Certification

A. If the Executive Officer determines that a vapor recovery system conforms to all requirements set form in paragraphs I through VII herein, he or she shall issue an order of certification. The order may prescribe the conditions for issuance of the certification including but not limited to: a minimum allowable on-stream factor, maximum allowable monthly throughput, installation constraints, operating parameters, compliance with safety codes and regulations, compliance with measurement standards regulations, and approval for use at self-service stations or at only attendant-serve stations.

B. If after certification of a system the manufacturer wishes to modify the system, the proposed modifications must be submitted to the Executive Officer in a format specified by the Executive Officer for approval prior to their implementation. Such modifications may include substitution of components, elimination of components and modification of the system configuration. No person shall install or operate a system which is different in any significant respect from the system certified by the Air Resources Board.

C. If after certification of a system, the Executive Officer finds the system to no longer meet the specified certification specifications, the Executive Officer may, as appropriate, revoke or modify his or her prior certification. Except in cases where the public safety requires immediate protection, the Executive Officer shall not revoke or modify a prior certification without the manufacturer's consent unless the Executive Officer conducts a public hearing. The manufacturer shall be notified of the public hearing in writing and the notification shall be given so as to be received by the manufacturer at least ten days before the hearing date.

D. Any manufacturer of a system shall, as a condition of certification of the system by the Air Resources Board, agree that so long as only one such system is certified by the Air Resources Board, such manufacturer shall either: (1) agree to enter into such cross-licensing or other agreements as the Executive Officer determines are necessary to ensure adequate competition among manufacturers of such systems to protect the public interest; and (2) agree as a condition to such certification that if only such system from one manufacturer is made available for sale to the public, the Executive Officer shall, taking into consideration the cost of manufacturing the system and the manufacturer's suggested retail price, and in order to protect the public interest, determine the fair and reasonable retail price of such system, and may require, as a condition to continued certification of such system, that the retail price not exceed the retail price determined by the Executive Officer.

STATE OF CALIFORNIA

AIR RESOURCES BOARD

STATIONARY SOURCE TEST METHODS

Volume 2

Certification and Test Procedures for Gasoline Vapor Recovery Systems

NOVEMBER 1978

STATIONARY SOURCE CONTROL DIVISION

INTRODUCTION

The contents of this volume are the certification and test procedures used by the Air Resources Board to approve gasoline vapor recovery systems for gasoline marketing operations.

TABLE OF CONTENTS

METHOD	TITLE
2-1	Test Procedures for Determining the Efficiency of Gasoline Vapor Recovery Systems at Service Stations Adopted December 9, 1975, Amended March 30, 1976, Amended August 9, 1978. Amended Sept. 1, 1982
2-2	Certification Procedures for Gasoline Vapor Recovery Systems at Service Stations Adopted March 30, 1976 Amended August 25, 1977, Amended August 9, 1978
2-3	Certification and Test Procedures for Vapor Recovery Systems at Gasoline Bulk Plants Adopted April 18, 1977, Amended August 9, 1978
2-4	Certification and Test Procedures for Vapor Recovery Systems at Gasoline Terminals Adopted April 18, 1977
2-5	Certification and Test Procedures for Vapor Recovery Systems of Gasoline Delivery Tanks Adopted April 18, 1977 Amended Sept. 1, 1982

METHOD 2-3

State of California

AIR RESOURCES BOARD

Certification and Test Procedures for Vapor Recovery Systems at Gasoline Bulk Plants

Adopted: April 18, 1977

Amended: August 9, 1978

TABLE OF CONTENTS

		Page
I.	General Applicability	1
II.	Definitions	1
III.	General Requirements	2
IV.	Performance Standards	2
V.	Application for Certification	3
VI.	Fees and Testing	5
VII.	Certification	5
VIII.	Test Procedures for Determining the Efficiency of Gasoline Vapor Control Systems at Bulk Plants	6

State of California

AIR RESOURCES BOARD

Certification and Test Procedures for Vapor Recovery Systems at Gasoline Bulk Plants

I. General Applicability

Section 41954 of the California Health and Safety Code required the Air Resources Board to adopt procedures for determining the compliance of any system designed for the control of gasoline vapor emissions during gasoline marketing operations, including storage, transport, and transfer operations with performance standards which the Board determines are reasonable and necessary to achieve or maintain any applicable ambient air quality standard.

These certification and test procedures are applicable for gasoline vapor recovery systems installed at bulk plants for controlling gasoline vapors emitted during the loading of storage tanks and delivery tanks.

II. Definitions

A. Bulk plant: An intermediate gasoline distributing facility where delivery to and from the storage is by truck.

B. Vapor-balance or displacement vapor recovery system: a gasoline vapor control system which uses direct displacement to force vapors into the storage tanks (or delivery truck tank) to prevent the emission of displaced vapors to the atmosphere during delivery of gasoline to the storage tanks or during the loading of delivery tanks from the storage tanks.

C. Secondary processing unit: a gasoline vapor control system which utilizes a means of eliminating or recovering gasoline vapors which otherwise would be vented during the transfer of gasoline.

D. Vacuum-assisted secondary processing system: a gasoline vapor control system which employs a pump, blower, or other vacuum inducing devices to aspirate the vapors, which otherwise would be vented during the transfer of gasoline to or from a bulk plant, into a processing unit.

E. Delivery tank: any container, including associated pipes and fittings, that is used for the transportation of gasoline on any highway.

III. General Requirements

A. Certification of a system by the California Air Resources Board does not exempt the system from compliance with other applicable codes and regulations such as state fire codes, weights and measures regulations, and safety.

B. An above ground bulk storage container shall be equipped with a pressure-vacuum (PV) relief valve with a minimum pressure relief setting of 90 percent of the container's maximum pressure rating. New bulk storage containers shall be designed to be compatible with a pressure-vacuum relief valve with a minimum pressure setting of +8 ounces per square in. gauge.

IV. Performance Standards

A. The system shall prevent emission to the atmosphere of 90 percent or that percentage by weight of the gasoline vapors displaced during transfer of gasoline to the storage tanks as required by applicable air pollution control district rules and regulations.

The percentage of control shall be determined as described in Section VIII.

C. All connections shall be vapor tight.

D. The system shall not cause the pressure in the delivery tanks, while either delivering to the bulk plant or loading at the bulk plant, to reach one (1) pound per square inch gauge.

V. Application for Certification

A. An application for certification of a vapor recovery system may be submitted to the Air Resources Board by any owner or operator. Certification will be granted to any applicant whose system or device meets the applicable standards and criteria.

B. The application shall be signed by the owner or operator or his authorized representative, and shall include the following:

1. A detailed description of the configuration of the vapor recovery system, including but not limited to the following:

a. The piping configuration and specifications (pipe sizes, lengths, fittings, material(s), etc.);

b. Product and vapor recovery hose connectors for mating to the delivery tank;

c. Engineering parameters for pumps and vapor processing units to be used as part of the vapor recovery system; and

d. Allowable pressure drops through the systems.

2. Evidence demonstrating the vapor recovery reliability of the system or device.
3. A description of tests performed to ascertain compliance with the general standards, and the results of such tests.
4. A statement of recommended maintenance procedures, equipment performance checkout procedures, and equipment necessary to assure that the vapor recovery system, in operation, conforms to the regulations, plus a description of the program for training personnel for such maintenance.
5. Four copies of the service and operating manuals for the system.
6. A statement that a vapor recovery system, installed at an operating facility, will be available for certification testing no later than six months after submission of the application for certification.
7. The estimated cost of the system and an estimate of the installation and yearly maintenance costs.
8. A copy of the warranty or warranties provided with the system.
9. If the application is for a system previously tested, but not certified, the application shall include identification of the system components which have been changed, including all new physical and operational characteristics, together with any new test results obtained by the applicant.
10. Such other information as the Air Resources Board may reasonably require.

VI. Fees and Testing

A fee not to exceed the actual cost of certification testing may be charged by the Air Resources Board to each applicant submitting system(s) for certification. The applicant may be required to demonstrate ability to pay the cost of testing prior to certification testing. The system will not be certified until the test fees, if any, have been paid in full to the Air Resources Board.

VII. Certification

A. If the Executive Officer determines that a vapor recovery system conforms to all requirements set forth in Paragraphs I through VI herein, he shall issue an order of certification. The order may prescribe the conditions for issuance of the certification including but not limited to: installation constraints, operating parameters, and compliance with safety codes and regulations.

B. If after certification of a system the owner wishes to change the system, the proposed changes must be submitted to the Air Resources Board in a format specified by the Air Resources Board for approval prior to their modification. No person may install a system which is different in any respect which may detrimentally affect the system efficiency from the system certified by the Air Resources Board.

C. If after certification of a system, the Air Resources Board finds the system to no longer meet the certification specifications, the Air Resources Board may, as appropriate, revoke or modify its certification. Except in cases where the public safety requires immediate protection, the Air Resources Board shall not revoke or modify a certification without the owner's or operator's consent unless the Air Resources Board conducts a public hearing. The owner operator shall be notified of the public hearing in writing and the notification shall be given so as to be received by the owner or operator at least ten days before the hearing date.

VIII. Test Procedures for Determining the Efficiency of Gasoline Vapor Control Systems at Bulk Plants

A. Application

The following test procedures are for determining the efficiency of vapor recovery systems controlling gasoline vapors emitted during the loading of delivery tanks at the bulk plant, and during the loading of bulk plant storage tanks.

B. Principle

Hydrocarbon mass emissions are determined directly using flowmeters and hydrocarbon analyzers. The mass of hydrocarbon vapor controlled (recovered is determined from the volume of gasoline dispensed (either to the bulk storage tank or delivery tank), pressure measurements, and concentration measurements of the vapor. The efficiency of the gasoline vapor control system is determined from the mass of hydrocarbons emitted and the mass of hydrocarbons controlled.

C. <u>Testing of Vapor Recovery System for Delivery of Gasoline to the Bulk Plant</u>

C.1 Principle and Test Conditions.

a. Principle. During a fuel delivery to the bulk plant, direct measurements of hydrocarbon concentrations and volume of hydrocarbon vapors vented (including emissions from any vapor processing unit) are made. All possible points of emission are checked for vapor leaks. The volume of gasoline delivered from the delivery tank to the bulk plant is recorded and the concentration tank to the bulk plant tank is recorded and the concentration of the hydrocarbon vapors returned to the delivery tank is measured. The efficiency of control is calculated from these determinations.

b. Test Conditions. The number of transport deliveries to be tested shall be established at the discretion of the Air Resouces Board based on an engineering evaluation of the system. As close as possible, the system shall be tested under normal operating conditions. (Dispensing rates shall be at the maximum rate possible consistent with safe and normal operating practices; the processing unit, if any, shall be operated in accordance with the manufacturer's established parameters; and simultaneous use of more than one dispenser during loading of bulk storage tanks shall occur to the extent that such would normally occur.)

C.2 Equipment Required for Bulk Plant Testing

a. Two (2) positive displacement gas meters each with a capacity of 3000 standard cubic feet per hour (SCFH) and a maximum pressure drop of not more than 0.50 inches of water at a flowrate of 30 SCFH.

b. Coupling for the vent vapor line to accommodate the gas meter with thermocouple, and pressure taps. Coupling to be sized for a minimum pressure drop.

c. Coupling for the vent of the secondary processing unit, if used, to accommodate the flow measuring device with the thermocouple, pressure and HC analyzer taps. Coupling to be sized for a minimum pressure drop.

d. Coupling for delivery tank vapor return line with thermocouple, pressure and HC analyzer taps. Coupling to be the same diameter as the vapor return line.

e. Two (2) hydrocarbon analyzers (either FID or ARB approved equivalent) with recorders and with a capability of measuring total gasoline vapor concentration of 100 percent as propane. Both analyzers to be of same make and model.

f. Three (3) flexible thermocouples or thermistors (0-150^{o}F) with a recorder system.

g. Barometer.

h. Two manometers or other pressure sensing devices capable of measuring zero to ten inches of water.

i. Two (2) adjustible pressure/vacuum (PV) relief valves capable of replacing the PV relief valve on the storage tank vent.

j Coupling for attaching PV valve to the dry gas meter (Figure 1).

k. Explosimeter.

C.3 Bulk Plant Storage Tank Loading Test Procedures

a. Connect appropriate coupler to vent of bulk tank, or if the vent has a PV valve, remove the PV valve and then connect the coupler to the vent. If a secondary processing unit is used, also connect a coupler to the vent of the secondary processing unit.

b. Connect the appropriate gas meter, HC analyzer with recorder, thermocouple and manometer to the vent coupler and connect the PV valve to the gas meter.

c. Connect appropriate coupler to the delivery tank vapor return lines.

d. Connect an HC analyser with a recorder, a manometer and a thermocouple to the taps on the vapor return line.

e. Connect delivery tank fuel and vapor return lines to appropriate bulk tank lines in accordance with the owner or operator's established procedures for the system.

f. Check the delivery tank and all connections for a tight seal before and during the test with the explosimeter.

g. Record the initial reading of the gas meter(s).

h. Start loading of the bulk tank in accordance with owner's or operator's established normal procedure.

i. Hydrocarbon concentrations, temperature and pressure measurements should be recorded starting after the first 15 seconds of the loading period followed by 60 second intervals. The gas meter readings may be taken at 120 second intervals.

j. Record barometric pressure and ambient temperature for the duration of the test.

k. At the end of the bulk tank delivery, disconnect the delivery tank from the bulk tank in accordance with owner's or operator's instructions (normal procedure). Leave the bulk tank vent instrumentation in place.

l. Continue recording hydrocarbon concentraions, temperatures, pressure and gas meter readings at the bulk tank vent at 20-minute intervals for one hour after the last bulk transfer is made.

m. Disconnect instrumentation from the vent.

n. Record volume of gasoline that is delivered.

o. Record final reading of gas meter.

C.4 Calculations

A. Volume of gas discharged through "i th" vent. This includes bulk tank vent and any control system vent.

$$V_{vsi} = \frac{V_{vi} \times 520 \times P_b}{T_{vi} \times 29.92}$$

V_{vsi} = Volume of gas discharged through "i th" vent in ft^3; corrected to 60°F and 29.92 in Hg.

P_b = Barometric pressure, in Hg.

V_{vi} = Volume of gas recorded by meter on "i th" vent in ft^3 corrected for amount of vapor removed for the hydrocarbon analysis.

T_{vi} = Average temperature in "i the" vent line, ^oR.

i th = The vent under consideration.

b. Volume of gas returned to the tank truck.

$$V_t = \frac{0.1337 G_t \; 520 \; (Pb + \Delta P)}{T_t \times 29.92}$$

Where:

Pb = Atmospheric pressure, in. Hg.

V_t = Volume of gas 60^{o}F and 29.92 in Hg.

G_t = Volume of gasoline delivered, gallons.

ΔP = Final guage pressure of tank truck; in Hg.

T_t = Average temperature of gas returned to tank truck, ^oR.

0.1337 = Conversion factor, gallons to ft^3.

c. $$E = \frac{[V_t \times C_t - \Sigma \, (C_{vi} \times V_{vsi})] \, 100}{(V_t \times C_t)}$$

Where E is the efficiency of control in percent.

C_t = The average fractional volumetric concentration of gasoline vapors in the return line to the truck as determined by the hydrocarbons analyzer, decimal fraction.

C_{vi} = The average fractional volumetric concentration of gasoline vapors in the "i the" vent as determined by the hydrocarbon analyzer, decimal fraction.

D. Testing of Vapor Recovery System for Filling of a Delivery Tank at a Bulk Plant

D.1 Principle and Test Conditions

a. Principle. During loading of a delivery tank at the bulk plant, direct measurements of hydrocarbon concentrations and volume of hydrocarbons vented (including emissions from any vapor processing unit) are made. All possible points of emission are checked for vapor leaks. The volume of gasoline dispensed to the delivery tank is recorded and the concentration of the hydrocarbon vapors returned to the bulk storage tank is measured. The efficiency of control is calculated from these determinations.

b. Test conditions. The number of delivery tank loadings to be tested shall be established at the discretion of the Air Resources Board on an engineering evaluation. The system shall be tested under normal operating conditions as close as possible. (Dispensing rates shall be at the maximum rate possible consistent with safe and normal operating practices, and the simultaneous use of more than one dispenser during loading of delivery tanks shall occur to the extent that such use would represent normal operation of the system.)

D.2 Equipment Required for Delivery Tank Testing at the Bulk Plant

a. Same as that required in Section C.2

D.3 Delivery Tank Loading Test Procedures.

a. Connect coupler to vent of bulk tank, or if the vent has a PV valve, remove the PV valve and then connect the coupler to the vent. If a secondary processing unit is used, also connect a coupler to the vent of the secondary processing unit.

b. Connect the appropriate gas meter, HC analyzer with recorder, thermocouple and manometer to the vent coupler and connect the PV valve to the gas meter.

c. Connect a coupler to the bulk storage tank vapor return lines.

d. Connect an HC analyzer with a recorder, a manometer and a thermocouple to the taps on the coupler on the vapor return line.

e. Connect bulk storage tank fill and vapor return lines to the delivery tank in accordance with owner or operator established procedures for the system.

f. Check the delivery tank and all connections for a tight seal with the explosimeter before and during the test.

g. Record the initial reading of the gas meter(s).

h. Start fueling of the delivery tank in accordance with manufacturer's established normal procedure.

i. Hydrocarbon concentrations, temperature and pressure measurements are to be recorded starting after the first 15 seconds of the unloading period followed by 60 second intervals. The gas meter readings may be taken at 120 second intervals.

j. Record, during the test, barometric pressure and ambient temperature.

k. At the end of the delivery tank loading disconnect the delivery tank from the bulk tank in accordance with owner or operators' instructions (normal procedure). Leave the bulk tank vent instrumentation in place.

l. Continue recording hydrocarbon concentrations, temperatures, pressure and gas meter readings at the bulk tank vent at 20-minute intervals for one hour, or until the system returns to normal conditions as specified by the manufacturer.

m. Disconnect instrumentation from the vent.

n. Record volume of gasoline that is delivered.

o. Record final reading of gas meter.

p. Repeat procedure as necessary for additional delivery tank loading.

D.5 Calculations

a. Volúme of gas discharged through "i th" vent. This includes bulk tank vent and any control system vent.

$$V_{vsi} = \frac{V_{vi} \times 520 \times P_b}{T_{vi} \times 29.92}$$

V_{vsi} = Volume of gas discharged through "i th" vent in Ft^3, corrected to 60°F and 29.92 in. Hg.

P_b = Barometric pressure, in. Hg.

V_{vi} = Volume of gas recorded by meter on "i th" vent in Ft^3, corrected for amount of vapor removed for the hydrocarbon analysis.

T_{vi} = Average temperature in "i th" vent line, ^{o}R.

i th = The vent under consideration.

b. Volume of gas returned to the bulk storage tank.

$$V_t = \frac{0.1337G_t \quad 520\ (Pb + \Delta P)}{T_t \times 29.92}$$

Where:

P_b = Atmospheric pressure, in Hg.

V_t = Volume of gas in ft^3 returned to the bulk storage tank at 60^o and 29.92 in Hg.

G_t = Volume of gasoline delivered, gallons.

ΔP = Final gauge pressure of bulk storage tank; in. Hg.

T_t = Average temperature of gas returned to bulk storage tank, ^{o}R.

0.1337 = Conversion factor, gallons to ft^3.

c. $$E_j = \frac{[V_t \times C_t - \Sigma\ (C_{vi} \times V_{vsi})]\ 100}{(V_t \times C_t)}$$

E_j = The efficiency of control per individual fueling in percent.

C_t = The average fractional volume concentration of gasoline vapors in the return line to the bulk storage tank as determined by the hydrocarbon analyzer, decimal fraction.

C_{vi} = The average fractional volume concentration of gasoline vapors in the "i th" vent as determined by the hydrocarbon analyzer, decimal fraction.

j = The individual loading considered.

d.

$$E_{ave} = \frac{\sum_{j=1}^{n=10} E_j}{10}$$

E_{ave} = The average efficiency of control in percent.

E_j = From (c) above.

E. Calibrations

E.1 Flow meters. Standard methods and equipment shall be used to calibrate the flow meters. The calibration curves are to be traceable to National Bureau of Standards (NBS) standards.

E.2. Temperature recording instruments. Calibrate daily prior to test period and immediately following test period using ice water (32°F) and a known temperature source of about 100°F.

E.3 Pressure recording instruments. Calibrate pressure transducers with a static pressure calibrator for a range of -28 to +28 inches water.

E.4 Total hydrocarbon analyzer. Follow the manufacturer's instructions concerning warm-up time and adjustments.

On each test day prior to testing and at the end of the day's testing, zero the analyzer with a zero gas (<3 ppm C) and span with 30 percent and 70 percent concentrations of propane.

E.5 A record of all calibrations made is to be maintained.

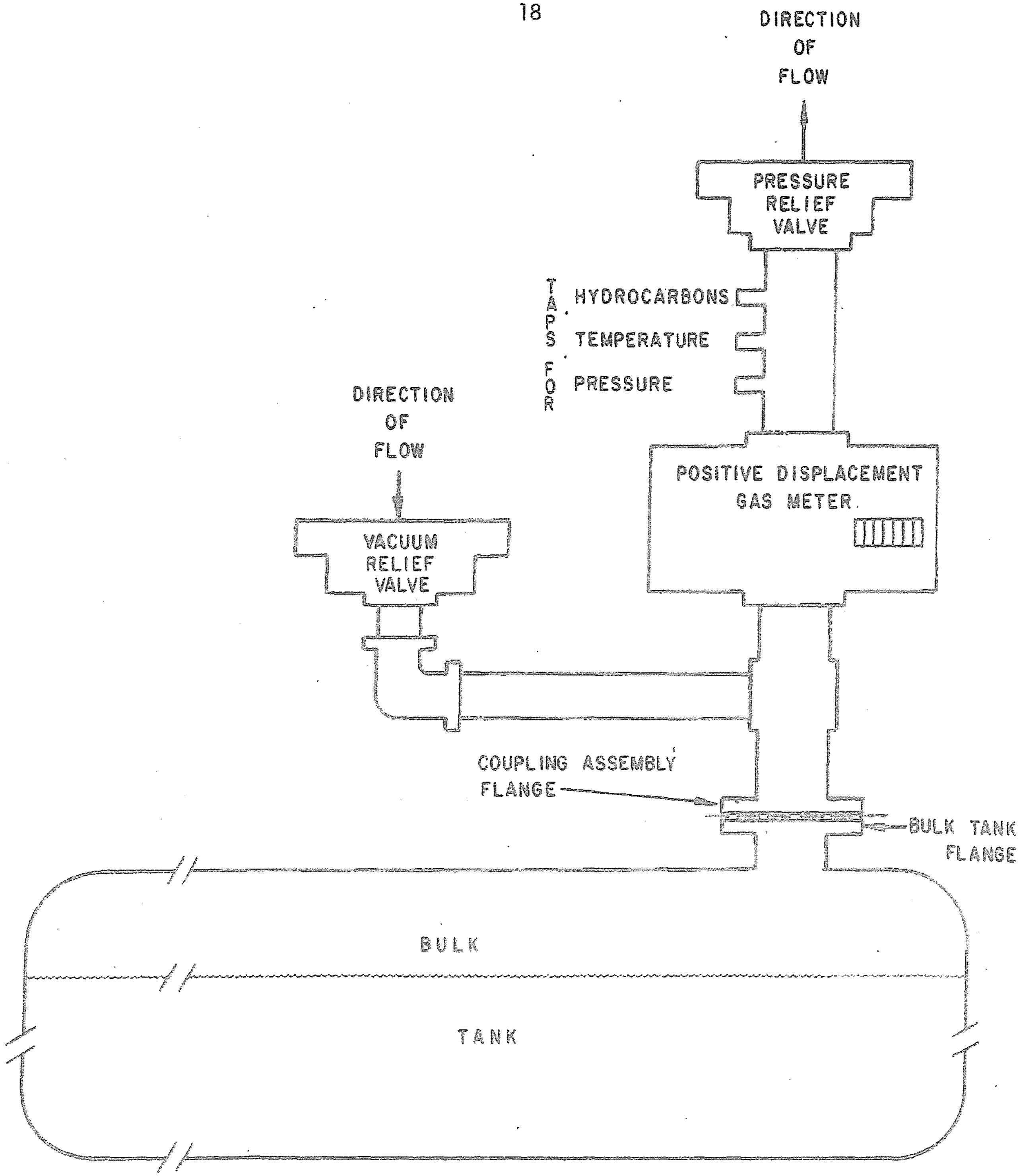

FIGURE
BULK TANK
TEST APPARATUS

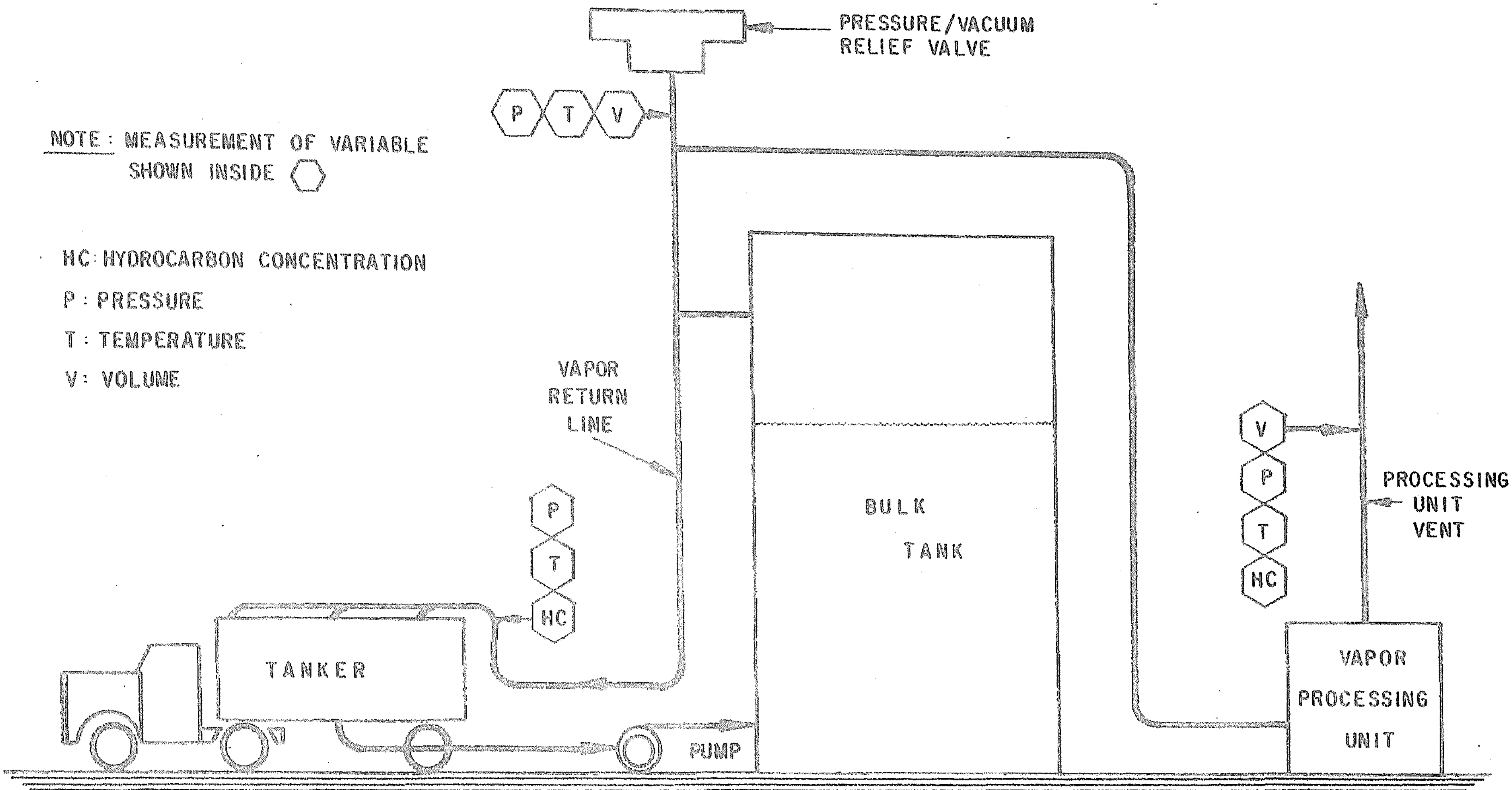

FIGURE
GASOLINE TRANSFER
FROM DELIVERY TANK TO BULK PLANT

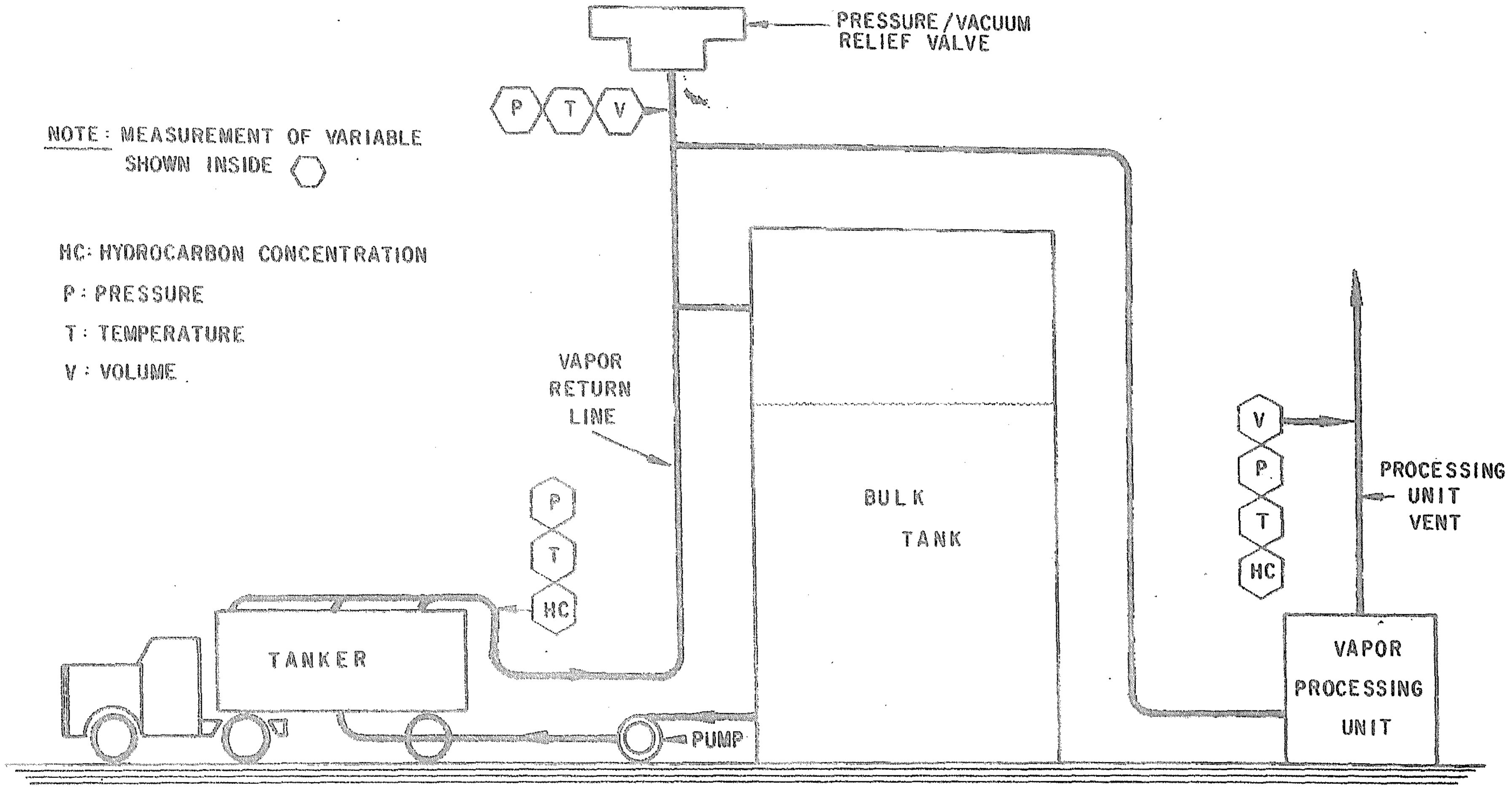

FIGURE
GASOLINE TRANSFER
FROM BULK PLANT TO DELIVERY TANK

STATE OF CALIFORNIA

AIR RESOURCES BOARD

STATIONARY SOURCE TEST METHODS

Volume 2

Certification and Test Procedures for Gasoline Vapor Recovery Systems

NOVEMBER 1978

STATIONARY SOURCE CONTROL DIVISION

INTRODUCTION

The contents of this volume are the certification and test procedures used by the Air Resources Board to approve gasoline vapor recovery systems for gasoline marketing operations.

TABLE OF CONTENTS

METHOD	TITLE
2-1	Test Procedures for Determining the Efficiency of Gasoline Vapor Recovery Systems at Service Stations Adopted December 9, 1975, Amended March 30, 1976, Amended August 9, 1978. Amended Sept. 1, 1982
2-2	Certification Procedures for Gasoline Vapor Recovery Systems at Service Stations Adopted March 30, 1976 Amended August 25, 1977, Amended August 9, 1978
2-3	Certification and Test Procedures for Vapor Recovery Systems at Gasoline Bulk Plants Adopted April 18, 1977, Amended August 9, 1978
2-4	Certification and Test Procedures for Vapor Recovery Systems at Gasoline Terminals Adopted April 18, 1977
2-5	Certification and Test Procedures for Vapor Recovery Systems of Gasoline Delivery Tanks Adopted April 18, 1977 Amended Sept. 1, 1982

METHOD 2-4

State of California

AIR RESOURCES BOARD

Certification and Test Procedures for Vapor Recovery Systems at Gasoline Terminals

Adopted

April 18, 1977

Table of Contents

Item		Page
I.	General Applicability	1
II.	Definitions	1
III.	General Requirements	2
IV.	Performance Standards	2
V.	Application for Certification	3
VI.	Fees and Testing	4
VII.	Certification	5
VIII.	Test Procedures for Determining the Efficiency of Gasoline Vapor Control Systems at Terminals	6

State of California

AIR RESOURCES BOARD

Adopted
April 18, 1977

Certification and Test Procedures for Vapor Recovery Systems at Gasoline Terminals

I. General Applicability

Section 41954 of the California Health and Safety Code requires the Air Resources Board to adopt procedures for determining the compliance of any system designed for the control of gasoline vapor emissions during gasoline marketing operations, including storage, transport, and transfer operations with performance standards which the Board determines are reasonable and necessary to achieve or maintain any applicable ambient air quality standard.

These certification and test procedures are applicable for gasoline vapor recovery systems installed at terminals for controlling gasoline vapors emitted during the loading of delivery tanks, from the loading of fixed roof gasoline storage tanks, and as a result of fixed roof tank breathing. These procedures are also applicable for marketing operations at refineries.

II. Definitions

A. Terminal: a primary distributing facility for delivery gasoline to bulk plants, service stations and other distribution points; and where delivery to the facility is by means other than truck.

B. Vapor Recovery System: system designed to collect and process gasoline vapors which would be emitted during loading of delivery tanks and fixed roof storage tanks, and as a result of breathing losses from fixed roof storage tanks.

C. Delivery Tank: any container, including associated pipes and fittings, that is used for the transportation of gasoline on any highway or railroad.

III. <u>General Requirements</u>

Certification of a system by the California Air Resources Board does not exempt the system from compliance with other applicable codes and regulations such as state fire codes, weights and measures regulations, and safety orders.

IV. <u>Performance Standards</u>

A. The vapor recovery system shall not emit more than 0.9* pound of hydrocarbons per 1,000 gallons of gasoline dispensed to delivery tanks. This shall be determined as described in Section VIII.

B. The vapor recovery unit shall not emit more than 0.9* pound of hydrocarbons per 1,000 gallons of gasoline loaded into any fixed roof storage tank(s). This performance standard is applicable only when the loading of fixed roof storage tank(s) is a batch operation. This shall be determined as described in Section VIII.

C. All connections shall be vapor tight.

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* 0.9 corresponds to 90% recovery by weight. Under Section 41954 (H & S Code) local regulations may require more stringent performance standards. In such cases, the allowable emission factor will be adjusted appropriately.

D. The vapor recovery system shall not cause the pressure in the delivery tanks to reach one (1) pound per square inch gage, during filling.

E. The system shall not cause out-breathing to occur from system pressure-vacuum relief valves including valves on any fixed roof tanks, during normal operations. This shall be determined as described in Section VIII.

V. Application for Certification

A. An application for certification of a vapor recovery system shall be made to the Air Resources Board by any owner or operator. Certification will be granted to any application whose system meet the applicable standards and criteria.

B. The application shall be in writing, signed by an authorized representative of the owner or operator, and shall include the following:

1. A detailed description of the configuration of the vapor recovery system including but not limited to the following:

   a. The piping configuration and specifications (pipe sizes, lengths, fittings, material(s), etc.).

   b. Product and vapor recovery hose connectors for mating to the delivery tank.

   c. Engineering parameters for pumps and vapor processing units to be used as part of the vapor recovery system.

   d. Allowable pressure drops through the systems.

2. Evidence demonstrating the vapor recovery reliability of the system or device.

3. A description of tests performed to ascertain compliance with the general standards, and the results of such tests.

4. A statement of recommended maintenance procedures, equipment performance checkout procedures, and equipment necessary to assure that the vapor recovery system, in operation, conforms to the regulations, plus a description of the program for training personnel for such maintenance.

5. Four copies of the service and operating manuals for the system.

6. A statement that a vapor recovery system, installed at an operating facility, will be available for certification testing no later than six months after submission of the application for certification.

7. The estimated cost of the system and an estimate of the installation and yearly maintenance costs.

8. A copy of the warranty or warranties provided with the system.

9. If the application is for a system previously tested, but not certified, the application shall include identification of the system components which have been changed, including all new physical and operational characteristics, together with any new test results obtained by the applicant.

10. Such other information as the Air Resources Board may reasonably require.

VI. <u>Fees and Testing</u>

A fee not to exceed the actual cost of certification testing may be charged by the Air Resources Board to each applicant submitting system(s) for certification. The applicant may be required to demonstrate ability to pay the cost of testing prior to certification testing. The system will not be certified until the test fees, if any, have been paid in full to the Air Resources Board.

VII. Certification

A. If the Executive Officer determines that a vapor recovery system conforms to all requirements set forth in Paragraphs I through VI herein, he shall issue an order of certification. The order may prescribe the conditions for issuance of the certification including but not limited to: installation constraints, operating parameters, and compliance with safety codes and regulations.

B. If after certification of a system the owner wishes to change the system, the proposed changes must be submitted to the Air Resources Board in a format specified by the Air Resources Board for approval prior to their modification. No person may install a system which is different, in any respect which may detrimentally affect the system efficiency, from the system certified by the Air Resources Board.

C. If after certification of a system, the Air Resources Board finds the system to no longer meet the certification specifications, the Air Resources Board may, as appropriate, revoke or modify its certification. Except in cases where the public safety requires immediate protection, the Air Resources Board shall not revoke or modify a certification without the owner's operator's consent unless the Air Resources Board conducts a public hearing. The owner or operator shall be notified of the public hearing in writing and the notification shall given so as to be received by the owner or operator at least ten days before the hearing date.

VIII. Test Procedures for Determining the Efficiency of Gasoline Vapor Control Systems at Terminals

A. Application

The following test procedures are for determining the efficiency of vapor recovery systems controlling gasoline vapors emitted during the storage of gasoline and the filling of delivery tanks at terminals.

B. Principle

During the normal operations at a terminal (loadings of delivery tanks and loadings of the storage tanks), all possible points of emission are checked for vapor leaks. The volume of gasoline delivered from the terminal storage tanks to the delivery tanks is recorded, the volume of gasoline delivered to any fixed roof storage tank(s) is recorded (as required), and the mass of the hydrocarbon vapors emitted from the processing unit measured. The mass emission of hydrocarbons is calculated from these determinations.

C. Test Conditions

The processing unit may be tested for a series of 24 consecutive 1-hour periods and pressures in the vapor holder and any fixed roof gasoline storage tanks may be monitored for 30 consecutive days. The Air Resources Board shall have the discretion of testing for longer or shorter periods as may be necessary for properly evaluating any system's compliance with performance standards. During the test of the processing unit, the pressure during the filling of a number of delivery tanks will be monitored. As close as possible, the system shall be tested under normal operating conditions (dispensing rates shall be at the maximum rate possible consistent with safe and normal operating practices; simultaneous use of more than one dispenser during transfer operations shall occur to the extent that such would normally occur, and the processing unit shall be operated in accordance with the manufacturer's established parameters), and shall be operated in accordance with the owner or operators established operating procedures.

D. Testing Processing Units Other than Incineration Units (Loading of Delivery Tanks)

1. Equipment Required for Terminal Testing

   a. Flowmeter with a capacity sufficient to determine the volume of exhaust from the vent of processing unit.

   b. Coupler for attaching the flowmeter to vent of processing unit with thermocouple and HC analyzer taps.

   c. Coupling for delivery tank vapor return line with pressure tap. Coupling to be the same diameter (I.D.) as the vapor return.

   d. One hydrocarbon analyzer (either FID or ARB approved equivalent) with recorder and with a capability of measuring total gasoline vapor concentration of 30 percent as propane.

   e. One (1) flexible thermocouple or thermister (0-150°F) with a recorder system.

   f. Two (2) pressure sensing devices (transducers or equivalent) capable of measuring zero to ten inches of water with recorder systems.

   g. Coupler with pressure tap for use between pressure-vacuum (PV) relief valve and fixed roof storage tank vent.

   h. Coupler with pressure tap for use between PV valve and vent on vapor holder tank.

i. One manometer capable of measuring zero to ten inches of water.

j. Explosimeter.

k. Barometer.

l. Recorder (for thermocouple).

2. <u>Test Procedure</u>

a. Connect appropriate coupler to vent of processing unit and connect flowmeter.

b. Connect HC analyzer (with recorder) to appropriate tap on coupler on processing unit vent.

c. Connect thermocouple with recorder to appropriate tap on coupler on processing unit vent.

d. Connect coupler between PV valve and vent of vapor holder tank and connect pressure sensing device (with recorder) to coupler.

e. Connect coupler between PV valve and fixed roof storage tank and connect pressure sensing device (with recorder) to coupler.

f. Connect the appropriate coupler to vapor return line from delivery tank. Connect the manometer to the coupling in vapor return line from delivery tank. Check the delivery tank and all connections for a tight seal, before and during fueling, with the explosimeter. Record the pressure in the vapor return line from the delivery tank at 5 minute intervals during the filling of the delivery tank. Repeat for the required number of delivery tanks.

g. Record the pressure on the bulk storage tank for the required period.

h. Record the pressure on the vapor-holder tank for the required period.

i. Record the HC concentration, temperature and exhaust gas flowrate from the processer vent for the required period.

j. At the end of the specified times, disconnect all instrumentation and couplings from the vapor recovery systems.

k. Record the volume of gasoline that is delivered during the specified testing times.

3. Calculations

a. Review pressures recorded during the filling of delivery tanks to determine if any equalled or exceeded one (1) pound per square inch

b. Volume of gas discharged through the processing unit vent.

$$V = \frac{Vp \times 520 \times Pb}{Tp \times 29.92}$$

Where:

V = Volume of gas discharged $ft.^3$, through processer vent, corrected to 60^0 and 29.92 in Hg.

P_b = Barometric pressure, in Hg;

V_p = Volume of gas $ft.^3$ determined by flowmeter on the processing vent, corrected for amount of vapor removed for the hydrocarbon analysis.

T_p = Average temperature in the processing vent line, ^oR.

c. Weight of hydrocarbons discharged through the processing vent per 1000 gallons of gasoline loaded into the delivery tanks.

$$W = \frac{C \times V \times M \times 1000}{379 \times G}$$

Where:

W = Weight of hydrocarbons discharged through the processor vent per 1000 gallons of gasoline loaded into delivery tanks, lbs.

C = Average fractional concentration of hydrocarbons at vent, decimal fraction.

V = From (2) above.

M = Molecular weight of hydrocarbons compound used to calibrate hydrocarbon analyzer, lbs/lb. Mole.

G = Total quantity of gasoline loaded into delivery tanks. (Gals).

d. Review the pressure recording from the transducers on the storage tanks and vapor holder and determine the number of times and total time (hours), if any, that the pressure exceeded the setting of the PV valve on either the vapor holder or on the fixed roof storage tank.

E Testing Processing Units Other Than Incineration Units (Loading of Fixed Roof Storage Tanks)

1. Equipment Required

   Same equipment as Section VIIID.1.

2. Test Procedures

   a. Connect appropriate coupler to vent of processing unit and connect flowmeter.

   b. Connect HC analyzer (with recorder) to appropriate tap on coupler on processing unit vent.

   c. Connect thermocouple with recorder to appropriate tap on coupler on processing unit vent.

d. Connect coupler between PV valve and vent of vapor holder tank and connect pressure sensing device (with recorder) to coupler.

e. Connect coupler between PV valve and fixed roof storage tank and connect pressure sensing device (with recorder) to coupler.

f. Record the pressure on the bulk storage tank for the required period.

g. Record the pressure on the vapor-holder tank for the required period.

h. Record the HC concentration, temperature and exhaust gas flowrate from the processer vent for the required period.

i. At the end of the specified times, disconnect all instrumentation and couplings from the vapor recovery systems.

j. Record the volume of gasoline that is delivered during the specified testing times.

k. Pressure monitoring of delivery tanks is to be performed, as appropriate, in accordance with Section VIII D.

3. Calculations

a. Volume of gas discharged through the processing unit vent.

Volume of gas discharged through the processing unit vent.

$$V = \frac{Vp \times 520 \times Pb}{Tp \times 29.92}$$

Where:

V = Volume of gas discharged $ft.^3$, through processer vent, corrected to 60^o and 29.92 in Hg.

P_b = Barometric pressure, in Hg;

V_p = Volume of gas ft.^{3} determined by Annubar on the processing vent, corrected for amount of vapor removed for the hydrocarbon analysis.

T_p = Average temperature in the processing vent line, ^oR.

b. Weight of hydrocarbons discharged through the processing vent per 1000 gallons of gasoline loaded into the delivery tanks.

$$W = \frac{C \times V \times M \times 1000}{379 \times G}$$

Where:

W = Weight of hydrocarbons discharged through the processor vent per 1000 gallons of gasoline loaded into delivery tanks, lbs.

C = Average fractional concentration of hydrocarbons at vent, decimal fraction.

c. Review the pressure recording from the transducers on the storage tanks and vapor holder and determine the number of times and total time (hours), if any, that the pressure exceeded the setting of the PV valve on either the vapor holder or on the fixed roof storage tank.

F. <u>Calibrations</u>

1. Flow meters. Standard methods and equipment shall be used to calibrate the flow meters. The calibration curves are to be traceable to National Bureau of Standards (NBS) standards.
2. Temperature recording instruments. Calibrate daily prior to test period and immediately following test period using ice water (32^{o}F) and a known temperature source about 100^{o}F.
3. Pressure recording instruments. Calibrate pressure transducers with a static pressure calibrator for a range of -2 to +2 psi.

4. Total hydrocarbon analyzer. Follow the manufacturer's instructions concerning warm-up time and adjustments. On each test day prior to testing and at the end of the day's testing, zero the analyzer with a zero gas (<3 ppm C) and span with 5, 10, 30 and 70 percent concentrations of propane.

5. A record of all calibrations made is to be maintained.

V =From (2) above.

M =Molecular weight of hydrocarbon compound used to calibrate hydrocarbon analyzer, lbs/lb Mole.

G =Total quantity of gasoline loaded into fixed roof storage tank(s) $\frac{\text{(Gals)}}{1000}$.

G. Testing Exhaust Emissions from Incinerating Type Processing Unit

1. Equipment Required

a. One (1) positive displacement flowmeter (capacity of 11,000 SCFH) with a coupler with pressure and temperature taps.

b. One (1) hydrocarbon analyzer (FID or ARB approved equivalent) capable of measuring hydrocarbons in the range 0 to 10 percent as propane.

c. One (1) oxygen analyzer (paramagnetic or ARB approved equivalent) capable of measuring oxygen in the range 0 to 25 percent by volume.

d. Apparatus for performing the Environmental Protection Agency Method 2 (Determination of Stack Gas Velocity and Volumetric Flow Rate).

e. One (1) sample conditioner capable of adjusting the temperature of the exhaust gas sample to a range acceptable to the hydrocarbon and oxygen analyzers.

f. One (1) 1/4" ID of appropriate length stainless steel sampling probe (SS316 or equivalent).

g. One (1) dry gas meter sufficiently accurate to measure the sample volume within one percent.

h. One (1) needle valve, or equivalent, to adjust flow rate.

i. One (1) rotameter, or equivalent, to measure a 0 to 10 SCFH flow range.

j. One (1) pump of a leak-free, vacuum type.

k. One (1) thermocouple with recorder, 0-15°F.

l. One (1) pressure sensor with recorder for a range of -2 to +2 psig.

2. Test Procedure

a. Insert the flowmeter (0-11,000 SCFH) into the pipe supplying the incinerator, connect thermocouple and pressure sensor and record initial volume.

b. Using the apparatus for Method 2, perform a velocity traverse of the incinerator exhaust. Determine the location of the average exhaust velocity.

c. Insert the sample probe to the location of the average exhaust velocity (leaving the Method 2 apparatus in place). Connect the sample conditioner, hydrocarbon analyzer, oxygen analyzer, sample pump, rotameter, needle valve and dry gas meter to the sample probe.

d. Start analyzer recorders.

e. Adjust the sample flow rate proportional to the stack gas velocity and sample until the dry gas meter registers one(1) $FT.^3$. Mark on analyzer recorder strip charts beginning and ending of sample period.

f. At the end of the test period, record the total volume of vapors going to the incinerator and average temperature and pressure.

g. Record the average hydrocarbon and oxygen concentration in the incinerator exhaust. Repeat as required.

h. Record the volume of gasoline delivered during the test period.

i. Pressure monitoring of delivery tanks and fixed roof storage tanks is to be performed, as appropriate, in accordance with Section VIII D and VIII E.

3. Calculations:

a. $$V_p = \frac{V \times 520 \times P_A}{T \times 29.29}$$

Where:

V_p =Volume of vapor going to the incinerator ($ft.^3$)

V =Volume of gas recorded by meter (ft^3)

P_A =Absolute pressure in the pipe going to the incinerator, in. Hg.

T =Average absolute temperature of the vapor, °R.

b. $$EA = \frac{O_2\%}{.264 - O_2\%}$$

Where:

EA =Excess air in the incinerator exhaust gas

$O_2\%$ =Percent oxygen in the incinerator exhaust

g. $$W = \frac{V_p\ C\ M\ (EA)}{379(G)}$$

Where:

W =Weight of hydrocarbons discharged through the incinerator vent in lbs per 1,000 gallons of gasoline into delivery tanks (or as appropriate fixed roof tanks).

V_p =From (a) above.

M =Molecular weight of hydrocarbon compound used to calibrate hydrocarbon analyzer, lbs/lb Mole.

EA =From (b) above.

G =Total quantity of gasoline loaded into delivery tanks (or, as appropriate, fixed roof storage tanks), Gals/1,000.

C =Average fractional concentration of hydrocarbons at vent, decimal fraction.

H. Alternative Test Methods

Techniques, other than those specified above, may be used for testing vapor recovery systems at terminals if prior approval is obtained from the Air Resources Board. Such approval will be based upon demonstrated equivalency with the methods in "D" through "G" above.

CALIFORNIA
AIR RESOURCES BOARD

Vapor Recovery Certification Procedure

CP-204

Certification Procedure for Vapor Recovery Systems of Cargo Tanks

Adopted: April 12, 1996
Amended: March 17, 1999
Amended: November 7, 2014
Amended: December 3, 2019
Amended: July 12, 2023

CP-204

Table of Contents

Section Title Page

1. General Information and Applicability 1

1.1. Legislative and Regulatory Requirements of Other Agencies 1

2. Summary of Certification Process..2

2.1. Application for Certification of an Individual Cargo Tank..2
2.2. Compatibility...2
2.3. Condition of Certification..3

3. Performance Standards and Test Procedures..3

3.1. Five Minute Performance Standard - Annual..3
3.2. Daily Static Pressure Performance Standard...4
3.3. Vapor and Liquid Leaks 5

4. Requirements for Determinations of Compliance and Violation 6

4.1. General Requirements...6
4.2. Specific Requirements...6
4.3. Other Requirements...7

5. Alternate Test Procedures 8

5.1. Alternate Test Procedures for Certification Testing 8
5.2. Request for Approval of Alternate Test Procedure 8
5.3. Response to Request..8
5.4. Testing of Alternate Test Procedures...8
5.5. Documentation of Alternate Test Procedures 9

List of Tables

Description **Page**

Table 3-1 Pressure or Vacuum Change Per Cargo Tank or Compartment Tested......................3

Table 3-2 Internal Vapor Valve Pressure Change Per Cargo Tank or Compartment Tested.......4

Table 3.2.1...5

Table 3.2.2 Internal Vapor Valve Performance Standard 5

California Environmental Protection Agency
California Air Resources Board

Vapor Recovery Certification Procedure

CP-204

Certification Procedure for Vapor Recovery Systems of Cargo Tanks

A set of definitions common to all Certification and Test Procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. General Information and Applicability

This procedure describes the process for certifying cargo tanks with a system that recovers vapors during the loading and unloading of gasoline. The cargo tank vapor recovery system prevents gasoline vapors from being emitted into the air.

Other vapor recovery certification procedures provide instructions for determining performance standards, performance specifications, and test procedures for equipment which recovers vapors emitted in association with gasoline marketing operations involving: dispensing facilities (CP-201 or CP-206); bulk plants and cargo tanks (CP-202); and supply lines, terminals, delivery lines, and cargo tanks (CP-203). This procedure establishes performance standards or specifications for cargo tanks, including trucks and trailers that transport gasoline. State law provides that no person shall operate, or allow the operation of, a cargo tank unless the cargo tank is certified and maintained in accordance with these procedures. Certifications shall be issued on an annual basis and shall expire on the last day of the month one year following the month of issuance of the certification.

1.1. Legislative and Regulatory Requirements of Other Agencies

In addition to CARB, other federal, state, or local government bodies may enforce laws and regulations applicable to vapor recovery systems. Cargo tank owners or operators are responsible for complying with all applicable laws and regulations including regulations of the California Highway Patrol, the Department of Forestry and Fire Protection, Office of the State Fire Marshal, and the Department of Industrial Relations, Division of Occupational Safety and Health.

2. Summary of Certification Process

The owner or operator of any cargo tank shall:

(1) annually test such cargo tank(s) in accordance with the provisions of section (§) 3.1 and

(2) annually apply for certification of such tank(s) in accordance with this certification procedure.

Tests shall be conducted by the owner or operator of the cargo tank, or a consultant or contractor, at the expense of the owner or operator. Prior to testing, the owner or operator shall notify the Executive Officer, no less than 48 hours prior to the start of test, of the date, time, and location of the test. The Executive Officer may observe or conduct tests referenced in § 3.1.

2.1. Application for Certification of an Individual Cargo Tank

The application for certification of individual cargo tanks shall be submitted to the Executive Officer through the CARB Online Cargo Tank Vapor Recovery Certification Program that can be accessed through the CARB webpage at www.arb.ca.gov/enf/cargotanks/cargotanks.htm, and shall contain the following information:

1. Name, address, email address, and telephone number of owner or operator, and company name (if applicable).
2. The sizes and number of compartments of the cargo tank.
3. The cargo tank number issued by CARB.
4. A statement that the tank has been tested according to the annual test procedures prescribed in § 3.1 of this certification procedure and complies with the corresponding performance standards.
5. All test data supporting the statement in item (4) above.
6. A declaration under penalty of perjury by the person conducting the test that the information contained in items (4) and (5) is true and correct.
7. A declaration under penalty of perjury by the applicant setting forth his or her property interest in the cargo tank and stating that all information is true and correct.

2.2. Compatibility

The cargo tank when connected to a CARB certified vapor recovery system at a bulk plant, terminal, gasoline dispensing facility (GDF) with an underground storage tank (UST), or GDF with an aboveground storage tank (AST) shall not prevent such systems from achieving the required vapor recovery efficiency and/or emission factor referenced in CP-202 for bulk plants, CP-203 for terminals, CP-201 for GDF with UST, and CP-206 for GDF with AST. The connectors and fittings of the cargo tank shall be compatible with a CARB certified Phase I system installed at GDFs with USTs and ASTs. Such compatibility may be achieved by the use of adapters.

2.3. Condition of Certification

When the Executive Officer determines the application complies with all applicable provisions of this certification procedure, the Executive Officer shall issue a non-transferable and non-removable decal to be affixed to the right side of the cargo tank on the vertical mid-line, near the front of the vessel. Furthermore, the owner/operator shall ensure that the CARB issued Cargo Tank Number for the vessel shall be on the cargo tank in a location that can be readily seen. As a condition of certification, the Executive Officer shall return a copy of the application to the applicant with stamped acknowledgement of receipt thereon, or other appropriate documentation of certification. The stamped copy of the application or other documentation of certification shall be kept with the cargo tank at all times.

3. Performance Standards and Test Procedures

3.1. Five Minute Performance Standard - Annual

All cargo tanks owner or operators shall conduct testing annually in accordance with TP-204.1, Determination of Five Minute Static Pressure Performance of Vapor Recovery Systems of Cargo Tanks, to verify compliance with performance standards referenced in this section. The results shall be submitted annually to the Executive Officer as provided by section 2.

3.1.1. Cargo Tanks or Compartment

The Five Minute performance standard listed in Table 3-1 shall be determined by TP-204.1, Determination of Five Minute Static Pressure Performance of Vapor Recovery Systems of Cargo Tanks.

Table 3-1
Pressure or Vacuum Change
Per Cargo Tank or Compartment Tested

Allowed Pressure Change (inches WC)	Cargo Tank or Compartment Capacity (gallons)
0.50	2500 or more
0.75	2499 to 1500
1.00	1499 to 1000
1.25	999 or less

3.1.2. Internal Vapor Valve

Every cargo tank shall have an internal vapor valve. A check valve or cap is not an acceptable alternative. The internal vapor valve shall comply with the performance standard listed in Table 3-2 when tested in accordance with TP-204.1.

Table 3-2
Internal Vapor Valve Pressure Change
Per Cargo Tank or Compartment Tested

Allowed Pressure Change In 5 Minutes (inches WC)	Cargo Tank or Compartment Capacity (gallons)
5.0	All

3.2. Daily Static Pressure Performance Standard

The Executive Officer shall conduct testing of cargo tanks in accordance with TP-204.2, Determination of One Minute Static Pressure Performance of Vapor Recovery Systems of Cargo Tanks, to determine compliance with applicable performance standards referenced in section 3.2.

3.2.1. The Daily Static Pressure Performance Standard, or one minute standard, is dependent on the headspace volume after loading and can vary from one load to the next. The one minute standard shall be determined by TP-204.2. All cargo tanks and compartment, including the internal vapor valve(s), shall be capable of meeting the one minute standard of Equation 3.2.

Equation 3.2

$$P_F = 18\left(\frac{N}{18}\right)^{\left(\frac{V_s}{5\,V_h}\right)}$$

where:

P_F minimum allowable one-minute final pressure, inches water column

V_s total cargo tank shell capacity, gallons

V_h cargo tank headspace volume after loading, gallons

18 initial pressures at start of test, inches water column

N see Table 3.2.1

Table 3.2.1

If V_s is	Then N is equal to
greater than or equal to 2,500 gallons	15.5 inches WC
between 1,500 and 2499 gallons	15.0 inches WC
between 1,000 and 1,499 gallons	14.5 inches WC
between 0 and 999 gallons	14.0 inches WC

3.2.2. Internal Vapor Valve Performance Standard

All cargo tank internal vapor vent valve(s) shall comply with the performance standard listed in Table 3.2.2 as determined by TP-204.2.

Table 3.2.2
Internal Vapor Valve Performance Standard

Test Time (minutes)	Maximum Allowable One-Minute Pressure Increase (inches WC)
1.0	1.1
2.0	2.2
3.0	3.3
4.0	4.4
5.0	5.5

The values in the right hand column are adjusted upward to account for a systematic bias caused by expansion in the headspace of the cargo tank subsequent to thermal conduction from the shell. The value of 5.5 at the bottom of the column corresponds equivalently to the 5.0 inches WC pressure increase allowed by the five minute performance standard.

Important: If individual compartments are to be tested, both V_s and V_h must be the volumes relating to that compartment alone, not all compartments.

3.3. Vapor and Liquid Leaks

The Executive Officer shall conduct testing of cargo tanks during the loading or after loading of gasoline to determine compliance with the vapor and liquid leak standards of this section in accordance with TP-204.3, Determination of Leak(s).

3.3.1. Vapor Leaks

A vapor leak is defined to be any source of gasoline vapors which causes a combustible gas detector meter reading exceeding 100 percent of the LEL as determined by TP-204.3, Determination of Leak(s).

3.3.2. Liquid Leaks

A liquid leak is defined to be liquid gasoline dripping at a rate in excess of three (3) drops per minute as determined by TP-204.3.

4. Requirements for Determinations of Compliance and Violation

The specifications of this section are primarily adopted pursuant to Health and Safety Code sections (H&SC §§ 41962 and 41974). In particular, H&SC § 41974 provides that the penalty provisions of Article 3 (commencing with Section 42400) of Chapter 4, Division 26 of the H&SC shall apply to gasoline cargo tank vapor recovery system violations.

4.1. General Requirements

It is a general requirement that any certified vapor recovery system shall comply with the specifications of certification which result from the application of this procedure to such vapor recovery system. Failure of such vapor recovery system to comply is a violation of such vapor recovery system's specifications of certification.

4.2. Specific Requirements

It shall be a specification of certification that each cargo tank shall comply with the compliance requirements listed below; failure of a cargo tank to comply with these requirements shall be a violation of that cargo tank's specification of certification.

4.2.1. Yearly Requirements

a. On an annual basis, each cargo tank shall prepare for pressure testing to determine if that cargo tank complies with the five minute performance standard as determined by TP-204.1.

b. Any such cargo tank which fails to demonstrate such compliance with five minute performance standard, daily static pressure performance standard, or vapor leak standard or liquid leak standard shall be subject to a penalty set by the Executive Officer. (See H&SC § 41974)

c. Any such cargo tank which fails to demonstrate compliance shall be taken out of service until such cargo tank is repaired, tested, and determined to comply.

4.2.2. Daily Requirements

a. On a permanent basis, any cargo tank shall be subject to daily static pressure performance standard testing.

Any such cargo tank which fails to demonstrate such compliance shall prepare for pressure testing pending one of the following outcomes:

(1) If no maintenance has been performed on such cargo tank while preparing for testing, such cargo tank may be tested to determine if such cargo tank complies with a static pressure performance standard according to the appropriate test procedure.

i. If such cargo tank complies, such cargo tank may be placed back in service with no penalty.

ii. If such cargo tank does not comply, such cargo tank shall be subject to a penalty set by the Executive Officer (see H&SC § 41974) and shall remain out of service until such cargo tank is repaired, tested, and determined to comply with the annual Five Minute Performance Standard as determined by TP-204.1.

(2) If maintenance has been performed on such cargo tank while preparing for testing, such cargo tank shall be permanently removed from service (salvaged) or shall be tested to determine if such cargo tank complies with the yearly standard according to the appropriate test procedure.

i. If such cargo tank complies, such cargo tank may be placed back in service and shall be subject to a penalty set by the Executive Officer. (See H&SC § 41974)

ii. If such cargo tank does not comply, the owner or operator of the cargo tank shall be subject to a penalty set by the Executive Officer (see H&SC § 41974) and shall remain out of service until such cargo tank is repaired, tested, and determined to comply with the yearly standard according to the appropriate test procedure.

(3) If the cargo tank is taken out of service permanently, such cargo tank shall be subject to a penalty set by the Executive Officer. (See H&SC § 41974)

4.3. Other Requirements

On a permanent basis, any cargo tank shall be subject to annual and daily static pressure performance testing to determine if any such cargo tank complies with the applicable annual and daily static pressure performance standards.

4.3.1. Any such cargo tank which fails to demonstrate such compliance shall be subject to a penalty set by the Executive Officer (see H&SC 41974) and shall be taken out of service.

4.3.2. Such cargo tank may be repaired and re-tested to determine if such cargo tank complies with the annual certification standard according to the appropriate test procedure.

a. If such cargo tank complies, the cargo tank may be placed back in service.

b. If such cargo tank does not comply, the cargo tank shall remain out of service until the cargo tank is repaired, tested, and determined to comply with the annual performance standard listed in section 3.1 of this procedure.

5. Alternate Test Procedures

Test procedures other than those specified in this certification procedure shall be used only if prior written approval is obtained from the Executive Officer. A test procedure is a methodology used to determine, with a high degree of accuracy, precision, and reproducibility, the value of a specified parameter. Once the test procedure is conducted, the results are compared to the applicable performance standard to determine the compliance status of the facility.

5.1. Alternate Test Procedures for Certification Testing

The Executive Officer shall approve, as required, those procedures necessary to verify the proper performance of the system.

5.2. Request for Approval of Alternate Test Procedure

Any person may request approval of an alternative test procedure. The request shall include the proposed test procedure, including equipment specifications and, if appropriate, all necessary equipment for conducting the test. If training is required to properly conduct the test, the proposed training program shall be included.

5.3. Response to Request

The Executive Officer shall respond within fifteen (15) days of receipt of a request for approval and indicating that a formal response will be sent within sixty (60) days. If the Executive Officer determines that an adequate evaluation cannot be completed within the allotted time, the Executive Officer shall explain the reason for the delay, and will include the increments of progress such as test protocol review and comment, testing, data review, and final determination. If the request is determined to be incomplete or unacceptable, the Executive Officer shall respond with identification of any deficiencies. The Executive Officer shall issue a determination regarding the alternate procedure within sixty (60) days of receipt of an acceptable request.

5.4. Testing of Alternate Test Procedures

All testing to determine the acceptability of the alternate procedure shall be conducted by the Executive Officer or by a third party responsible to and under the direction and control of Executive Officer. Testing shall be conducted in accordance with the written procedures and instructions provided by the Executive Officer. The testing shall, at a minimum, consist of nine sets of data pairs, pursuant to U.S. Environmental Protection Agency (EPA) Reference Method 301, "Field Validation of Pollutant Measurement Methods from Various Waste Media", 40 CFR Part 63,

Appendix A, 57 Federal Register page 61992. Criteria established in U.S. EPA Reference Method 301 shall be used to determine whether equivalency between the two test methods exists. Method approval of the procedure shall be granted, on a case-by-case basis, only after all necessary testing has been conducted. Because of the evolving nature of technology and procedures for vapor recovery systems, such approval may or may not be granted in subsequent cases without a new request for approval and additional testing to determine equivalency. If, after approval is granted, subsequent information demonstrates that equivalency between the two methods no longer meets the U.S. EPA Reference Method 301 requirements, the alternate status of the procedure shall be revoked by the Executive Officer.

5.5. Documentation of Alternate Test Procedures

Any such approvals for alternate test procedures and the evaluation testing results shall be maintained in the Executive Officer's files and shall be made available upon request. Any time an alternate procedure and the reference procedure are both conducted and yield different results, the results determined by the reference procedure shall be considered the true and correct results.

California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedure

TP-204.1

Determination of
Five Minute Static Pressure Performance of
Vapor Recovery Systems of
Cargo Tanks

Adopted: April 12, 1996
Amended: March 17, 1999
Amended: November 7, 2014

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

TP-204.1

Determination of Five Minute Static Pressure Performance of Vapor Recovery Systems of Cargo Tanks

1 APPLICABILITY

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

1.1 General Applicability

This procedure is used to determine compliance with the five minute static pressure performance standard referenced in Vapor Recovery Certification Procedure 204 (CP-204), "Certification Procedure for Vapor Recovery Systems of Cargo Tanks." This procedure may be used to determine the five minute static pressure associated with the dispensing of any fluid, although it is written to reflect application to the hydrocarbon vapors associated with the dispensing of gasoline.

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

The cargo tank, mounted on either the truck or trailer, is pressurized to 18 inches water column (WC) and the pressure in the system is then allowed to decay for five (5) minutes. Similarly in a separate test, the cargo tank is evacuated to negative six (-6) inches WC and the pressure in the system is then allow to decay for five (5) minutes. The acceptability of the final pressure or vacuum level is based on the capacity of the cargo tank and is listed in CP-204. The performance of the cargo tank internal vapor valve can be determined by pressurizing the cargo tank to 18 inches WC and then closing the internal vapor valves. The system is then allowed to decay for five (5) minutes. The acceptability of final pressure level for the internal vapor valve is listed in CP-204.

3 BIASES AND INTERFERENCES

Thermal expansion due to direct sunlight on an exposed cargo tank can bias the results of this test procedure. Keep 100 percent of the length of the vapor space of a cargo tank in shade during testing.

4 EQUIPMENT

4.1 Source of air or inert gas capable of pressurizing tanks to 27.7 inches of water (1 psi) above atmospheric pressure.

4.2 Low pressure (5 psi divisions) regulator for controlling pressurization of tank.

4.3 Water manometer, or equivalent, with 0 to 25 inch range, with scale readings of 0.1 inch.

4.4 Test cap for vapor line with a shut-off valve for connection to the pressure and vacuum supply hoses. The test cap is to be equipped with a tap for connecting the manometer.

4.5 Caps for liquid delivery line.

4.6 Vacuum pump of sufficient capacity to evacuate tank to ten inches of water.

4.7 Pressure and vacuum supply hose of 1/4 inch internal diameter.

4.8 In-line, pressure vacuum relief valve set to activate at one (1) psi and with a capacity equal to the pressurizing or evacuating pumps.

5 PRE-TEST PROTOCOL

5.1 The requirement that each compartment shall have its own internal vapor valve must be met to conduct this test.

5.2 The following shall be performed for all cargo tanks subject to testing in accordance with this test procedure:

5.2.1 Cargo tank and trailers shall be empty of gasoline or product to conduct this test.

<u>Warning: Under no circumstances shall the vapors in any cargo tank be purged or vented directly to the atmosphere.</u>

5.2.2 Cargo tank shall be purged by one of the following methods:

(a) Air from the purged cargo tank shall be routed to an incinerator that is certified by ARB and permitted by a district.

(b) Cargo tank vapors shall be routed to an ARB certified vapor recovery system at a bulk plant or terminal when water is used to purge the cargo tank. The water can be reused. If the water is disposed of, it shall conform to all applicable federal, state, and local regulations.

(c) Cargo tank vapors shall be routed to an ARB certified vapor recovery system at a bulk plant or terminal when a liquid with a vapor pressure of less than four pounds Reid Vapor Pressure (<4 psi RVP) is used to purge the cargo tank.

(d) Any purging method or system must be approved in writing by the Executive Officer.

6 TEST PROCEDURE

This test shall be conducted with product hoses and vapor hoses connected and exposed to the pressurized cargo tanks or compartments. The cargo tank shall meet the standards for all three tests in consecutive runs.

6.1 Static Pressure Performance, Positive Pressurization

6.1.1 Open and close the dome covers.

6.1.2 Connect static electrical ground connections to tank. Attach the delivery and vapor hoses, remove the delivery elbows and plug the liquid delivery fittings.

6.1.3 Attach the test cap to the vapor recovery line of the cargo tank.

6.1.4 Connect the vacuum and pressure supply hose and the pressure-vacuum relief valve to the shut-off valve. Attach the pressure source to the hose. Attach a manometer to the pressure tap.

6.1.5 Connect compartments of the tank internally to each other if possible.

6.1.6 Applying air pressure slowly, pressurize the tank, or alternatively the first compartment, to 18 inches WC.

6.1.7 Close the shut-off valve, allow the pressure in the cargo tank to stabilize (adjust the pressure if necessary to maintain 18 inches WC), record the time and initial pressure.

6.1.8 At the end of five minutes, record the final time and pressure.

6.1.9 Calculate and record the pressure change (inches WC) between initial pressure of+18 inches WC and the final pressure.

6.1.10 Repeat sections 6.1.6 through 6.1.9 for each compartment if they are not interconnected.

6.2 Static Pressure Performance, Vacuum Test (Negative Pressurization)

6.2.1 Connect vacuum source to pressure and vacuum supply hose referenced in section 6.1.4.

6.2.2 Slowly evacuate the tank, or alternatively the first compartment, to six (6) inches WC vacuum. Close the shut-off valve, allow the pressure in the cargo tank to stabilize (adjust the pressure if necessary to maintain a vacuum or negative six (-6) inches WC), and record the initial pressure and time. At the end of five (5) minutes, record the final pressure and time.

6.2.3 Calculate and record the pressure change (inches WC) from the initial 6 inches of WC and the final pressure. If pressurized air lines or other equipment penetrate the cargo tank headspace, record and report the value of the pressure change as zero.

6.2.4 Repeat sections 6.2.2 to 6.2.3 for each compartment if they are not interconnected.

6.3 Internal Vapor Valve Performance, Positive Pressurization

6.3.1 After completing the vacuum and pressure tests (section 6.1 and 6.2), pressurize the tank as in section 6.1.6 18 inches WC.

6.3.2 Close the cargo tank's internal valve(s) thereby isolating the vapor return line and manifold from the cargo tank.

6.3.3 Relieve the pressure in the vapor return line to atmospheric pressure.

6.3.4 Seal the vapor return line and after five (5) minutes record the final gauge pressure existing in the vapor return line and manifold.

6.3.5 Calculate the pressure change (inches WC) from + 18 inches WC to the final pressure.

7 REQUIREMENTS AT CONCLUSION OF PRESSURE TESTING

The entire cargo tank, including tank, domes, dome vents, piping hose connections, adaptors, couplings, hoses and delivery elbows shall be inspected for evidence of wear, damage, or maladjustment that could be a potential leak source. Any part found to be defective shall be adjusted, repaired or replaced as necessary.

8 REPORTING RESULTS

Results for a given cargo tank shall be reported by the company responsible for testing as listed on the 48 hour test notification that was submitted to the Board. Results can be submitted through the ARB Online Cargo Tank Vapor Recovery Certification Program that can be accessed through the ARB webpage at www.arb.ca.gov/enf/cargotanks/cargotanks.htm.

9 ALTERNATE TEST PROCEDURES

9.1 U.S. EPA Method 27

U.S. EPA Method 27 referenced in the Code of Federal Regulations – Title 40, Chapter I, Subchapter C, Part 63, Subpart R, section 63.425(e), (as last amended on December 19, 2003) may be used an alternate to the procedure described in Section 6 with the following exceptions:

a. The purging of vapor from cargo tanks and compartments shall be conducted in accordance with section 5.

b. Results of each test conducted shall comply with the performance standards reference in section 3.1 CP-204 without taking the arithmetic mean of two successive results as allowed by section 40 CFR 63.425(e)

c. Results from three consecutive tests (pressure, vacuum, and internal vapor valve) run in any sequence shall comply with performance standards reference in section 3.1 of CP-204.

9.2 Other Alternate Test Procedures

This test procedure shall be conducted as specified. Modifications to this test procedure shall not be used to determine compliance unless prior written approval has been obtained from the Executive Officer, pursuant to section 5 of Certification Procedure 204 (CP-204).

California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedures

TP-204.2

Determination of One Minute
Static Pressure Performance of
Vapor Recovery Systems of Cargo Tanks

Adopted: April 12, 1996
Amended: March 17, 1999
Amended: May 27, 2014

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

TP-204.2

Determination of One Minute Static Pressure Performance of Vapor Recovery Systems of Cargo Tanks

1 APPLICABILITY

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" or “CARB” refers to the California Air Resources Board, and the term "Executive Officer" refers to the Executive Officer of the ARB or his or her authorized representative or designee.

1.1 General Applicability

This procedure is used to determine compliance with the daily static pressure performance standard or one minute standard referenced in Vapor Recovery Certification Procedure 204 (CP-204), “Certification Procedure for Vapor Recovery Systems of Cargo Tanks.” This procedure may be used to determine daily static pressure associated with the dispensing of any fluid, although it is written to reflect application to the hydrocarbon vapors associated with the dispensing of gasoline.

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

Upon completion of loading operations at the bulk plant or terminal, the gasoline cargo tank is pressurized with nitrogen to 18 inches water column (WC). By using the total cargo tank shell capacity, post-loading headspace volume, and the Ideal Gas Law, a one-minute maximum allowable pressure decay is calculated. The pressure decay is monitored for one minute and compliance is determined by comparison with the maximum allowable calculated value. The leak rate through the cargo tank internal vapor vent valve is similarly determined.

3 BIASES AND INTERFERENCES

Thermal expansion due to direct sunlight on an exposed cargo tank can bias the results of this test procedure. Keep at least 75% of the length of the vapor space of a cargo tank in the shade during testing.

Cargo tank leakage exceeding the nitrogen feed rate precludes the use of this method. Such leakage demonstrates the inability of the cargo tank to meet its performance standard. The minimum nitrogen flowrate shall be calculated as shown in §9.2, or obtained from Table 5.

Pressure stability may not be achievable, within a reasonable time period, if the tank has been purged with air prior to loading gasoline. This tends to bias this test procedure toward determination of compliance. In such a case, the cargo tank shall be moved to disturb the liquid and saturate the vapor space.

Vapor leaks due to a faulty cargo tank vapor coupler or facility vapor hose coupler inherently shall constitute the violation of the one minute standard for any tank subject to this test procedure.

If the load prior to testing is diesel over gasoline, this tends to bias this test procedure toward determination of non-compliance. In such a case, the following steps shall be taken to eliminate this bias:

(1) The pressure decay portion of the test shall be conducted three times to compensate for the absorption of gasoline vapors into the diesel. For the purpose of this interference, diesel shall be defined as any petroleum distillate with a vapor pressure under 4.0 pounds Reid.

(2) The first two tests will promote absorption of the gasoline vapors into the diesel to eliminate this bias.

4 SENSITIVITY, RANGE, AND PRECISION

4.1 Mechanical Pressure Gauges

Mechanical gauges shall be a minimum of two inches in diameter.

The readability of a mechanical pressure gauge shall be:

0.20 inches WC on a full scale not to exceed thirty (30) inches WC for cargo tank tests and

0.10 inches WC on a full scale not to exceed ten (10) inches WC for internal vapor valve tests.

The accuracy of a mechanical pressure gauge shall be one (1.0) percent of full scale.

4.2 Other Pressure Gauges

The full scale range of other pressure gauges shall not exceed twenty (20) inches WC for cargo tank tests and for internal vapor valve tests.

The accuracy of other pressure gauges shall be 0.5 percent of full scale for cargo tank tests and for internal vapor valve tests.

5 EQUIPMENT

5.1 Nitrogen High Pressure Cylinder

Use a high pressure cylinder capable of maintaining a pressure of 2000 pounds per square inch gauge (psig). The cylinder shall be equipped with a compatible two-stage regulator with a one (1) psig relief valve and a flow control metering valve. The outlet of the metering valve shall be equipped with flexible tubing, a quick-connect fitting, and a one psi relief valve.

5.2 Vapor System Pressure Assembly

Use an OPW 634-B, or equivalent, cap (or OPW 634-A plug if applicable). The assembly shall be equipped with a 0-30 inch WC pressure gauge, a metering valve, and a quick connect fitting (see Figure 1).

5.3 Vapor Valve Pressure Gauge

Use a pressure measuring device with a design range suitable for the pressure being measured. The tap for the pressure measurement shall be located on the sample coupling attached to the inlet of the volume meter.

5.4 Leak Test Assembly

Use OPW 633-D, 633-F, and 633-A (or 633-B if applicable) couplers, or equivalent as shown in Figure 2 to leak test the vapor system pressure assembly.

5.5 Flexible Tubing

Use high-pressure tubing equipped with a quick-connect fitting at each end to connect the nitrogen supply to the pressure assembly.

5.6 Nitrogen

Use a commercial grade nitrogen.

5.7 Stopwatch

Use a stopwatch accurate and precise to within 0.2 second.

5.8 Liquid Leak Detector

Use leak detection solution, or equivalent, to detect vapor leaks in the vapor system pressure assembly.

5.9 Combustible Gas Detector

Use a Bacharach Instrument Company Model 0023-7356, or equivalent, to quantify any vapor leaks at the cargo tank vapor coupler during loading operations.

6 PRE-TEST PROTOCOL

The cargo tank shall adhere to all applicable certification conditions referenced in CP-204.

6.1 Leak Check of Test Equipment

Assemble the vapor system pressure assembly as shown in Figure 1.

Leak test the vapor system pressure assembly by connecting it to the leak test assembly and pressurizing, with nitrogen, to 20 inches WC. The decay rate shall not exceed 2 inches WC in five minutes.

6.2 Cargo Tank Location

Locate any cargo tank to be tested where at least 75% of its length will be in shade for the duration of the test.

6.3 Cargo Tank Preparation

6.3.1 In general, this test procedure shall be performed on cargo tanks in conditions of routine operation, maintenance, and repair. Other conditions shall be documented in the test report.

6.3.2 If performance of this test procedure is required due to demonstrated non-compliance with the leak performance standards, the test report shall document compliance with the following conditions:

6.3.2.1 No repairs or maintenance of the cargo tank shall be allowed from the time of such demonstration until after the performance of this test procedure.

6.3.2.2 Any movement or disturbance of the cargo tank or its contents shall be kept to a reasonable and practical minimum. For example:

(1) The cargo tank may be moved for business reasons if it occupies a position needed by another cargo tank.
(2) The cargo tank may be moved to meet the environmental requirements for cargo tank location.
(3) The cargo tank shall be moved to saturate the vapor space before testing if it was purged with air before gasoline loading.

7 TEST PROCEDURE

For those cargo tanks with product lines that are manifolded, this test procedure shall be conducted on a per compartment basis.

7.1 Initial Data Collection and Pressurization

7.1.1 From the identification plate on the cargo tank, determine and record the cargo tank shell capacity.

7.1.2 Upon completion of the loading operations, record the total volume loaded.

7.1.3 If the system back pressure during loading was measured, enter the maximum observed pressure and number of arms loading.

7.1.4 If required by the safety procedures of the loading facility, ensure that a ground cable is connected to the cargo tank. If the cargo tank is remote from the loading rack so that the ground cable is not attached to the loading rack, then attach the ground cable to the nitrogen supply bottle. Connect the vapor system pressure assembly to the vapor coupler of the cargo tank. Open the internal vapor valve(s) of the cargo tank and record the initial headspace.

7.1.5 If the initial headspace pressure exceeds 18 inches water column, use the metering valve on the vapor system pressure assembly to reduce the pressure to 18.0 inches WC.

7.1.6 If the initial headspace pressure is less than 18 inches WC, adjust the delivery pressure on the nitrogen cylinder regulator such that the nitrogen feed rate exceeds the minimum allowable flow rate for an empty cargo tank. See equation in §9.2, or Table 5. Connect the nitrogen supply to the pressure assembly and increase the cargo tank headspace pressure to 18 inches WC.

7.1.7 For the next 30 ± 5 seconds, carefully adjust the headspace pressure to 18.0 inches WC.

7.2 Static Pressure Performance Measurement

7.2.1 Zero and re-start the stopwatch with the headspace pressure at 18.0 inches WC. After 60 ± 5 seconds record the headspace pressure as the "one-minute final pressure".

7.2.2 If the one-minute final pressure is less than 10 inches water column, the internal vapor valve portion of the test, as specified next, cannot be conducted.

7.3 Re-pressurization

7.3.1 Re-pressurize the cargo tank headspace to 18 inches WC. Close the internal vapor vent valve(s), wait for 30 ± 5 seconds, then, remove the pressure assembly cap to relieve the pressure, to atmospheric, downstream of the vapor vent valve. Wait for 15 ± 5 seconds. Replace the pressure assembly cap.

7.3.2 Connect the 0-10 inches WC pressure gauge to the quick connect fitting on the vapor system pressure assembly.

7.4 Internal Vapor Valve Performance Measurement

7.4.1 Interval Headspace Pressures

Zero and start the stopwatch as the pressure assembly cap is replaced. Repeat the following steps for up to five continuous intervals (each interval = 60 ± 5 seconds):

(1) record the total headspace pressure increase as the "interval pressure" in sequence, depending on the next step); and

(2) if the total headspace pressure increase is equal to or less than the corresponding allowable value specified in section 3.2.2 of CP-204, proceed to measure the "final pressure" as specified below; otherwise return to step (1).

7.4.2 Final Headspace Pressure

Within five seconds of the end of the last continuous interval above, open the vapor valve and record the headspace pressure as the "final pressure."

Remove the vapor system pressure assembly from the cargo tank.

8.0 REQUIREMENTS AT THE CONCLUSION OF PRESSURE TESTING

At the conclusion of pressure testing, the cargo tank owner or operator shall inspect the entire cargo tank and compartments, including tank, domes, dome vents, piping hose connections, adaptors, couplings, hoses and delivery elbows for evidence of wear, damage, or maladjustment that may be a potential leak source. Any part found to be defective shall be adjusted, repaired or replaced as necessary.

9 CALCULATING RESULTS

9.1 One Minute Static Pressure Performance Standard

The minimum allowable one-minute final headspace pressure of a complying loaded cargo tank shall be obtained from the application of Tables 1 through 4, or shall be calculated as follows:

$$P_F = 18\left(\frac{N}{18}\right)^{\left(\frac{V_s}{5\,V_h}\right)}$$

Where:

P_F = minimum allowable one-minute final pressure, inches water column

V_s = total cargo tank shell capacity, gallons

V_h	=	cargo tank headspace volume after loading, gallons
18	=	initial pressure at start of test, inches water column
N	=	five minute performance standard, inches water column

Where:

If (Vs) is:			Then (N) equals:
≥		2,500	15.5
1,500	to	2,499	15.0
1,000	to	1,499	14.5
0	to	999	14.0

Important: If individual compartments are to be tested, both V_s and V_h must be the volumes relating to that compartment alone, not all compartments.

Note: Tables 1 through 5 are convenient results of the calculation described above.

In these tables, the columns are headed by values of V_h and the rows are preceded by values of V_s.

Obtain the calculated result for P_F by finding the value of P_F at the intersection of the appropriate column and row for V_h and V_s.

9.2 Minimum Nitrogen Flowrate

The minimum nitrogen flowrate required to test a cargo tank shall exceed the following calculated value by at least ten percent, or obtained from Table 6:

$$Fn = \frac{V_s (18.0 - N)}{(7.481 \text{ x } 5 \text{ x } 406.9)}$$

Where:

Fn	=	minimum required nitrogen flowrate, CFM
Vs	=	total cargo tank shell capacity, gallons
18	=	initial pressure at start of test, inches water column
N	=	five minute performance standard, inches water column
5	=	5 minutes
406.9	=	atmospheric pressure, inches water column
7.481	=	number of gallons per cubic foot

9.3 Internal Vapor Valve Performance Standard

The internal vapor valve performance standard is found in section 3.2.2 of CP-204.

9.4 Conversion from One Minute to Five Minute Pressure

The conversion of the one-minute final pressure to the equivalent five-minute final pressure of an empty cargo tank shall be calculated as follows:

$$P_{f\,5} \quad = \quad 18\,e^{-\left[5\left(\frac{V_h}{V_s}\right)\ln\left(\frac{18}{P_{f\,1}}\right)\right]}$$

Where:

Pf	=	equivalent five-minute final pressure for an empty cargo tank, inches water column
V_s	=	total cargo tank shell capacity, gallons
V_h	=	cargo tank headspace volume after loading, gallons
$P_{f\,1}$	=	one-minute final pressure from Line 7 of the data sheet (Figure 3), inches water column
18	=	initial pressure at start of test, inches water column
5	=	5 minutes
ln	=	natural logarithm
e	=	constant equal to 2.71828

10 ALTERNATE PROCEDURES

This test procedure shall be conducted as specified. Modifications to this test procedure shall not be used to determine compliance unless prior written approval has been obtained from the Executive Officer, pursuant to section 5 of Certification Procedure 204 (CP-204).

11 EXAMPLE FIGURES AND TABLES

Each figure or table provides an illustration of an implementation which conforms to the requirements of this test procedure; other implementations which so conform are acceptable, too. Any specifications or dimensions provided in the figures or tables are for example only, unless such specifications or dimensions are provided as requirements in the text of this or some other required test procedure.

Figure 1
Vapor System Pressure Assembly

Figure 2
Leak Test Assembly

Table 1
One-Minute Static Performance Standard (4,000 to 9,900 gallons ullage)

Table 2
One-Minute Static Performance Standard (2,500 to 3,999 gallons ullage)

Table 3
One-Minute Static Performance Standard (1,500 to 2,499 gallons ullage)

Table 4

One-Minute Static Performance Standard (1,000 to 1,499 gallons ullage)

Table 5
One-Minute Static Performance Standard (300 to 999 gallons ullage)

Table 6
Minimum Nitrogen Feed Rate

FIGURE 1

Vapor System Pressure Assembly

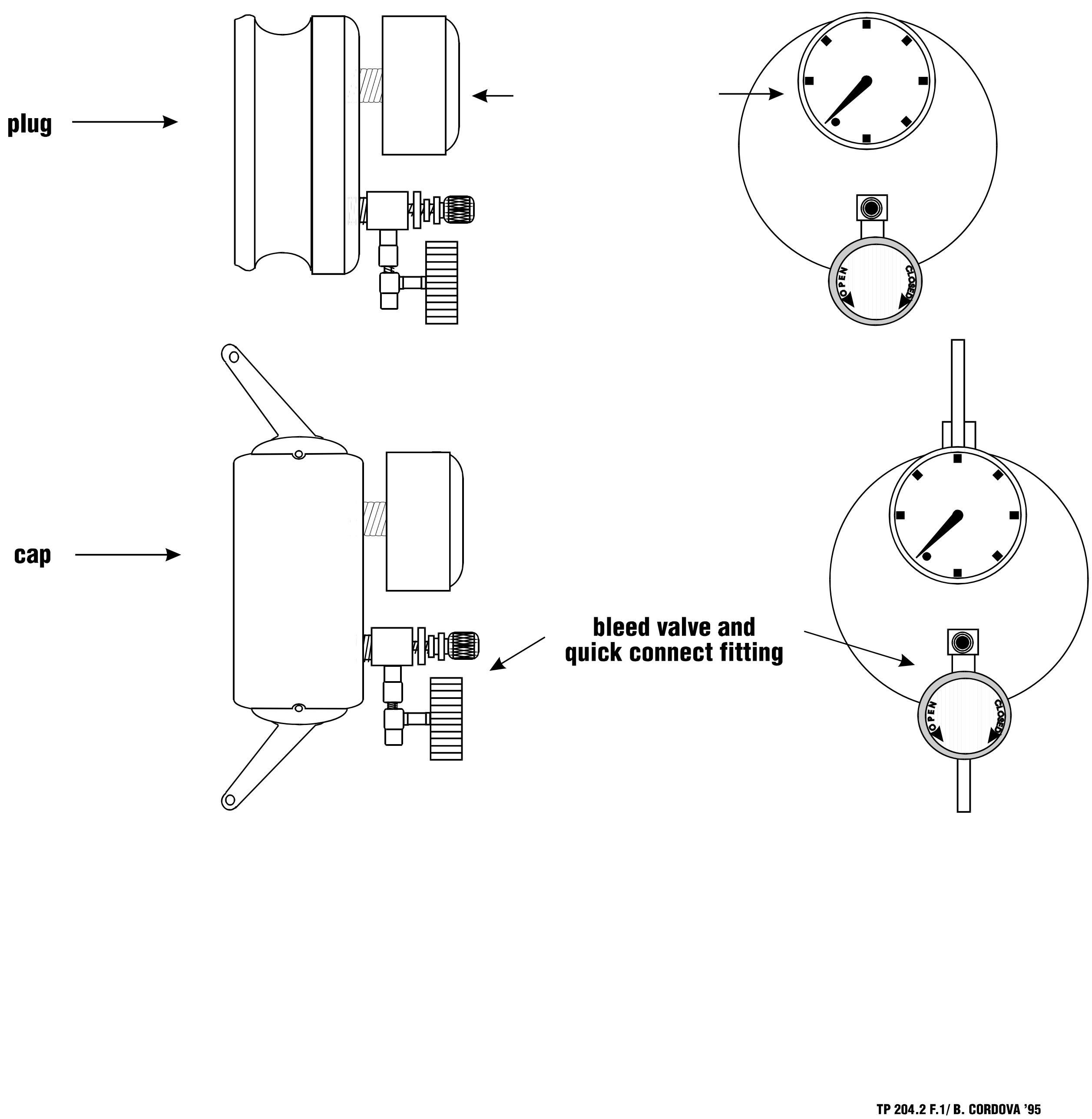


FIGURE 2
Leak Test Assembly

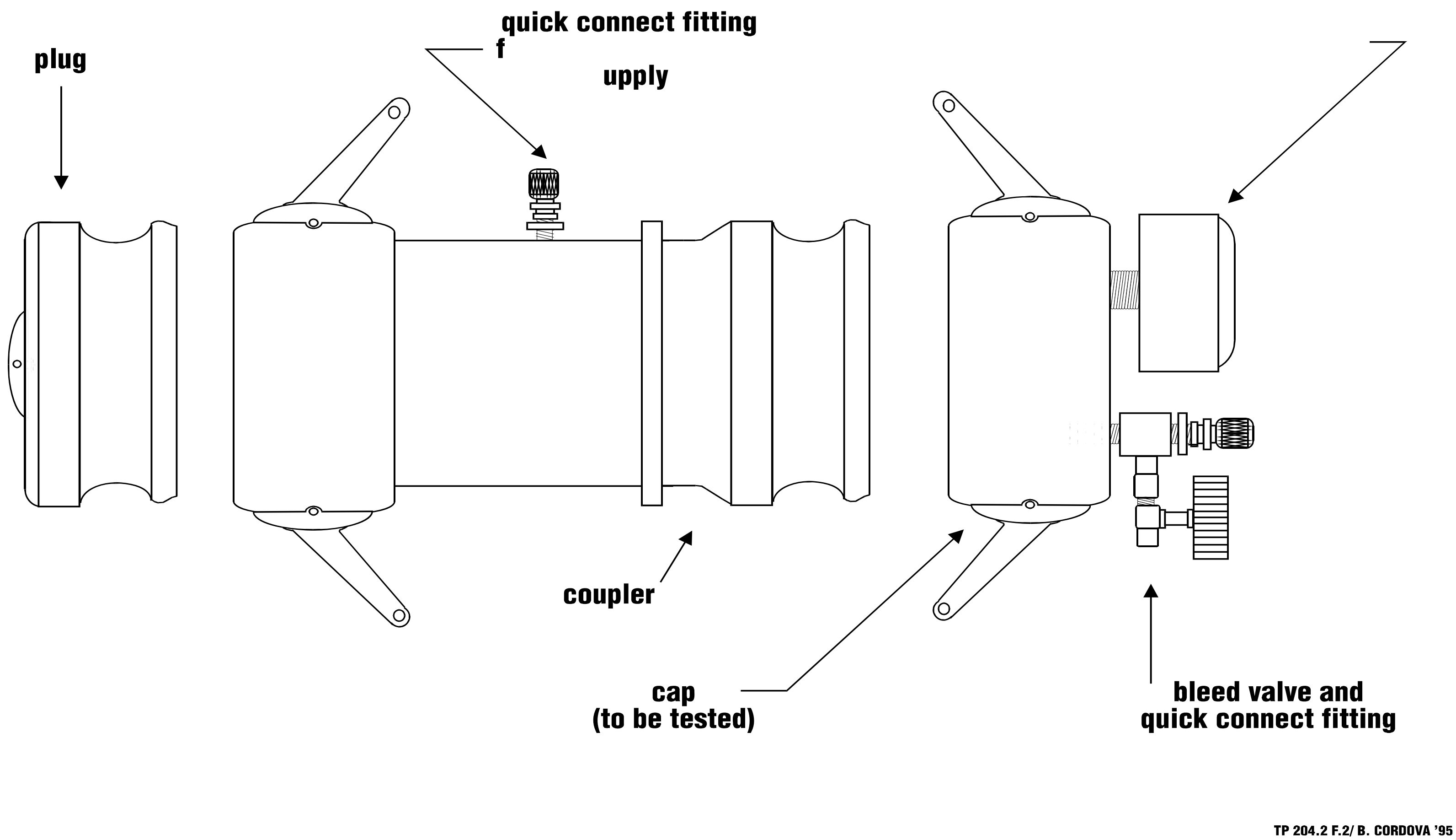


Table 1
One-Minute Static Performance Standard
(4,000 to 9,900 gallons ullage)
(See § 9.1)

	100	150	200	250	300	350	400	450	500	550	600	650	700
	----	----	----	----	----	----	----	----	----	----	----	----	----
4,000	**5.4**	**8.1**	**9.9**	**11.2**	**12.1**	**12.8**	**13.3**	**13.8**	**14.2**	**14.5**	**14.7**	**15.0**	**15.2**
4,100	5.3	7.9	9.8	11.0	12.0	12.7	13.2	13.7	14.1	14.4	14.7	14.9	15.1
4,200	**5.1**	**7.8**	**9.6**	**10.9**	**11.8**	**12.6**	**13.1**	**13.6**	**14.0**	**14.3**	**14.6**	**14.8**	**15.0**
4,300	5.0	7.6	9.5	10.8	11.7	12.5	13.1	13.5	13.9	14.2	14.5	14.8	15.0
4,400	**4.8**	**7.5**	**9.3**	**10.6**	**11.6**	**12.4**	**13.0**	**13.4**	**13.8**	**14.2**	**14.5**	**14.7**	**14.9**
4,500	4.7	7.3	9.2	10.5	11.5	12.3	12.9	13.3	13.8	14.1	14.4	14.6	14.9
4,600	**4.5**	**7.2**	**9.0**	**10.4**	**11.4**	**12.1**	**12.8**	**13.3**	**13.7**	**14.0**	**14.3**	**14.6**	**14.8**
4,700	4.4	7.1	8.9	10.3	11.3	12.0	12.7	13.2	13.6	13.9	14.2	14.5	14.7
4,800	**4.3**	**6.9**	**8.8**	**10.1**	**11.2**	**11.9**	**12.6**	**13.1**	**13.5**	**13.9**	**14.2**	**14.4**	**14.6**
4,900	4.2	6.8	8.7	10.0	11.0	11.8	12.5	13.0	13.4	13.8	14.1	14.4	14.6
5,000	**4.0**	**6.6**	**8.5**	**9.9**	**10.9**	**11.7**	**12.4**	**12.9**	**13.3**	**13.7**	**14.0**	**14.3**	**14.5**
5,100	3.9	6.5	8.4	9.8	10.8	11.6	12.3	12.8	13.3	13.6	14.0	14.2	14.5
5,200	**3.8**	**6.4**	**8.3**	**9.7**	**10.7**	**11.5**	**12.2**	**12.7**	**13.2**	**13.6**	**13.9**	**14.2**	**14.4**
5,300	3.7	6.3	8.1	9.5	10.6	11.4	12.1	12.7	13.1	13.5	13.8	14.1	14.4
5,400	**3.6**	**6.1**	**8.0**	**9.4**	**10.5**	**11.3**	**12.0**	**12.6**	**13.0**	**13.4**	**13.8**	**14.0**	**14.3**
5,500	3.5	6.0	7.9	9.3	10.4	11.3	11.9	12.5	13.0	13.3	13.7	14.0	14.2
5,600	**3.4**	**5.9**	**7.8**	**9.2**	**10.3**	**11.2**	**11.8**	**12.4**	**12.9**	**13.3**	**13.6**	**13.9**	**14.2**
5,700	3.3	5.8	7.7	9.1	10.2	11.1	11.8	12.3	12.8	13.2	13.5	13.8	14.1

	300	350	400	450	500	550	600	650	700	750	800	850	900
	----	----	----	----	----	----	----	----	----	----	----	----	----
9,200	**7.2**	**8.2**	**9.0**	**9.8**	**10.4**	**10.9**	**11.4**	**11.8**	**12.1**	**12.5**	**12.8**	**13.0**	**13.3**
9,300	7.1	8.1	8.9	9.6	10.3	10.9	11.3	11.7	12.1	12.4	12.7	13.0	13.2
9,400	**7.1**	**8.1**	**8.9**	**9.6**	**10.3**	**10.8**	**11.3**	**11.7**	**12.0**	**12.4**	**12.7**	**12.9**	**13.2**
9,500	7.0	8.0	8.8	9.6	10.2	10.7	11.2	11.6	12.0	12.3	12.6	12.9	13.1
9,600	**6.9**	**7.9**	**8.8**	**9.5**	**10.1**	**10.7**	**11.2**	**11.2**	**11.9**	**12.3**	**12.6**	**12.8**	**13.1**
9,700	6.8	7.9	8.7	9.4	10.1	10.6	11.1	11.5	11.9	12.2	12.5	12.8	13.0
9,800	**6.8**	**7.8**	**8.7**	**9.4**	**10.0**	**10.6**	**11.0**	**11.5**	**11.8**	**12.2**	**12.5**	**12.8**	**13.0**
9,900	6.7	7.7	8.6	9.3	10.0	10.5	11.0	11.4	11.8	12.1	12.4	12.7	12.9

Table 2
One-Minute Static Performance Standard
(2,500 to 3,999 gallons ullage)
(See § 9.1)

	100	150	200	250	300	350	400	450	500	550	600	650	700
	----	----	----	----	----	----	----	----	----	----	----	----	----
2500	**8.5**	**10.9**	**12.4**	**13.3**	**14.0**	**14.5**	**14.9**	**15.2**	**15.5**	**15.7**	**15.9**	**16.0**	**16.2**
2600	8.3	10.7	12.2	13.2	13.9	14.4	14.8	15.1	15.4	15.6	15.8	16.0	16.1
2700	**8.0**	**10.5**	**12.0**	**13.0**	**13.8**	**14.3**	**14.7**	**15.0**	**15.3**	**15.5**	**15.7**	**15.9**	**16.0**
2800	7.8	10.3	11.8	12.9	13.6	14.2	14.6	14.9	15.2	15.5	15.7	15.8	16.0
2900	**7.6**	**10.1**	**11.7**	**12.7**	**13.5**	**14.0**	**14.5**	**14.8**	**15.1**	**15.4**	**15.6**	**15.8**	**15.9**
3000	7.3	9.9	11.5	12.6	13.3	13.9	14.4	14.7	15.0	15.3	15.5	15.7	15.8
3100	**7.1**	**9.7**	**11.3**	**12.4**	**13.2**	**13.8**	**14.3**	**14.6**	**15.0**	**15.2**	**15.4**	**15.6**	**15.8**
3200	6.9	9.5	11.2	12.1	13.1	13.7	14.2	14.6	14.9	15.1	15.3	15.5	15.7
3300	**6.7**	**9.3**	**11.0**	**12.1**	**13.0**	**13.6**	**14.1**	**14.5**	**14.8**	**15.0**	**15.2**	**15.5**	**15.6**
3400	6.5	9.1	10.8	12.0	12.8	13.5	14.0	14.4	14.7	15.0	15.2	15.4	15.6
3500	**6.3**	**9.0**	**10.7**	**11.8**	**12.7**	**13.5**	**13.9**	**14.3**	**14.6**	**14.9**	**15.1**	**15.3**	**15.5**
3600	6.1	8.8	10.5	11.7	12.6	13.2	13.8	14.2	14.5	14.8	15.0	15.3	15.4
3700	**6.0**	**8.6**	**10.4**	**11.6**	**12.4**	**13.3**	**13.6**	**14.1**	**14.4**	**14.7**	**15.0**	**15.2**	**15.4**
3800	5.8	8.4	10.2	11.4	12.3	13.0	13.5	14.0	14.3	14.6	14.9	15.1	15.3
3900	**5.6**	**8.3**	**10.0**	**11.3**	**12.2**	**12.9**	**13.4**	**13.9**	**14.3**	**14.6**	**14.8**	**15.0**	**15.2**
3999	**5.4**	**8.1**	**9.9**	**11.2**	**12.1**	**12.8**	**13.3**	**13.8**	**14.2**	**14.5**	**14.7**	**15.0**	**15.2**

TABLE 3

One-Minute Static Performance Standard
(1,500 to 2,499 gallons ullage)

(See § 9.1)

	50	100	150	200	250	300	350	400	450	500	550	600
	----	----	----	----	----	----	----	----	----	----	----	----
1,500	**6.0**	**10.4**	**12.5**	**13.7**	**14.5**	**15.0**	**15.4**	**15.7**	**15.9**	**16.1**	**16.3**	**16.4**
1,550	5.8	10.2	12.3	13.6	14.4	14.9	15.3	15.6	15.9	16.1	16.2	16.4
1,600	**5.6**	**10.0**	**12.2**	**13.4**	**14.3**	**14.8**	**15.2**	**15.6**	**15.8**	**16.0**	**16.2**	**16.3**
1,650	5.4	9.9	12.1	13.3	14.1	14.7	15.2	15.5	15.7	16.0	16.1	16.3
1,700	**5.2**	**9.7**	**11.9**	**13.2**	**14.0**	**14.6**	**15.1**	**15.4**	**15.7**	**15.9**	**16.1**	**16.2**
1,750	5.0	9.5	11.8	13.1	13.9	14.6	15.0	15.3	15.6	15.8	16.0	16.2
1,800	**4.8**	**9.3**	**11.6**	**13.0**	**13.8**	**14.5**	**14.9**	**15.3**	**15.6**	**15.8**	**16.0**	**16.1**
1,850	4.7	9.2	11.5	12.8	13.7	14.4	14.8	15.2	15.5	15.7	15.9	16.1
1,900	**4.5**	**9.0**	**11.3**	**12.7**	**13.6**	**14.3**	**14.8**	**15.1**	**15.4**	**15.7**	**15.9**	**16.0**
1,950	4.3	8.8	11.2	12.6	13.5	14.2	14.7	15.1	15.4	15.6	15.8	16.0
2,000	**4.2**	**8.7**	**11.1**	**12.5**	**13.4**	**14.1**	**14.6**	**15.0**	**15.3**	**15.6**	**15.8**	**15.9**
2,050	4.0	8.5	10.9	12.4	13.3	14.0	14.5	14.9	15.2	15.5	15.7	15.9
2,100	**3.9**	**8.4**	**10.8**	**12.3**	**13.3**	**13.9**	**14.5**	**14.9**	**15.2**	**15.4**	**15.7**	**15.8**
2,150	3.8	8.2	10.7	12.2	13.2	13.9	14.4	14.8	15.1	15.4	15.6	15.8
2,200	**3.6**	**8.1**	**10.5**	**12.1**	**13.1**	**13.8**	**14.3**	**14.7**	**15.1**	**15.3**	**15.6**	**15.7**
2,250	3.5	7.9	10.4	11.9	13.0	13.7	14.2	14.7	15.0	15.3	15.5	15.7
2,300	**3.4**	**7.8**	**10.3**	**11.8**	**12.9**	**13.6**	**14.2**	**14.6**	**14.9**	**15.2**	**15.5**	**15.7**
2,350	3.2	7.6	10.2	11.7	12.8	13.5	14.1	14.5	14.9	15.2	15.4	15.6
2,400	**3.1**	**7.5**	**10.0**	**11.6**	**12.7**	**13.4**	**14.0**	**14.5**	**14.8**	**15.1**	**15.4**	**15.6**
2,450	3.0	7.4	9.9	11.5	12.6	13.4	13.9	14.4	14.8	15.1	15.3	15.5
2,499	**2.9**	**7.2**	**9.8**	**11.4**	**12.5**	**13.3**	**13.9**	**14.3**	**14.7**	**15.0**	**15.3**	**15.5**

TABLE 4

One-Minute Static Performance Standard
(1,000 to 1,499 gallons ullage)
(See § 9.1)

	25	50	75	100	125	150	175	200	225	250
	----	----	----	----	----	----	----	----	----	----
1,000	**3.2**	**7.6**	**10.1**	**11.7**	**12.7**	**13.5**	**14.1**	**14.5**	**14.9**	**15.1**
1,050	2.9	7.3	9.8	11.4	12.5	13.3	13.9	14.3	14.7	15.0
1,100	**2.7**	**7.0**	**9.5**	**11.2**	**12.3**	**13.1**	**13.7**	**14.2**	**14.6**	**14.9**
1,150	2.5	6.7	9.3	10.9	12.1	12.9	13.5	14.0	14.4	14.8
1,200	**2.3**	**6.4**	**9.0**	**10.7**	**11.9**	**12.7**	**13.4**	**13.9**	**14.3**	**14.6**
1,250	2.1	6.1	8.8	10.5	11.7	12.6	13.2	13.7	14.2	14.5
1,300	**1.9**	**5.8**	**8.5**	**10.3**	**11.5**	**12.4**	**13.1**	**13.6**	**14.0**	**14.4**
1,350	1.7	5.6	8.3	10.0	11.3	12.2	12.9	13.4	13.9	14.3
1,400	**1.6**	**5.4**	**8.0**	**9.8**	**11.1**	**12.0**	**12.7**	**13.3**	**13.8**	**14.1**
1,450	1.5	5.1	7.8	9.6	10.9	11.8	12.6	13.2	13.6	14.0
1,499	**1.3**	**4.9**	**7.6**	**9.4**	**10.7**	**11.7**	**12.4**	**13.0**	**13.5**	**13.9**

TABLE 5

One-Minute Static Performance Standard
(300 to 999 gallons ullage)
(See § 9.1)

	25	50	75	100	125	150	175	200	225	250
	----	----	----	----	----	----	----	----	----	----
300	**9.8**	**13.3**	**14.7**	**15.5**	**16.0**	**16.3**	**16.5**	**16.7**	**16.8**	**17.0**
350	8.9	12.7	14.2	15.1	15.6	16.0	16.3	16.5	16.6	16.8
400	**8.1**	**12.0**	**13.8**	**14.7**	**15.3**	**15.7**	**16.0**	**16.3**	**16.5**	**16.6**
450	7.3	11.4	13.3	14.4	15.0	15.5	15.8	16.1	16.3	16.4
500	**6.6**	**10.9**	**12.9**	**14.0**	**14.7**	**15.2**	**15.6**	**15.9**	**16.1**	**16.3**
550	6.0	10.4	12.5	13.7	14.4	15.0	15.4	15.7	15.9	16.1
600	**5.4**	**9.8**	**12.0**	**13.3**	**14.1**	**14.7**	**15.2**	**15.5**	**15.7**	**16.0**
650	4.9	9.4	11.6	13.0	13.9	14.5	14.9	15.3	15.6	15.8
700	**4.4**	**8.9**	**11.3**	**12.7**	**13.6**	**14.2**	**14.7**	**15.1**	**15.4**	**15.6**
750	4.0	8.5	10.9	12.3	13.3	14.0	14.5	14.9	15.2	15.5
800	**3.6**	**8.1**	**10.5**	**12.0**	**13.0**	**13.8**	**14.3**	**14.7**	**15.1**	**15.3**
850	3.3	7.7	10.2	11.7	12.8	13.5	14.1	14.5	14.9	15.2
900	**2.9**	**7.3**	**9.8**	**11.4**	**12.5**	**13.3**	**13.9**	**14.4**	**14.7**	**15.0**
950	2.7	6.9	9.5	11.2	12.3	13.1	13.7	14.2	14.6	14.9
999	**2.4**	**6.6**	**9.2**	**10.9**	**12.0**	**12.9**	**13.5**	**14.0**	**14.4**	**14.7**

TABLE 6

Minimum Nitrogen Feed Rate
(See §9.2)

CARGO TANK CAPACITY (GALLONS)	MINIMUM NITROGEN FEED-RATE, CFM
2,500	**0.41**
2,700	0.49
2,900	**0.52**
3,100	0.56
3,300	**0.60**
3,500	0.63
3,700	**0.69**
3,900	0.71
4,100	**0.74**
4,300	0.78
4,500	**0.81**
4,700	0.85
4,900	**0.89**
5,100	0.92
5,300	**0.96**
5,500	0.99
5,700	**1.03**
5,900	1.07
9,000	**1.63**
9,200	1.66
9,400	**1.70**
9,600	1.74
9,800	**1.77**

California Environmental Protection Agency

Air Resources Board

Vapor Recovery Test Procedures

TP-204.3

Determination of Leak(s)

Adopted: April 12, 1996
Amended: March 17, 1999
Amended: November 7, 2014

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

TP-204.3

Determination of Leak(s)

1 APPLICABILITY

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" or “CARB” refers to the California Air Resources Board, and the term "Executive Officer" refers to the Executive Officer of the ARB or his or her authorized representative or designee.

1.1 General Applicability

The procedure is used to determine the leak-tightness of vapor control systems used in the loading of gasoline cargo tanks. It may be utilized to determine the leak-tightness of gasoline cargo tanks during loading without taking the delivery tank out of service and to determine the leak-tightness of vapor control systems at gasoline terminals and bulk plants at any time. It is also effective to determine leak tightness when the vapor control system does not create back-pressure in excess of the pressure limits of the cargo tank certification test (18 inches of water column (WC) referenced in CP-204, Certification Procedure for Vapor Recovery Systems of Cargo Tanks**.**

2 PRINCIPLE AND SUMMARY OF TEST PROCEDURE

A portable instrument is used to detect VOC leaks from individual sources. A leak definition concentration based on a reference compound is specified in each applicable regulation. This procedure is intended to locate and classify leaks only, and is not to be used as a direct measure of mass emission rates from individual sources.

3 BIASES AND INTERFERENCES

Individual Vapor Leak Check Duration

The duration of vapor leak checks will systematically bias the results positively (toward a determination of violation). To control this bias, leak checks shall be performed individually with a fresh air purge between each leak check. Each leak check shall have a duration of less than twice the instrument response time (typically, less than sixteen seconds). Leak checks with a duration of greater than twice the instrument response time are invalid. The probe must be purged with fresh air for more than two instrument response times (more than sixteen seconds) between individual leak checks.

4 EQUIPMENT AND SUPPLIES

4.1 Manometer

Liquid manometer, or equivalent, capable of measuring up to 7500 pascals (30 inches WC) gauge pressure with ± 25 pascals (0.1 inch WC) precision.

4.2 Combustible gas detector

A portable hydrocarbon gas analyzer with associated sampling line and probe using catalytic oxidation to detect and measure concentrations of combustible gas in air.

4.2.1 Safety

Personnel shall assume that the combustible gas detector will be operated in an explosive atmosphere and comply with all pertinent regulations.

4.2.2 Range

Minimum range of 0-100 percent of the lower explosive limit (LEL) expressed as propane (0 to 21,000 ppm).

4.2.3 Probe Diameter

Sampling probe internal diameter of 0.625 cm (1/4 inch).

4.2.4 Probe Length

Probe sampling line of sufficient length for easy maneuverability during testing.

4.2.5 Response Time

Response time to 90 percent of the final stable reading shall be less than 8 seconds for detector with sampling line and probe attached.

4.3 Stopwatch

Accurate and precise to within ±0.2 sec.

4.4 Graduated cylinder

Glass or plastic. 1 milliliter (mL) graduations, minimum volume 50 mL.

5 CALIBRATION PROCEDURE

Calibration is part of each application of the test procedure, see §6.2.

6 TEST PROCEDURE

6.1 Pressure

Place a pressure tap in the terminal or bulk plant vapor control system, as close as reasonably possible to the connection with the cargo tank and before any check valves in the terminal or bulk plant recovery system. Connect the manometer. Record the pressure periodically during testing.

6.2 Calibration

Calibrate the combustible gas detector with 2.1 percent by volume (21,000 ppm) propane in air for 100 percent LEL response. Calibration gas shall be traceable to NIST-SRM.

6.3 Monitoring Procedure - Vapor Leaks

During loading, check the periphery of all potential sources of leakage of the cargo tank and of the terminal or bulk plant, vapor collection system with a combustible gas detector.

6.3.1 Probe Distance

For a mobile leak source (e.g. cargo tank) the detector probe inlet shall be 2.5 cm from the potential leak source. The distance can be maintained during monitoring by putting a 2.5 cm extension on the probe tip.

For a stationary leak source (e.g. loading rack) the probe tip shall be placed at the surface of the suspected leak interface except for a moving part, such as a rotating shaft, for which the probe tip distance shall be 1 cm. The distance can be maintained during monitoring by putting a 1 cm extension on the probe tip.

6.3.2 Probe Movement

Move the probe slowly (approximately 4 cm/sec). If there is any meter deflection at a potential leak source, move the probe to locate the point of highest meter response.

6.3.3 Probe Position

The probe inlet shall be positioned in the path of the vapor flow from a leak so as to maximize the measured concentration.

6.3.4 Wind

Attempt to block the wind from the area being monitored.

6.3.5 Detector Response Time

The detector response time must be equal to or less than 8 seconds and the detector shall not probe any potential leak source for longer than twice the detector response time.

6.3.6 Recording

Record the highest detector reading and location for each leak being monitored.

6.4 Monitoring Procedure - Liquid Leaks

Check cargo tank and bulk plant or terminal system for liquid leaks. Count the number of drops for two minutes.

6.4.1 For Liquid Leaks during Disconnect

Capture liquid lost upon disconnect and measure the volume using graduated cylinder.

6.4.2 Recording

For liquid leaks, record location and number of drops per minute. For liquid leaks during disconnect, record location (loading arm, recovery arm), cargo tank and volume for each consecutive disconnects.

7 ALTERNATE PROCEDURES

7.1 U.S. EPA Method 21 - Determination of Volatile Organic Compound Leaks

U.S. EPA Method 21 is an approved alternative procedure as it applies to the performance of this test procedure subject to the provisions of 6.3.1 regarding probe distances.

7.2 Other Alternative Test Procedures

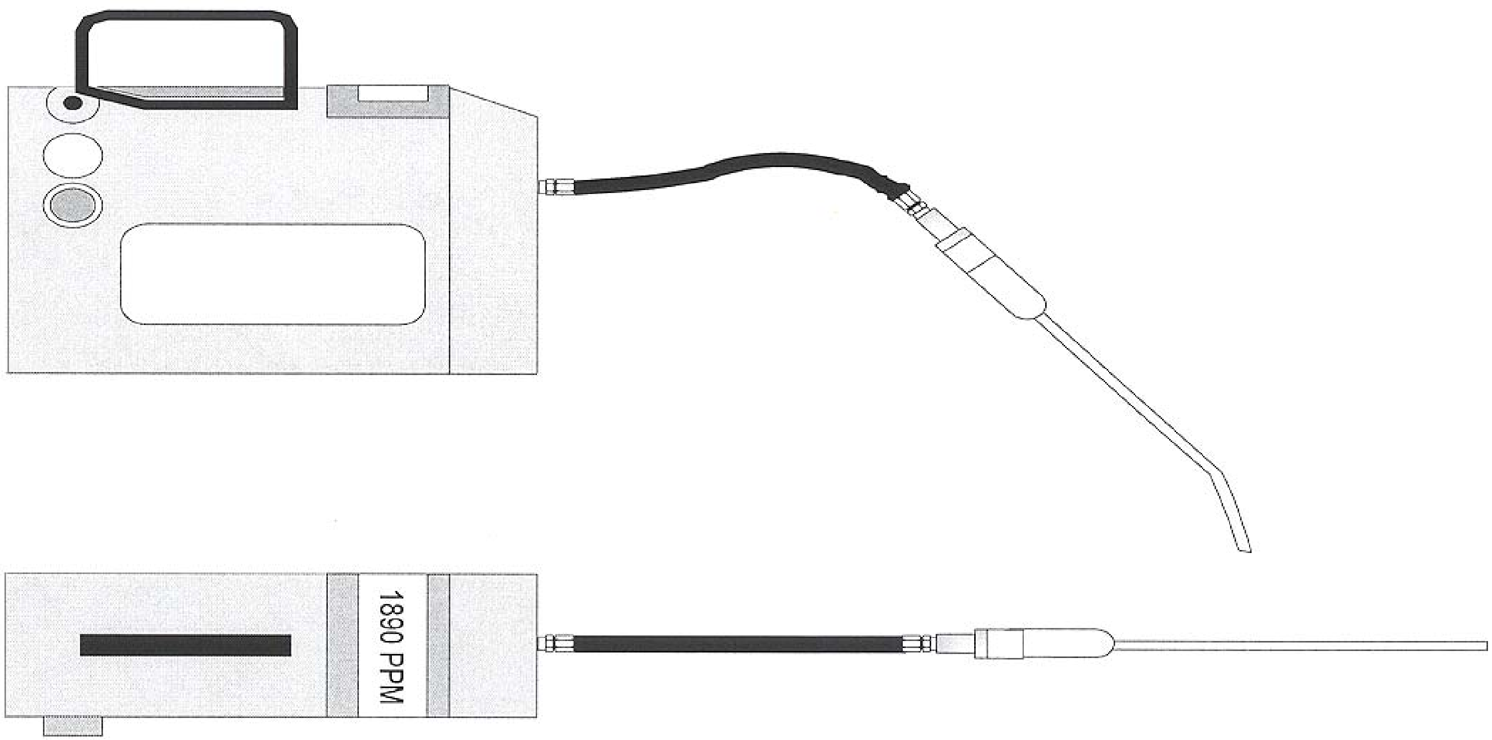
This test procedure shall be conducted as specified. Modifications to this test procedure shall not be used to determine compliance unless prior written approval has been obtained from the Executive Officer, pursuant to section 5 of Certification Procedure 204 (CP-204).

8 FIGURES

Each figure provides an illustration of an implementation which conforms to the requirements of this test procedure; other implementations which so conform are acceptable, too. Any specifications or dimensions provided in the figures are for example only, unless such specifications or dimensions are provided as requirements in the text of this or some other required test procedure.

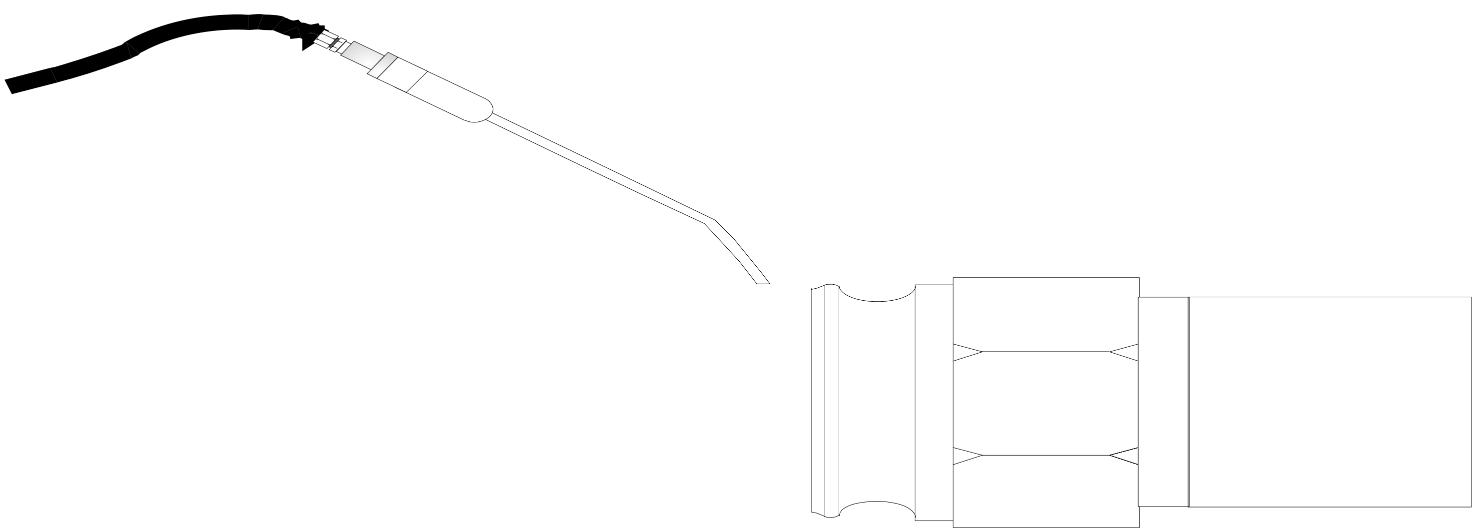
Figures 1 and 2 provide illustrations of a combustible gas meter alone and in use.

FIGURE 1
Phase I Leak Check (View of Combustible Gas Detector)



TP 204.3 F.1/ B. CORDOVA '95

FIGURE 2



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State of California

AIR RESOURCES BOARD

TEST PROCEDURE FOR GASOLINE VAPOR LEAK DETECTION USING COMBUSTIBLE GAS DETECTOR

Adopted: September 1, 1982

State of California
AIR RESOURCES BOARD

TEST PROCEDURE FOR GASOLINE VAPOR LEAK DETECTION USING COMBUSTIBLE GAS DETECTOR

1. PRINCIPLE AND APPLICABILITY

The procedure is applicable for the determination of the leak-tightness of vapor control systems used in the loading of gasoline delivery tanks. It may be utilized to determine the leak-tightness of gasoline delivery tanks during loading without taking the delivery tank out of service, and to determine the leak-tightness of vapor control systems at gasoline terminals and bulk plants at any time. It is applicable for gasoline delivery tanks during loading operations and is effective to determine leak tightness only if the vapor control system does not create back-pressure in excess of the pressure limits of the delivery tank certification leak test (18 inches of water gauge). This procedure does not supersede any local APCD procedures regarding gasoline loading operations which are more stringent.

2. DEFINITIONS

2.1 Delivery tank. Any container, including associated pipes and fittings, that is used for the transport of gasoline, and is required to be certified in accordance with Section 41962 of the California Health and Safety Code.

2.2 Delivery tank vapor collection equipment. Any piping, hoses, and devices on the delivery tank used to collect and route the gasoline vapors in the tank to the bulk terminal or bulk plant.

2.3 Vapor control system. Any piping, hoses, equipment, and devices at the bulk terminal, or bulk plant which is used to collect, store, and/or process gasoline vapors.

2.4 Vapor Leak. A vapor leak is defined to be any source of gasoline vapors which causes a combustible gas detector meter reading of 100 percent of the LEL. A marginal vapor leak may be verified by conducting a pressure/vacuum leak test. A vapor leak does not include any vapor resulting from liquid spillage or liquid leaks.

2.5 Liquid Leak. A liquid leak is defined to be the dripping of liquid organic compounds at a rate in excess of three (3) drops per minute from any single leak source other than the liquid fill line and vapor line disconnect operations. A liquid leak from liquid fill line and vapor line disconnect operations is defined to be: (1) more than two (2) milliliters liquid drainage per disconnect from a top loading operation; or (2) more than ten (10) milliliters liquid drainage from a botton loading operation. Such liquid drainage for disconnect operations shall be determined by computing the average drainage from three consecutive disconnects at any one permit unit.

3. APPARATUS AND SPECIFICATIONS

3.1 Manometer. Liquid manometer, or equivalent, capable of measuring up to 7500 pascals (30 inches H_2O) gauge pressure with ±25 pascals (0.1 inch H_2O) precision.

3.2 Combustible gas detector. A portable hydrocarbon gas analyzer with associated sampling line and probe using catalytic oxidation to detect and measure concentrations of combustible gas in air.

3.2.1. Safety. Certified as safe for operation in explosive atmosphere.

3.2.2 Range. Minimum range of 0-100 percent of the lower explosive limit (LEL) expressed as propane.

3.2.3 Probe diameter. Sampling probe internal diameter of 0.625 cm (1/4 inch).

3.2.4 Probe length. Probe sampling line of sufficient length for easy maneuverability during testing.

3.2.5 Response time. Response time for full-scale deflection of less than 8 seconds for detector with sampling line and probe attached.

3.3 Stopwatch.

3.4 Graduated cylinder. Glass or plastic.

4. TEST PROCEDURE

4.1 Pressure. Place a pressure tap in the terminal or bulk plant vapor control system, as close as reasonably possible to the connection with the delivery tank and before any check valves in the terminal or bulk plant recovery system. Connect the manometer. Record the pressure periodically during testing.

4.2 Calibration. Calibrate the combustible gas detector with 2.2 percent by volume propane in air for 100 percent LEL response. Calibration gas is to be certified traceable to National Bureau of Standards reference materials.

4.3 Monitoring procedure - vapor leaks. During loading, check the periphery of all potential sources of leakage of the delivery tank and of the terminal or bulk plant, vapor collection system with a combustible gas detector. During the time when the tank is being loaded, check the periphery of all potential sources of leakage of the terminal or bulk plant vapor collection system with a combustible gas detector.

4.3.1 Probe distance. The probe inlet shall be 2.5 cm from the potential leak source. The distance can be maintained during monitoring by putting a 2.5 cm extension on the probe tip.

4.3.2 Probe movement. Move the probe slowly (approximately 4 cm/sec). If there is any meter deflection at a potential leak source, move the probe to locate the point of highest meter response.

4.3.3 Probe position. As much as possible, the probe inlet shall be positioned in the path of the vapor flow from a leak so as to maximize the measured concentration.

4.3.4 Wind. Attempt as much as reasonably possible to block the wind from the area being monitored.

4.3.5 Recording. Record the highest detector reading and location for each being monitored.

4.4 Monitoring procedure - liquid leaks. Check delivery tank and bulk plant or terminal system for liquid leaks. Count the number of drops for two minutes.

4.4.1 For liquid leaks during disconnect. Capture liquid lost upon disconnect and measure the volume using graduated cylinder.

4.4.2 Recording. For liquid leaks, record location and number of drops per minute. For liquid leaks during disconnect, record location (loading arm, recovery arm), delivery tank and volume for each consecutive disconnects.

5. ALTERNATIVE METHODS

5.1 Approval. Techniques, other than those specified above, may be used if prior approval is obtained from the Air Resources Board Executive Officer. Such approval will be based upon equivalency with the methods above.