Source Sampling Manual
Volume II

December, 1980

Revisions:

May, 1981
January, 1992
April, 2015

Operations Division
811 SW 6th Avenue
Portland, OR 97204
Phone: 503-229-5696
800-452-4011
Fax: 503-229-5850
Contact: Jill Inahara
www.oregon.gov/DEQ

DEQ is a leader in restoring, maintaining and enhancing the quality of Oregon's air, land and water.

DEQ

State of Oregon
Department of Environmental Quality

This report prepared by:

Oregon Department of Environmental Quality
811 SW 6th Avenue
Portland, OR 97204
1-800-452-4011
www.oregon.gov/DEQ

Contact:
Mark Bailey, 541-633-2006
Jill Inahara, 503-229-5001

Alternative formats (Braille, large type) of this document can be made available.
Contact DEQ's Office of Communications & Outreach, Portland, at
503-229-5696, or toll-free in Oregon at 1-800-452-4011, ext. 5696.

Table of Contents

DEQ METHOD 30 1

1.0 Introduction 2

2.0 Acceptance of Test Results 2

3.0 Small Storage Tank Filling (Phase I Systems): 3

3.1 Principle and Applicability: 3

3.2. Test Equipment 3

3.3 Testing Procedure: 4

3.4. Calculations: 5

4.0 Test Procedure for Determining the Control Efficiency of Gasoline Vapor Incinerators 6

4.1. Principle and Applicability: 6

4.2. Test Scope and Conditions: 6

4.3. Test Equipment: 7

4.4 Test Procedure: 7

4.5 Calculations: 7

5.0 Acceptance of Systems: 9

6.0 Calibration of Equipment: 10

7.0 Alternate Equipment 11

8.0 Recordkeeping: 11

FIGURE A – DISPLACEMENT SYSTEM 12

FIGURE B – VACUUM ASSISTED SECONDARY 13

DEQ METHOD 31 14

1.0 Introduction: 15

1.1 Principle: 15

1.2 Applicability: 15

2.0 Acceptance Of Test Results: 15

3.0 Definitions: 15

3.1 Bulk Gasoline Plant: 15

3.2 Delivery Vessel: 16

3.3 Vapor Balance System: 16

3.4 Secondary Processing Unit: 16

4.0 Test Of Vapor Recovery System For Delivery Of Gasoline To The Bulk Plants: 16

4.1 Application: 16

4.2 Principle and Test Conditions: 16

4.3 Equipment Required for Bulk Plant Testing: 16
4.4 Bulk Plant Storage Tank Loading Test Procedure (Figure A): 17
4.5 Calculations: 18
5.0 Testing Of Vapor Recovery System For Filling of A Delivery Tank At A Bulk Plant: 19
5.1 Application: 19
5.2 Principle and Test Conditions: 19
5.3 Equipment Required for Delivery Tank Testing at the Bulk Plant: 20
5.4 Delivery Tank Loading Test Procedures: 20
5.5 Calculations: 21
6.0 Calibrations 22
6.1 Flow meters 22
6.2 Temperature measuring instruments 22
6.3 Pressure measuring instruments 23
6.4 Total hydrocarbon analyzer 23
7.0 Recordkeeping 23
FIGURE A - BULK TANK TEST APPARATUS 24
FIGURE B - GASOLINE TRANSFER FROM DELIVERY TANK TO BULK PLANT 25
FIGURE C - GASOLINE TRANSFER FROM BULK PLANT TO DELIVERY TANK 26
FIGURE D – DATA SHEET 27
FIGURE E – CALCULATION SHEET 28
DEQ METHOD 32 29
1.0 Introduction: 30
1.1 Principles: 30
1.2 Applicability: 30
2.0 Acceptance Of Test Results 30
3.0 Definitions 30
3.1 Delivery Tank: 30
3.2 Compartment 30
3.3 Delivery Tank Vapor Collection System 30
4.0 Apparatus 30
4.1 Pressure Source 30
4.2 Regulator 31
4.3 Vacuum Source 31
4.4 Manometer 31
4.5 Test Cap for Vapor Recovery Hose Fittings 31
4.6 Cap for Liquid Delivery Hose Fitting 31
4.7 Pressure/Vacuum Supply Hose 31
4.8 Pressure/Vacuum Relief Valves 31

5.0 Pretest Condition 31
5.1 Purging of Vapor 31
5.2 Location 31
6.0 Visual Inspection 31
6.1 Inspection Procedure 31
7.0 Pressure Test Procedure 32
7.1 Pressure Test 32
8.0 Vacuum Test Procedure 32
9.0 Alternative Test Methods 33
10.0 Test Reports 33
11.0 Recordkeeping 33
FIGURE A - DATA SHEET 34
FIGURE B – GASOLINE TANKS 36
DEQ METHOD 33 37
1.0 Introduction 38
1.1 Principle: 38
1.2 Applicability: 38
2.0 Acceptance Of Test Results 38
3.0 Definitions 38
3.1 Bulk Gasoline Terminal 38
3.2 Delivery Vessel 39
3.3 Vapor Balance System 39
4.0 Test Procedures For Determining the Efficiency of Gasoline Vapor Control Systems at Terminals 39
4.1 Application 39
4.2 Principle 39
4.3 Test Conditions 39
4.4 Calibrations 40
5.0 Testing Vapor Control Systems (Other Than Incineration Units) When Loading Delivery Tanks 40
5.1 Equipment Required 40
5.2 Test Procedure 41
5.3 Calculations 42
6.0 Testing Vapor Control Systems (Other Than Incineration Units) When Loading Fixed Roof Storage Tanks 43
6.1 Equipment Required 43
6.2 Test Procedures 43
6.3 Calculations 44
7.0 Testing Exhaust Emissions From Incineration-Type Processing Unit 45
7.1 Equipment Required 45
7.2 Test Procedure 45

7.3 Calculations..46
8.0 Alternative Test Methods 47
9.0 Recordkeeping..47
Appendix I, Submerged Fill Inspection Guideline, May 1, 1981 48

This Page Left Blank on Purpose

DEQ METHOD 30

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

STATE OF OREGON
DEPARTMENT OF ENVIRONMETNAL QUALITY

DEQ Air Quality Program
Portland, Oregon
December 1, 1980

Revisions:
May 15, 1981
January 23, 1992

Method 30

Test Procedures for Determining the Efficiency of Gasoline vapor recovery systems at Service Stations and Similar Facilities with Small Storage Tanks

1.0 Introduction

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

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

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 allowable alteration shall be recorded and included in the test report. 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 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 absorbent, compressors, heat exchangers, combustors, piping, etc.

For the purpose of determining compliance with applicable Administrative Rules, equipment on systems with 90 percent or greater control efficiency shall be considered to be vapor tight.

2.0 Acceptance of Test Results

Results of this method will be accepted as a demonstration of compliance status of the equipment tested, provided that the methods included or referenced in this procedure are strictly adhered to. A statement containing at least the minimum amount of information regarding the test procedures applied should be included with the results.

Deviations from the procedure described herein will be permitted only if permission from DEQ is obtained in writing in advance of the test.

3.0 Small Storage Tank Filling (Phase I Systems):

3.1 Principle and Applicability:

3.1.1 Principle: During a fuel delivery, the volume of gasoline delivered from the tank to the storage 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 storage 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.

3.1.2. Applicability: The method is applicable to all control systems which have a vapor line connecting the storage tank to the tank truck.

The storage tank is filled by submerged fill.

3.2. Test Equipment

3.2.1. For each vent, including restricted vents and vents of any processing units, a positive displacement meter, with a capacity of 3,000 standard cubic feet per hour (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 record volume vented in such a manner that this date can be correlated with simultaneously recorded hydrocarbon concentration data. A manifold for meter outlet with taps for a hydrocarbon (HC) analyzer, a thermocouple, and a pressure sensor is to be used with the positive displacement meter.

3.2.2. Coupling for the vent vapor line to connect the gas meter. Coupling to be sized so as to create no significant additional pressure drop in the system.

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

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

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

3.2.6. Two (2) hydrocarbon analyzers (Flame Ionization Detector, FID, or DEQ approved equivalent) with recorders and with a capacity of measuring total gasoline vapor concentration of 100 percent as propane. Both analyzers to be of same make and model.

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

3.2.8. Explosimeter

3.2.9. Barometer

3.2.10. Three (3) manometers or other pressure sensing devices capable of measuring zero to ten inches of water.

3.2.11. Thermometer

3.3 Testing Procedure:

3.3.1. The test during filling operating will be conducted under, as closely as feasible, normal conditions for the station. Normal conditions will include delivery time and station operating conditions.

3.3.2. Connect manifold to outlet of positive displacement meter and restriction 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 outlet. If appropriate, connect another manifold and meter to the vent of the vacuum assisted secondary processing unit. If the system uses an incinerator to control emissions, use test procedures set forth in Section 4.0.

3.3.3. Connect the HC analyzer with recorder, thermocouple and manometer to the vent manifold. Calibrate the equipment in accordance with Section 6.0.

3.3.4. Connect the couplers to the tank truck fuel and vapor return lines.

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

3.3.6. Connect tank fuel and vapor return lines to appropriate underground tank lines in accordance with written procedure for the system.

3.3.7. Check the tank truck and all vapor line connections for a tight seal before and during the test with the explosimeter.

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

3.3.9. Start filling of the storage tank in accordance with manufacturers' established normal procedure.

3.3.10. 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.

3.3.11. Record at the start and the end of the test, barometric pressure and ambient temperature.

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

3.3.13. Continue recording hydrocarbon concentrations, temperature, pressure and gas meter readings at the storage 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.

3.3.14. Disconnect instrumentation from the vent(s).

3.3.15. Record volume of gasoline that is delivered.

3.3.16. Record final reading of gas meter.

3.4. Calculations:

3.4.1. Volume of gas discharged through "i_{th}" vent (V_{vi}). This includes underground tank vent and any other control system vent.

$$V_{vsi} = \frac{V_{vi} \times 528 \times P_b}{T_{vi} \times 29.92} \quad (ft^3)$$

Where:

V_{vsi} = Volume of gas discharged through "i_{th}" vent, corrected to 68°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_{th}" = The vent under consideration.

3.4.2. Volume of gas returned to the tank truck, (V_t) corrected to 68°F and 29.92 in. Hg.

$$V_t = \frac{0.1337 \times G_t \times [528(P_b + \Delta H)]}{T_t \times 29.92} \quad (ft^3)$$

Where:

G_t = Volume of gasoline delivered, (gal)

ΔH = Final gauge pressure of truck tank, (in Hg)

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

P_b = Barometric pressure, (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

3.4.3. Control Efficiency (E%):

$$E\% = \frac{V_t \times C_t \times 100}{(V_t \times C_t) + \sum(C_{vi} \times V_{vsi})}$$

Where:

E% = the efficiency of control in percent.

V_t = From 3.4.2 above

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

Cvi = The average fractional volume concentration of gasoline vapor in the "ith" vent as determined by the hydrocarbon analyzer, (decimal fraction).

V_{vsi} = From 3.4.1. above.

4.0 Test Procedure for Determining the Control Efficiency of Gasoline Vapor Incinerators

4.1. Principle and Applicability:

4.1.1. Principle: 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.

4.1.2. Applicability: This method is applicable as a performance test method for gasoline vapor control incinerators.

4.2. Test Scope and Conditions:

4.2.1. Station 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. Vehicles shall be fueled as is normal for the test period.

4.2.2. Fuel Reid Vapor Pressure (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.

4.3. Test Equipment:

4.3.1. 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 analyzers.

4.3.2 Sample System: The sample probe is to be of a material unaffected by combustion gases (S.S. 307, 316, 3365, etc.). The sample pump should be oil-less and leak-tight. Sample lines are to be inert, teflon is recommended. A thermocouple (0-2000^{o}F) shall be used to monitor temperature of exhaust gases at the inlet to sampling system.

4.3.3 Carbon Dioxide Analyzer: A non-dispersive infrared analyzer calibrated with known quantities of CO_2 concentrations in the exhaust gas.

4.3.4 Other equipment is specified in Section 3.2.

4.4 Test Procedure:

4.4.1 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 a point of maximum velocity head as determined by the number of equal areas of a cross-section 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.

4.4.2 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.

4.4.3 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 HCs 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.

4.4.4 The quantity of gasoline dispensed during each test shall be recorded.

4.5 Calculations:

CO_{2e} = 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 Hg).

T_i = Temperature of gas at inlet meter (^oR).

V_i = Inlet gas volume ($ft.^3$).

F = Dilution Factor.

51.8×10^{-6} = Multiplication factor to convert parts per million by volume as propane to grams per cubic foot at 68°F. (52.7×10^{-6} at 68°F)

4.5.1 Calculate the standard total gas volume (V_s) at the burner inlet for each test. (Standard temperature 68°F, standard pressure 29.92 in Hg)

$$V_s = V_i \text{ X } \frac{(P_i + P_b)}{(T_i)} \times \frac{528}{29.92} \text{ (SCF)} \quad (1)$$

4.5.2 Calculate an average vapor volume to liquid volume (v/1) at the inlet for each test.

$$(v/1)_i = \frac{V_s}{L_d}, \text{ (SCF/gal)} \quad (2)$$

4.5.3 Calculate the mass emission rate $(m/l)_i$ at the inlet for each test.

$$(m/l)_i = 51.8 \times 10^{-6} \times HC_i \times (v/l)_i, \text{ (g/gal)} \quad (3)$$

4.5.4 A carbon dilution factor (F) can be calculated for the incinerator using the inlet and outlet HC concentrations and the ambient CO_2 concentration. The important criterion for this 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.

$$F = \frac{HC_i}{HC_e + \frac{(CO_{2e} - CO_{2a})}{3}} \quad (4)$$

4.5.5 The mass emission rate at the exhaust, $(m/l)_e$, 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 HCi, several peak values of $(m/l)_e$ will be required as discussed above. If some correlations between HC_i and HC_e occur over the burning cycle of the system, this calculation should be used to show the change in mass emission rate.

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

4.5.6 Mass control efficiency (E%) can be calculated for an average value over each 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.

$$E\% = 100\,[1 - (F \times HC_e)/(HC_i)] \qquad (6)$$

5.0 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 accommodate 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 must be ascertained. Some of the conditions that may be imposed upon an acceptance are:

5.1 Allowable pressure drop in the lines leading from the dispensing nozzle to the underground tank.

5.2 The method of calculating the pressure drop.

5.3 The model of dispensing nozzle which may be used.

5.4 The manner in which vapor return lines may be manifolded.

5.5 The type of restriction to be placed on the vent of the underground tank.

5.6 The number of dispensing nozzles which may be serviced by a secondary system.

5.7 Allowable delivery rates.

5.8 Use of the system on full-service stations only.

6.0 Calibration of Equipment:

6.1 Standard methods of equipment shall be used to calibrate the flow meters. The calibration curves to be traceable to National Institute of Standards & Technology (NIST) standards.

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

6.3 Calibrate pressure sensing and recording instructions (transducers) prior to the Phase I 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 test.

6.4 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 prepared with measured 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 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 30 percent and 70 percent 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.

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. and when the cylinder pressure drops to 10 percent of the original pressure.

6.5 Non-dispersive 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 the air. A calibration shall be prepared using a minimum of five prepared calibration gases in the range of concentration 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 the air at a level near the highest concentration expected. The spanning procedure shall occur at least twice per test day.

6.6 The barometer shall be calibrated against an NIST traceable standard at least once every 6 months.

6.7 A record of all calibrations must be maintained and submitted with the test report.

7.0 Alternate Equipment

Alternate equipment and techniques may be used if prior written approval is obtained from DEQ.

8.0 Recordkeeping:

A record of the results for tests which are performed for compliance determination shall be maintained at the facility site according to OAR 340-232-0080 and 340-232-0100.

FIGURE A – DISPLACEMENT SYSTEM

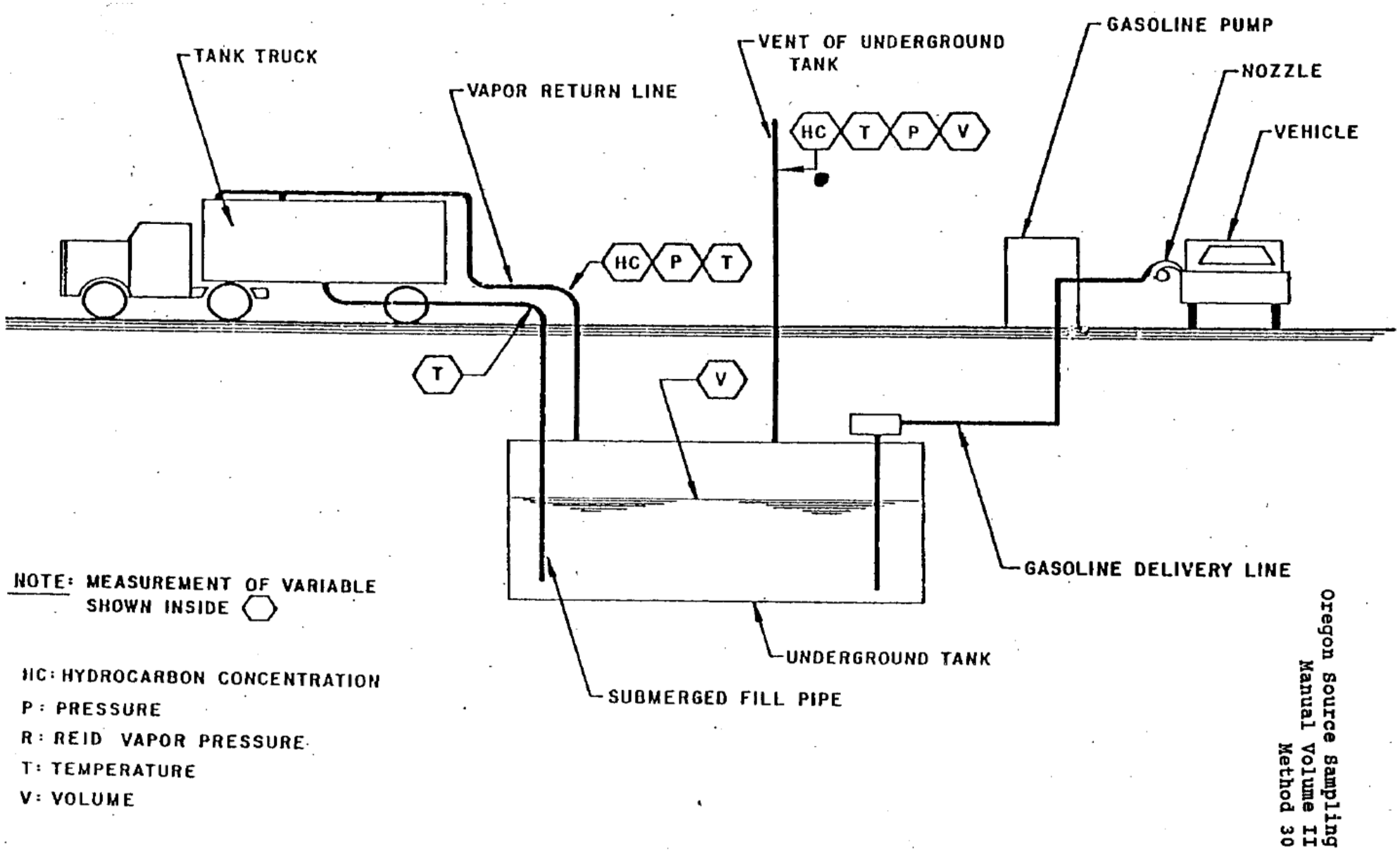


FIGURE A DISPLACEMENT SYSTEM

FIGURE B – VACUUM ASSISTED SECONDARY

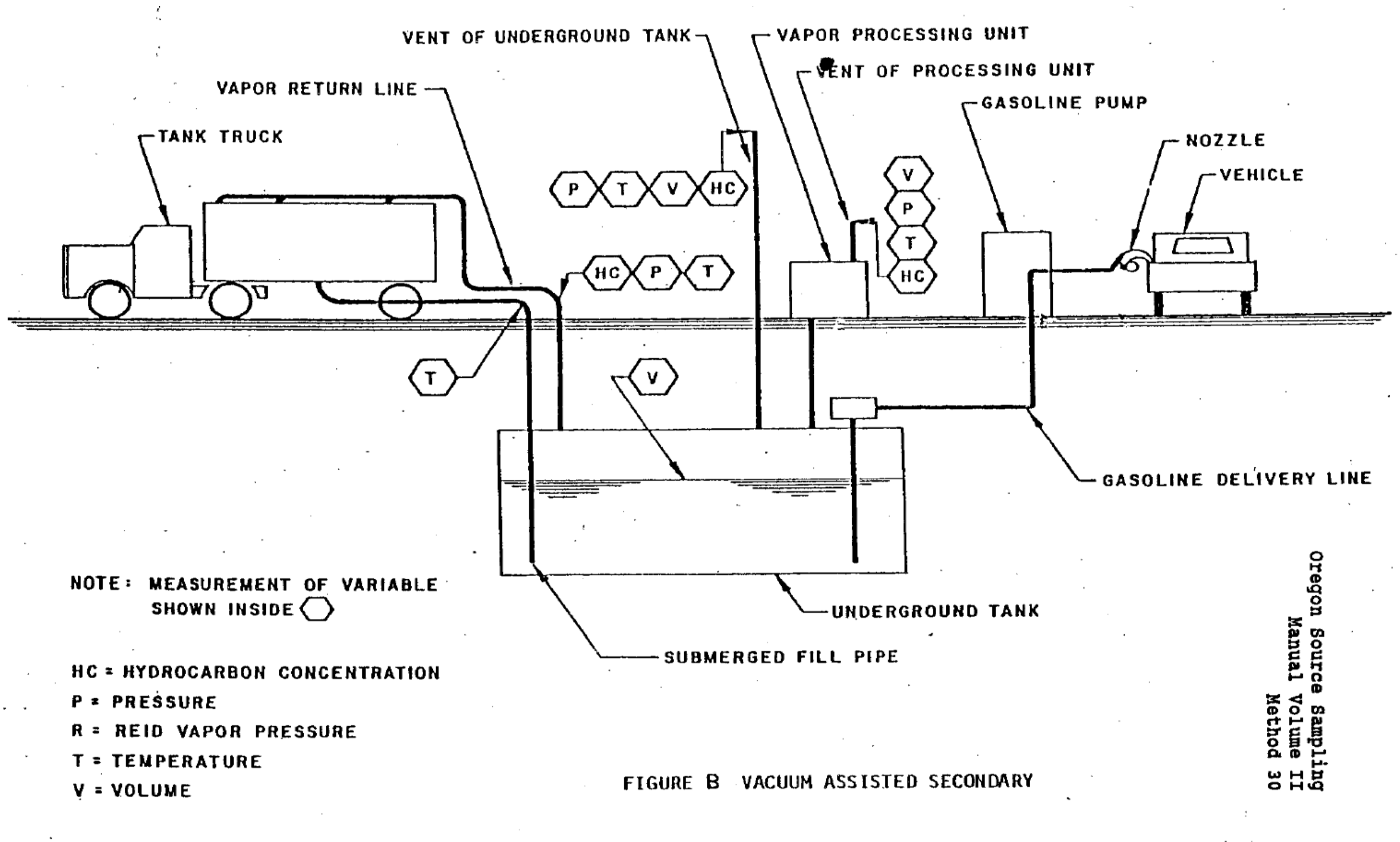


FIGURE B VACUUM ASSISTED SECONDARY

DEQ METHOD 31

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

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY

DEQ Air Quality Program
Portland, Oregon
December 1, 1980

Revisions:
May 15, 1981
January 23, 1992

Method 31

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

1.0 Introduction:

1.1 Principle:

Hydrocarbon mass emissions are determined directly using flowmeters and hydrocarbon analyzers.

The mass of hydrocarbon vapor to be controlled or recovered is determined from the volume of gasoline dispensed (either to the bulk storage tank or delivery tank) by pressure, temperature, and concentration measurements of the vapor.

The efficiency of the gasoline vapor control system is determined from the mass of the hydrocarbons emitted and the mass of hydrocarbons controlled.

For purposes of determining compliance with applicable Administrative Rules, equipment on systems with 90 percent or greater control efficiency shall be considered to be vapor tight.

1.2 Applicability:

These procedures are applicable for testing gasoline vapor recovery systems installed at bulk plants for controlling gasoline vapors emitted during the load of bulk storage tanks and for loading of delivery tanks from bulk tanks. Filling of storage tanks will be by submerged fill.

2.0 Acceptance Of Test Results:

2.1 Results of this method will be accepted as a demonstration of compliance of the equipment tested, provided that the methods included or referenced in this procedure are strictly adhered to. A statement containing at least the minimum amount of information regarding the test procedures applied should be included with the results.

Deviations from the procedure described herein will be permitted only if permission from DEQ is obtained in writing in advance of the test.

3.0 Definitions:

3.1 Bulk Gasoline Plant:

"Bulk Gasoline Plant" means a gasoline storage and distribution facility which receives gasoline from bulk terminals by railroad car or trailer transport, stores it in tanks, and subsequently dispenses it via account trucks to local farms, businesses, and gasoline dispensing facilities.

3.2 Delivery Vessel:

"Delivery Vessel" means any tank truck or trailer used for the transport of gasoline from sources of supply to stationary storage tanks.

3.3 Vapor Balance System:

"Vapor Balance System" means a combination of pipes and/or hoses which create a closed system between the vapor spaces of an unloading tank and a receiving tank such that vapors displaced from the receiving tank are transferred to the tank being unloaded.

3.4 Secondary Processing Unit:

"Secondary Processing Unit" means a gasoline vapor control system which utilizes some process as a means of elimination or recovering gasoline vapors which otherwise would be vented to the atmosphere during the transfer of gasoline to or from a bulk plant.

4.0 Test Of Vapor Recovery System For Delivery Of Gasoline To The Bulk Plants:

4.1 Application:

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

4.2 Principle and Test Conditions:

4.2.1 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 leads. The volume of gasoline delivery from the delivery tank to the bulk plant 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.

4.2.2 Test Conditions: The number of transport deliveries to be tested shall be established by DEQ 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. Simultaneous use of more than one dispenser during loading of bulk storage tanks shall occur to the extent that such would normally occur.)

4.3 Equipment Required for Bulk Plant Testing:

4.3.1 Two (2) positive displacement dry gas meters each with a capacity of 3,000 standard cubic feet per hour (SCFH) a readability of one cubic foot and a maximum pressure drop of not more than 0.50 inches of water at a flowrate of 30 SCFH.

4.3.2 Two (2) hydrocarbon (HC) analyzers with recorders and with the capability of measuring total gasoline vapor concentration of 100 percent as propane. Both analyzers to be of same make and model, either Flame Ionization Detector or a DEQ approved equivalent.

4.3.3 Three (3) flexible thermocouples or thermistors (0-150^{o}F) with a temperature recorder system having a readability of 1^{o}.

4.3.4 Barometer (Aneroid or Mercury), $\pm$ 0.1 in. Hg. readability.

4.3.5 Two (2) manometers or other pressure sensing devices capable of measuring zero to ten inches of water with a readability of 0.1 inches of water.

4.3.6 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.

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

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

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

4.3.10 Coupling for attaching the PV value to the dry gas meter. (Appendix Figure A)

4.3.11 Explosimeter.

4.4 Bulk Plant Storage Tank Loading Test Procedure (Figure A):

4.4.1 Connect appropriate coupler to vent of bulk plant, 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.

4.4.2 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.

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

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

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

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

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

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

4.4.9 Hydrocarbon concentrations, temperature and pressure measurements should be recorded starting after the first 15 seconds of the loading periods followed by 60 second intervals. The gas meter readings must be taken at least every 120 seconds.

4.4.10 Record barometric pressure and ambient temperature during the test.

4.4.11 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.

4.4.12 Continue recording hydrocarbon concentrations, temperature, pressure, and gas meter readings at the bulk tank vent at 20 minute intervals for one hour after the last bulk transfer is made.

4.4.13 Disconnect instrumentation from the vent.

4.4.14 Record volume of gasoline that is delivered.

4.4.15 Record final reading of gas meter(s).

4.5 Calculations:

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

$$V_{vsi} = \frac{V_{vi} \times 528 \times P_b}{T_{vi} \times 29.92}$$

Where:

V_{vsi} = Volume of gas discharged through "i th" vent corrected to 68°F and 29.92 in. Hg, \ (ft^3).

P_b = Barometric pressure, (in. Hg).

V_{vi} = Volume of gas recorded by meter on "ith" vent corrected for amount of vapor removed for the hydrocarbon analysis, (ft^3).

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

4.5.2 Volume of gasoline vapor returned to the tank truck.

$$V_t = \frac{0.1337 G_t \times 528(P_b + P)}{T_t \times 29.92}$$

Where:

P_b = Barometric pressure, (in. Hg).

V_t = Volume of gasoline vapor, corrected to 68°F and 29.92 in. Hg., (ft^3)

G_t = Volume of gasoline delivered, (gal.).

P = Final Gauge pressure of tank truck, (in. Hg).

T_t = Average temperature of vapor returned to tank truck (°R).

0.1337 = Conversion factor, (gallons to ft^3). 1 US gal. = 0.1337 ft^3.

4.5.3 Efficiency of Vapor Control System

$$E = \frac{V_t \times C_t - \ (C_{vi} \times V_{vsi})\ \ 100}{(V_t \times C_t)}$$

Where:

E = 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 hydrocarbon analyzer, (decimal fraction).

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

5.0 Testing Of Vapor Recovery System For Filling of A Delivery Tank At A Bulk Plant:

5.1 Application:

The following test procedures shall be used for determining the efficiency of vapor recovery systems controlling gasoline vapors emitted during the filling of delivery tanks at a bulk plant.

5.2 Principle and Test Conditions:

5.2.1 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.

5.2.2 **Test Conditions:** The number of delivery tank loadings to be testing shall be established by DEQ based 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 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).

5.3 Equipment Required for Delivery Tank Testing at the Bulk Plant:

5.3.1 Same as that required in Section 4.3.

5.4 Delivery Tank Loading Test Procedures:

5.4.1 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.

5.4.2 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.

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

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

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

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

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

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

5.4.9 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.

5.4.10 Record the barometric pressure and ambient temperature before and after the test.

5.4.11 At the end of the delivery tank loading 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.

5.4.12 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.

5.4.13 Disconnect instrumentation from the vent.

5.4.14 Record volume of gasoline that is delivered.

5.4.15 Record final reading of gas meter.

5.4.16 Repeat procedure as necessary for additional delivery tank loading.

5.5 Calculations:

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

$$V_{vsi} = \frac{V_{vi} \times 528 \times P_b}{T_{vi} \times 29.92}$$

Where:

V_{vsi} = Volume of gas discharged through "i_{th}" vent corrected to 68° 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 (ft^3, corrected for amount of vapor removed for the hydrocarbon analysis).

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

"i_{th}"= The vent under consideration.

5.5.2 Volume of gas returned to the bulk storage tank.

$$V_t = \frac{0.1337 G_t \times 528(P_b + P)}{T_t \times 29.92}$$

Where:

P_b = Barometric pressure, (in. Hg).

V_t = Volume of gas returned to the bulk storage tank corrected to 68°F and 29.92 in. Hg, (ft^3).

G_t = Volume of gasoline delivered, (gallons).

P = Final gauge pressure of bulk storage tank, (in. Hg).

T_t = Average temperature of vapor returned to bulk storage tank, (°R).

0.1337 = Conversion factor, (gallons to Ft^3). 1 US gal. = 0.1337 ft^3.

5.5.3 Efficiency of Vapor Control System

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

Where:

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.

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

Where:

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

E_j = From 5.5.3 above.

n = Number of Loadings Tested.

6.0 Calibrations

6.1 Flow meters

Standard methods and equipment shall be used to calibrate the flow meters within thirty (30) days prior to any test or test series. The calibration curves are to be traceable to NIST.

6.2 Temperature measuring instruments

Calibrate immediately prior to any test period and immediately following test period using ice water (32°F.) and a known temperature source of about 100°F.

6.3 Pressure measuring instruments

Calibrate pressure transducers within thirty (30) days prior to the test period and immediately after the test period with a static pressure calibrator of known accuracy.

6.4 Total hydrocarbon analyzer

Follow the manufacturer's instruction 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.

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

7.0 Recordkeeping

A copy of the results of these tests which are performed for compliance determination shall be maintained at the facility site according to OAR 340-232-0080 and 340-232-0100.

FIGURE A - BULK TANK TEST APPARATUS

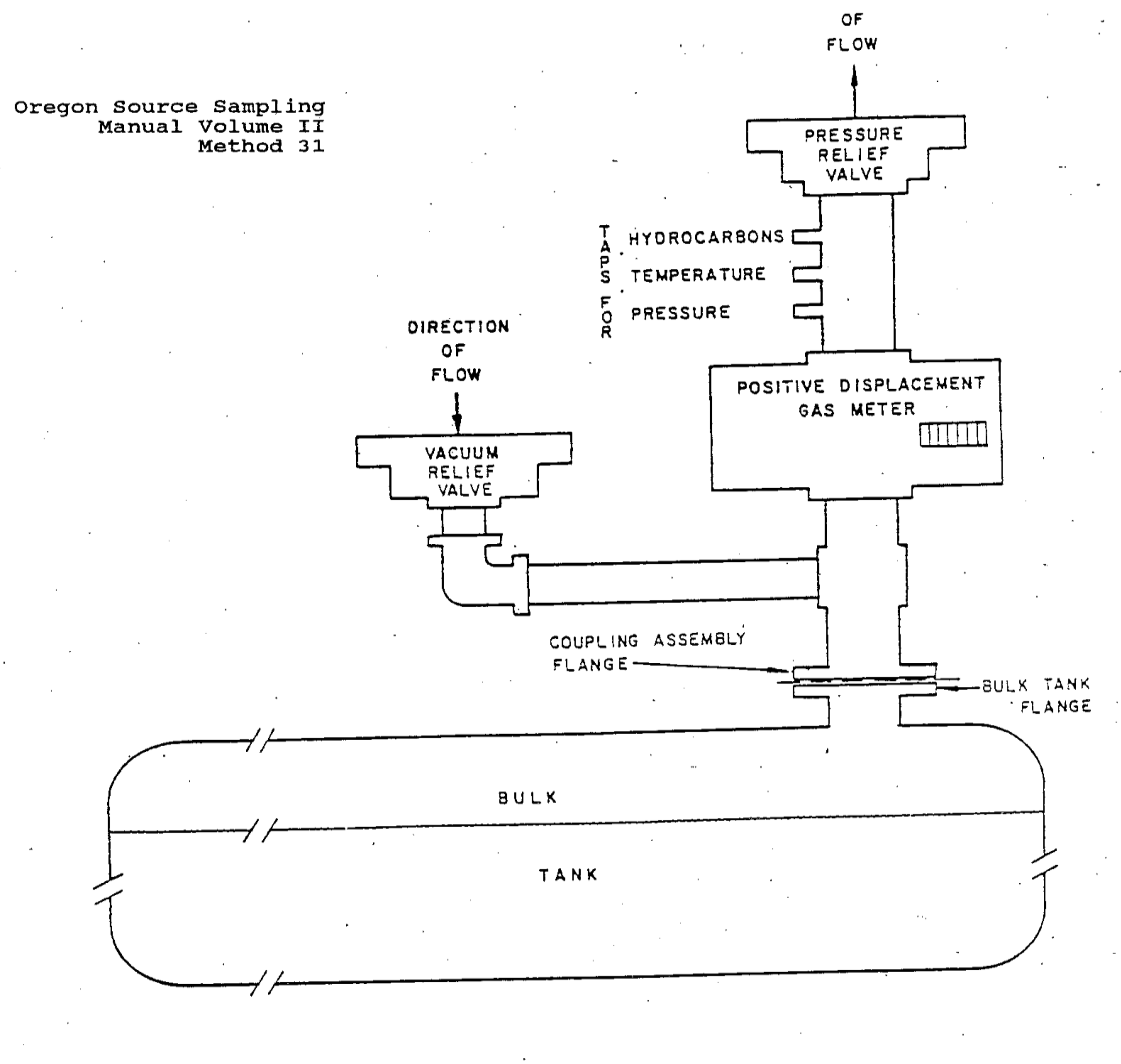


FIGURE A
BULK TANK
TEST APPARATUS

METHOD 31

FIGURE B - GASOLINE TRANSFER FROM DELIVERY TANK TO BULK PLANT

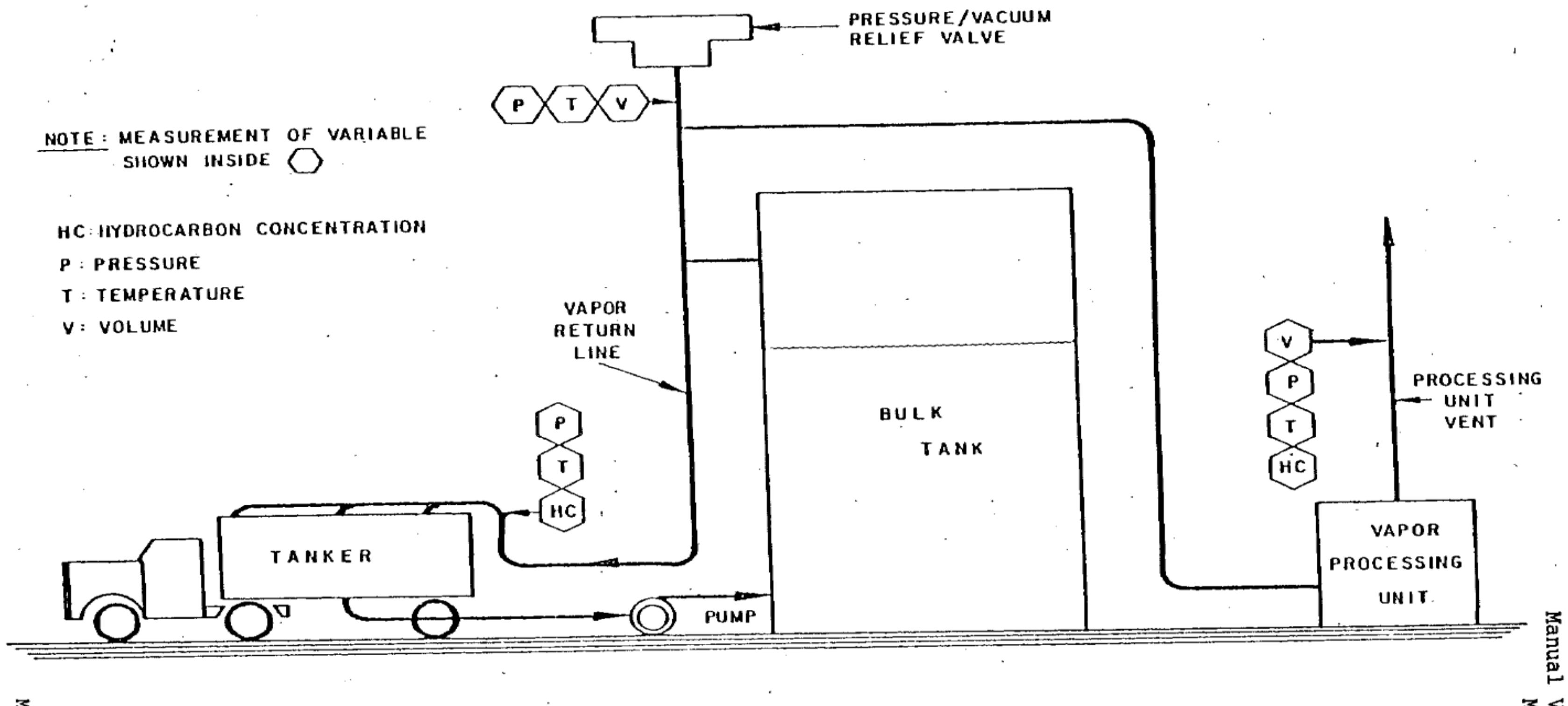


FIGURE · B
GASOLINE TRANSFER
FROM DELIVERY TANK TO BULK PLANT

METHOD 31

Manual Volume 11
Method 31

FIGURE C - GASOLINE TRANSFER FROM BULK PLANT TO DELIVERY TANK

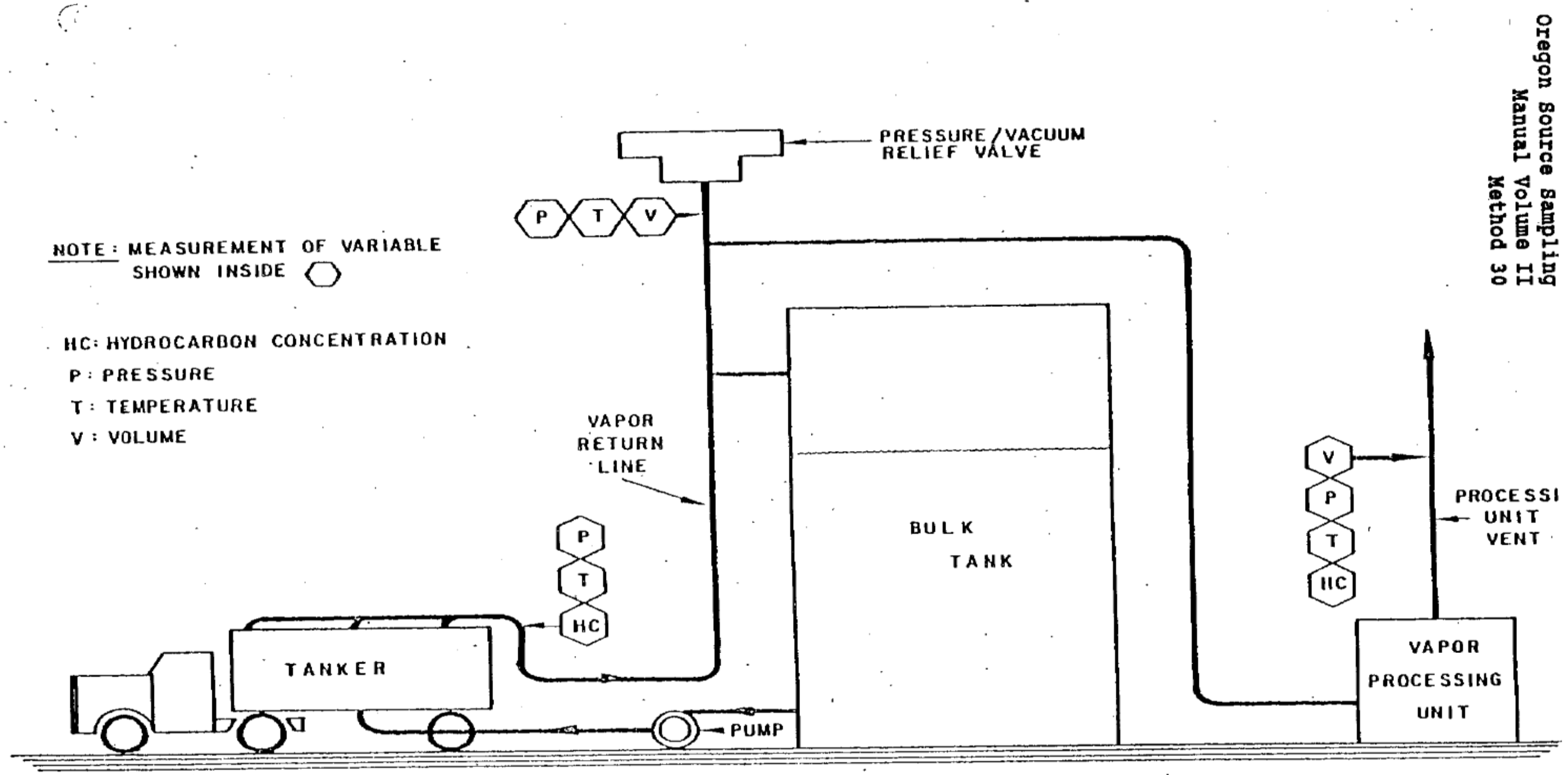


FIGURE C
GASOLINE TRANSFER
FROM BULK PLANT TO DELIVERY TANK

METHOD 31

FIGURE D – DATA SHEET

Gasoline Vapor Control Equipment Test Method # ____________

Date of Test ________________________

Ambient Temperature ________________ °F

Barometric Pressure ________________ In.Hg

Plant ________________________

Address ________________________

____

Operator ________________________

Gasoline Handling Process:

Start Time: Finish Time: Test Time: Test Run # Gals Del.

Test Equipment Location:

#	Time	Meter Reading	Press	Temp	HC	#	Time	Meter Reading	Press	Temp	HC	

FIGURE E – CALCULATION SHEET

Vapor Control Equipment Efficiency Determination

Test Method: ________
Date: ________________
Test Run # ___________

Plant ________________________________
Address ______________________________
____

Test Equipment Location: ____
____

Calculations: (Refer to Paragraphs 4.5 or 5.5 in test Procedure.)

Volume of gas discharged through "i th" vent.

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

Volume of gasoline vapor returned to bulk tank or tank truck

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

Efficiency of Vapor Control System

$$E \text{ or } E_j = \frac{\left[V_t \times C_t - \sum (C_{vi} \times V_{vs})\right]}{V_t \times C_t} \times 100$$

E = Bulk Plant Loading Test
E_j = Delivery Tank Loading Test

Average Efficiency of All Loadings Tested

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

METHOD 31

DEQ METHOD 32

Test Procedures for Vapor Control
Effectiveness of Gasoline Delivery Tanks

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY

DEQ Air Quality Program
Portland, Oregon
December 1, 1980

Revisions:
May 15, 1981
January 23, 1992

Method 32

Test Procedures for Vapor Control Effectiveness of Gasoline Delivery Tanks

1.0 Introduction:

1.1 Principles:

Pressure and vacuum are applied to the compartments of gasoline truck tanks and the change in pressure/vacuum is recorded after a specified period of time.

1.2 Applicability:

This method is applicable to determining the leak tightness of gasoline truck tanks in use and equipped with vapor collected equipment.

2.0 Acceptance Of Test Results

2.1 Results from this method will be accepted as a demonstration of compliance provided that the methods included or referenced in this procedure are strictly adhered to. A report containing at least the minimum amount of information regarding the test should be included with the results. Deviations from the procedures described herein will be permitted only if permission from DEQ is obtained in writing in advance of the test.

3.0 Definitions

3.1 Delivery Tank:

Any container, including associated pipes and fittings, that is used for the transport of gasoline.

3.2 Compartment

A liquid-tight division in a delivery tank.

3.3 Delivery Tank Vapor Collection System

The entire delivery tank, including domes, dome vents, cargo tank, piping, hose connections, hoses and delivery elbow, and vapor recovery lines.

4.0 Apparatus

4.1 Pressure Source (See Figure B)

Pump or compressed gas cylinder of air or inert gas sufficient to pressurize the delivery tank to 6250 Pascals (25 inches H_2O) above atmospheric pressure.

4.2 Regulator

Low pressure regulator for controlling pressurization tank.

4.3 Vacuum Source

Vacuum pump of sufficient capacity to evacuate a tank to 2500 Pascals (10 inches H_2O) below atmospheric pressure. (The intake manifold of an "idling" gasoline engine is a very good vacuum source).

4.4 Manometer

Liquid manometer, or equivalent, capable of measuring up to 6250 Pascals (25 inches H_2O) gauge pressure with $\pm$ 25 Pascals ($\pm$ 0.1 inches H_2O) readability. Manometer must be positioned vertically.

4.5 Test Cap for Vapor Recovery Hose Fittings

This cap should have a tap for the manometer connection with a fitting with shut-off valve and pressure/vacuum relief valves for connection to the pressure/vacuum supply hose.

4.6 Cap for Liquid Delivery Hose Fitting

4.7 Pressure/Vacuum Supply Hose

4.8 Pressure/Vacuum Relief Valves

The test apparatus shall be equipped with an in-line pressure/vacuum relief valve set to activate at 7000 Pascals (28 inches H_2O) above atmospheric pressure or 3000 Pascals (12 inches H_2O) below atmospheric pressure, with a capacity equal to the pressurizing or evacuating pumps.

5.0 Pretest Condition

5.1 Purging of Vapor

The delivery tank shall be purged of gasoline vapors and tested empty. The tank may be purged by any safe method such as flushing with diesel fuel, heating fuel or jet fuel. (Hauling a load of above fuel before test may be performed.)

5.2 Location

The delivery tank shall be tested where it will be protected from direct sunlight or any other heat source which may affect the pressure/vacuum test results.

6.0 Visual Inspection

6.1 Inspection Procedure

The entire delivery tank including domes, dome vents, cargo tank, piping, hose connections, hoses and delivery elbow shall be inspected for any evidence of wear, damage or misadjustment that could be a potential lead source. Any part found to be defective shall be adjusted, repaired or replaced, as necessary, before the test.

7.0 Pressure Test Procedure

7.1 Pressure Test

7.1.1 The dome covers are to be opened and closed.

7.1.2 Connect static electrical ground connections to delivery tank. Attach the delivery and vapor hoses, remove the delivery elbows and plug the liquid delivery hose fitting with cap.

7.1.3 Attach the test cap vapor recovery hose of the delivery tank.

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

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

7.1.6 Applying air pressure slowly, pressurize the tank, or alternatively the first compartment, to 4500 Pascals (18 inches of water).

7.1.7 Close the shut-off valve, allow the pressure in the delivery tank to stabilize. Adjust the pressure, if necessary, to maintain 4500 Pascals (18 inches of H_2O). Record the initial time and pressure.

7.1.8 At the end of five minutes, record the final time and pressure and then slowly vent tank to atmospheric pressure.

7.1.9 Repeat for each compartment if they were not interconnected.

7.1.10 If the reading is less than 3750 Pascals (15 inches of water), the tank or compartment fails the test. Delivery tanks which do not pass the pressure test are to be repaired and retested.

8.0 Vacuum Test Procedure

8.1 Connect vacuum source to pressure and vacuum supply hose.

8.2 Slowly evacuate the tank, or alternatively the first compartment to 1500 Pascals (6 inches of H_2O) vacuum.

8.3 Close the shut-off valve, allow the pressure in the delivery tank to stabilize. Adjust the vacuum, if necessary, to maintain 1500 Pascals (6 inches of water). Record initial time and pressure.

8.4 At the end of five minutes, record the final time and pressure and then slowly vent back to atmospheric pressure.

8.5 Repeat for each compartment if they were not interconnected.

8.6 If the reading is less than 750 Pascals (3 inches of water) vacuum, the tank or compartment fails the test. Delivery tanks which do not pass the vacuum test are to be repaired and retested.

9.0 Alternative Test Methods

9.1 Techniques, other than those specified above, may be used for purging, pressurizing, or evacuating the delivery tanks, if prior approval is obtained from DEQ. Such approval will be based upon demonstrated equivalency with the methods above.

10.0 Test Reports

The contents of the following report form example shall be considered the minimum acceptable contents for reporting the results of the tests.

11.0 Recordkeeping

A copy of the results of these tests which are performed for compliance determination shall be maintained at the facility site and by the delivery tank owner according to OAR 340-232-0080 and 340-232-0100.

FIGURE A - DATA SHEET

TANK LEAK CHECK
DATA SHEET

Oregon Source Sampling
Manual Volume II
Method 32

I. GENERAL

1. Truck/Trailer Owner ____________________

   Address ____________________

2. Test Site ____________________ Date ____________________

3. Owner's Unit No. ____________________

4. Truck TP* or AP* Oregon License No. ____________________

5. Tank Trailer HTP* or ATP* Oregon License No. (1981) ____________________

6. Tank DOT* Certification Plate - Mfg. Serial No. ____________________

   - Specification - MC ____________________

II. PRESSURE CHECK (INITIAL)

1. Pressure Readings	Initial (In H_2O)	After 5 min. (In H_2O)	Pressure Change	Tank (Compart.) Volume
(a) Complete Tank	18			
(b) Compartment #1				
(c) " #2				
(d) " #3				
(e) " #4				
(f) " #5				

(g) Pass ________ Fail ____________

(h) Reason for failure ____________________

____

2. PRESSURE CHECK (after rework - if failure noted above)

(a) Complete Tank				
(b) Compartment #1				
(c) Compartment #2				
(d) Compartment #3				

FIGURE A - DATA SHEET (Con't)

	Initial (In H_2O)	After 5 min. (In H_2O)	Pressure Change	Tank (Compart.) Volume
(e) Compartment #4	________	________	________	________
(f) Compartment #5	________	________	________	________

(g) Pass ________ Fail ____________

(h) Reason for failure ______________________________________

____

3. VACUUM CHECK

(a) Complete Tank	________	________	________	________
(b) Compartment #1	________	________	________	________
(c) Compartment #2	________	________	________	________
(d) Compartment #3	________	________	________	________
(e) Compartment #4	________	________	________	________
(f) Compartment #5	________	________	________	________

(g) Pass ________ Fail ____________

(h) Reason for Failure ______________________________________

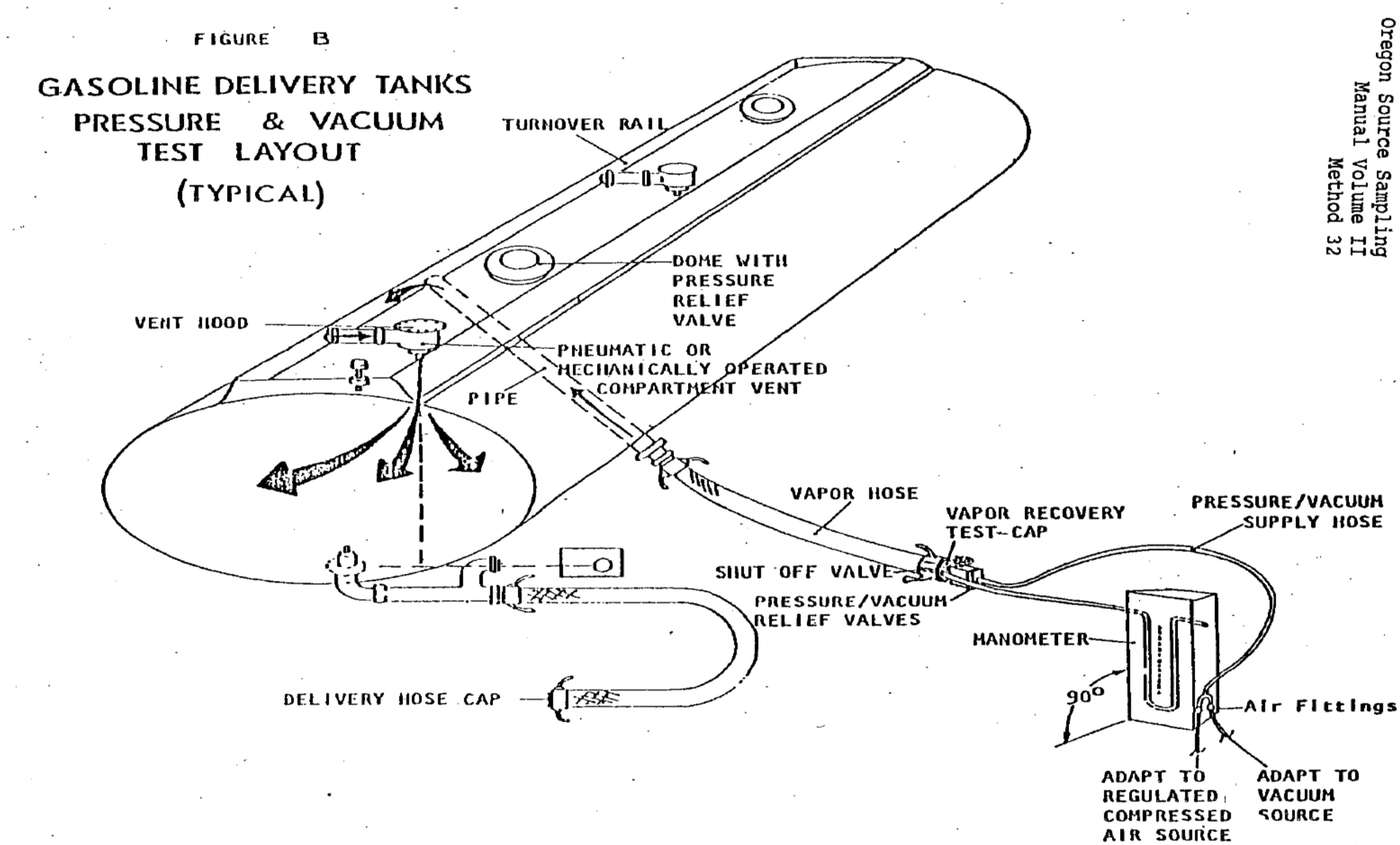
____

Signature of Person Conducting Test ______________________

Date ______________________

*TP - Truck Plate (use Item 4 if truck and tank are on the same chassis)
AP - Apportionment Plate (use Item 4 if truck and tank are on the same chassis)
HTP - Heavy Trailer Plate (use Item 5 for a tank trailer)
ATP - Apportionment Trailer Plate (use Item 5 for a tank trailer)
DOT - Department of Transportation

FIGURE B – GASOLINE TANKS



DEQ METHOD 33

Test Procedures for Gasoline Vapor
Control Systems at Bulk Gasoline Terminals

STATE OF OREGON
DEPARTMENT OF ENVIRONMENTAL QUALITY

DEQ Air Quality Program
Portland, Oregon
December 1, 1980

Revisions:
January 23, 1992

METHOD 33

1.0 Introduction

1.1 Principle:

Hydrocarbon mass emissions are determined directly, using flowmeters and hydrocarbon analyzers.

The mass of hydrocarbon vapor to be controlled or recovered is determined from the volume of gasoline dispensed (either to the bulk terminal facilities or to delivery tanks), and by temperature, pressure and concentration measurements of the released vapor.

The efficiency of the gasoline vapor control systems is determined from the mass of the hydrocarbons emitted and the mass of the hydrocarbons controlled.

1.2 Applicability:

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

2.0 Acceptance Of Test Results

2.1 Results of these tests will be accepted as a demonstration of compliance determination of the equipment tested provided that the methods included or referred to in this procedure are strictly adhered to. A statement containing at least the minimum amount of information regarding the test procedures applied should be included with the report of the test results.

Deviations from the procedure described herein will be permitted only if permission from DEQ is obtained in writing in advance of the test.

3.0 Definitions

3.1 Bulk Gasoline Terminal

"Bulk gasoline terminal" means a gasoline storage facility which receives gasoline from refineries primarily by pipeline, rail, ship, or barge, and delivers gasoline to bulk gasoline plants or to commercial or retail accounts primarily by tank truck.

3.2 Delivery Vessel

"Delivery vessel" means any tank truck or trailer unit for the transport of gasoline from sources of supply to stationary storage tanks.

3.3 Vapor Balance System

"Vapor balance system" means a combination of pipes or hoses which create a closed system between the vapor spaces of an unloading tank and receiving tank such that vapors displaced from the receiving tank are transferred to the tank being unloaded.

4.0 Test Procedures For Determining the Efficiency of Gasoline Vapor Control Systems at Terminals

4.1 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.

4.2 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.

4.3 Test Conditions

The processing unit may be tested for a series of 24 consecutive one hour periods and pressures in the vapor holder and any fixed roof gasoline storage tanks may be monitored for 30 consecutive days. DEQ shall determine whether testing for longer or shorter periods may be necessary for properly evaluating any system's compliance with performance3 standards. During the test of the processing unit, the pressure during the filling of a number of delivery tanks will be monitored. As much as possible, the system shall be tested under normal operating conditions. Dispensing rate 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 as well as in accordance with the owner's or operator's established operating procedures.

4.4 Calibrations

4.4.1 Flowmeters

Standard methods and equipment shall be used to calibrate the flowmeters every month or every five tests, whichever comes first. The calibration curves are to be traceable to NIST standards.

4.4.2 Temperature measuring instruments

Calibrate prior4 to test period and immediately following test period using ice water (32°F) and a known temperature source of about 100°F.

4.4.3 Pressure measuring instruments

Calibrate pressure transducers every month and immediately after each test with a static pressure calibrator of known accuracy.

4.4.4 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 (<3ppm C) and span with 5, 10, 30, and 70 percent concentrations of propane.

4.4.5 A record of all calibration is to be maintained by the source testing person for at least 1 year.

5.0 Testing Vapor Control Systems (Other Than Incineration Units) When Loading Delivery Tanks

5.1 Equipment Required

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

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

5.1.3 Coupler for delivery tank vapor return line with pressure tap.

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

5.1.5 One (1) flexible thermocouple or thermistor (0-150°F) with recorder system having a readability of 1°F.

5.1.6 Two (2) pressure sensing devices (transducers or equivalent) capable of measuring zero to ten inches of water with recorder systems having a readability of 0.01 in. H_2O.

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

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

5.1.9 One manometer capable of measuring zero to ten inches of water with a readability of 0.1 in. H_2O.

5.1.10 Explosimeter.

5.1.11 Barometer (Aneroid or Mercury), ± 0.1 in. Hg. readability.

5.2 Test Procedure

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

5.2.2 Connect hydrocarbon analyzer, with recorder, to appropriate tap on coupler on processing unit vent.

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

5.2.4 Connect coupler between PV valve and vent of vapor holder tank and connect pressure sensing device, with recorder, to coupler.

5.2.5 Connect coupler between PV valve and fixed roof bulk storage tank and connect pressure sensing device, with recorder, to coupler.

5.2.6 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.

5.2.7 Record the pressure on the bulk storage at the start and finish of the test period.

5.2.8 Record the pressure on the vapor-holder tank at the start and the finish of the test period.

5.2.9 Record the hydrocarbon concentrations, temperature and exhaust gas flowrate from the processor vent at the start and the finish of the test period.

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

5.2.11 Record the volume of gasoline that is delivered over the time of the test period.

5.3 Calculations

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

5.3.2 Volume of gas discharged through the processing unit vent.

$$V = \frac{V_p \times 528 \times P_b}{T_p \times 29.92}$$

Where:

V = Volume of gas discharged through processor vent, corrected to 68°F and 29.92 in. Hg, (ft^3).

P_b = Barometric pressure, (in. Hg).

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

T_p = Average temperature in the processing vent line, (°R.)

5.3.3 Weight of hydrocarbons discharged through the processing vent per 1,000 gallons of gasoline loaded into the delivery tanks.

$$W = \frac{C \times V \times M \times 1000}{385 \times G}$$

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 5.3.2 above.

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

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

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.

6.0 Testing Vapor Control Systems (Other Than Incineration Units) When Loading Fixed Roof Storage Tanks

6.1 Equipment Required

Same equipment as in Section 5.1.

6.2 Test Procedures

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

6.2.2 Connect hydrocarbon analyzer, with recorder, to appropriate tap on coupler on processing unit vent.

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

6.2.4 Connect coupler between PV valve and vent of vapor holding tank and connect pressure sensing device, with recorder, to coupler.

6.2.5 Connect coupler between PV valve and fixed roof storage tank and connect pressure sensing device, with recorder, to coupler.

6.2.6 Record the pressure on the bulk storage tank and connect pressure sensing device, with recorder, to coupler.

6.2.7 Record the pressure on the vapor-holding tank at the start and finish of the test period.

6.2.8 Record the hydrocarbon concentration, temperature and exhaust gas flowrate from the processor vent at the start and finish of the test.

6.2.9 At the end of the specified times, disconnect all instr4umentation and couplings from the vapor recovery systems.

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

6.2.11 Pressure monitoring of delivery tanks is to be performed, as appropriate, in accordance with Section 5.2.6.

6.3 Calculations

6.3.1 Volume of gas discharged through the processing unit vent.

$$V = \frac{V_p \times 528 \times P_b}{T_p \times 29.92}$$

Where:

V = Volume of gas discharged through processor vent, corrected to 68°F and 29.92 in. Hg, (ft^3).

P_b = Barometric pressure, (in. Hg).

V_p = Volume of gas determined by flow meter on the processing vent, corrected for amount of vapor removed by hydrocarbon analysis, (ft^3).

T_p = Average temperature in the processing vent line, (°R).

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

$$W = \frac{C \times V \times M \times 1000}{385 \times G}$$

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 6.3.1 above.

M = Molecular weight of hydrocarbon compound used to calibrate hydrocarbon analyzer, (lbs/lb Mole); (44 for propane).

G = Total quantity of gasoline loaded into fixed roof storage tank(s), (gals).

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.

7.0 Testing Exhaust Emissions From Incineration-Type Processing Unit

7.1 Equipment Required

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

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

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

7.1.4 Apparatus for performing the State of Oregon, DEQ source sampling Method #2 (Determination of Stack Velocity and Volumetric Flow Rate).

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

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

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

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

7.1.9 One (1) rotameter, or equivalent, to measure a 0 to 10 SCFH flow range, with a readability of 0.1^{o}.

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

7.1.11 One (1) thermocouple with recorder, 0 - 150^{o}F with a readability of 1^{o}.

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

7.1.13 Calibration of test equipment according to recommended procedure, Section 4.4, page 3.

7.2 Test Procedure

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

7.2.2 Using the appar4atus and procedure for Method 2, 7.1.4, perform a velocity traverse of the incinerator exhaust vapor.

7.2.3 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.

7.2.4 Start analyzer recorders.

7.2.5 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.

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

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

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

7.2.9 Pressure monitoring of delivery tanks and fixed roof storage tanks is to be performed, as appropriate, in accordance with Section 5.2.6 and 6.2.6.

7.3 Calculations

7.3.1

$$V_p = \frac{V \times 528 \times PA}{T \times 29.92}$$

Where:

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

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

PA = Absolute pressure in the pipe going to the incinerator, (in. Hg).

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

7.3.2

$$EA = \frac{O_{2\%}}{.264N_2\% - O_2\%}$$

Where:

EA = Excess air in the incinerator exhaust gas.

$O_2\%$= Percent by volume oxygen in the incinerator exhaust.

$N_2\%$= Percent by volume nitrogen in the incinerator exhaust.

7.3.3

$$W = \frac{V_p \times C \times M \times (EA) \times 1000}{385 \times G}$$

Where:

W = Weight of hydrocarbons discharged through the incinerator vent per 1000 gallons of gasoline into delivery tanks, or, as appropriate, fixed roof tanks, (lbs).

V_p = From 7.3.1 above.

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

EA = From 7.3.2 above.

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

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

8.0 Alternative Test Methods

Techniques, other than those specified above, may be used for testing vapor recovery systems at terminals if prior written approval is obtained from DEQ Such approval will be based upon demonstrated equivalency with the methods in Section 5 through Section 8.

9.0 Recordkeeping

A record of the results for tests which are performed for compliance determination shall be maintained at the facility site according to OAR 340-232-0080 and 340-232-0100.

Appendix I, Submerged Fill Inspection Guideline, May 1, 1981

Department of Environmental Quality
Air Program
VOC Compliance Determination Guideline
Submerged Fill

Gasoline Dispensing Facilities

OAR 340-244-0240(3) requires submerged filling of gasoline storage tanks at gasoline dispensing facilities (service stations, motor pools, etc.).

“Submerged Fill” is defined in OAR 340-244-0030(29) as “the filling of a gasoline storage tank through a submerged fill pipe whose discharge is no more than the applicable distance specified in OAR 340-244-0240(3) from the bottom of the tank. Bottom filling of gasoline storage tanks is included in this definition.”

The applicable distance in OAR 340-244-0240(3) is no more than 12 inches from the bottom of the storage tank for submerged fill pipes installed on or before November 9, 2006 or no more than 6 inches from the bottom of the storage tank for submerged fill pipes installed after November 9, 2006. Submerged fill pipes not meeting these specifications are allowed if can be demonstrated that the liquid level in the tank is always above the entire opening of the fill pipe. Documentation providing such demonstration must be made available for inspection by DEQ during the course of a site visit.

Bulk Gasoline Plants

OAR 340-232-0080(1)(a) requires submerged filling at bulk gasoline plants in the Portland-Vancouver Air Quality Maintenance Area, Medford-Ashland Air Quality Maintenance Area, and Salem-Keizer Area Transportation Study (SKATS) Area.

“Submerged Fill" is defined in OAR 340-232-0030(70) as "any fill pipe or hose, the discharge opening of which is entirely submerged when the liquid is 6 inches above the bottom of the tank; or when applied to a tank which is loaded from the side, shall mean any fill pipe, the discharge of which is entirely submerged when the liquid level is 28 inches, or twice the diameter of the fill pipe, whichever is greater, above the bottom of the tank."

40 CFR 63.11086(a) requires submerged filling at bulk gasoline plants statewide.

Submerged Fill" is defined in 40 CFR 63.11100 as "the filling of a gasoline cargo tank or a stationary storage tank through a submerged fill pipe whose discharge is no more than the applicable distance specified in 40 CFR 63.11086(a) from the bottom of the tank. Bottom filling of gasoline cargo tanks or storage tanks is included in this definition.

The applicable distance in 40 CFR 63.11086(a) is no more than 12 inches from the bottom of the storage tank for submerged fill pipes installed on or before November 9, 2006 or no more than 6 inches from the bottom of the storage tank for submerged fill pipes installed after November 9, 2006. Submerged fill pipes not meeting these specifications are allowed if can be demonstrated that the liquid level in the tank is always above the entire opening of the fill pipe. Documentation providing such demonstration must be made available for inspection by DEQ during the course of a site visit.

<u>Gasoline Delivery Vessels</u>

OAR 340-232-0085(1)(a) requires submerged filling of delivery vessels receiving gasoline from a bulk gasoline terminal or a bulk gasoline plant, with a daily throughput of 4,000 or more gallons based on a 30-day rolling average, located in the Portland-Vancouver AQMA.

"Submerged Fill" is defined in OAR 340-232-0030(70) as "any fill pipe or hose, the discharge opening of which is entirely submerged when the liquid is 6 inches above the bottom of the tank; or when applied to a tank which is loaded from the side, shall mean any fill pipe, the discharge of which is entirely submerged when the liquid level is 28 inches, or twice the diameter of the fill pipe, whichever is greater, above the bottom of the tank."

<u>Technique to determine compliance</u>

(1) For underground tanks, open the fill pipe and determine that a submerged fill pipe extends down into the tank.

(2) Take a 20 foot measure tape or equivalent stick with an L extension on the bottom (11) and lower it down the fill tube, forcing the tape catch to scrape against the tube side, or catch on the bottom of the fill pipe.

(3) Note when scraping ceases; the bottom of the fill tube has been reached. Read the tape or mark the stick.

(4) Extend the tape on down to the bottom of the tank. Read the tape, or marking stick.

(5) If the difference in tape readings is at or less than the applicable distance the source is in compliance with the submerged fill pipe rule.

(6) Bulk plants or above-ground-tanks which are bottom filled can be considered in compliance, so long as the top of the fill line is less than twice the diameter of fill pipe or less than 18 inches above the tank bottom.

(7) Cylindrical tanks with horizontal fill pipes that do not meet requirements of (6) but have an elbow extending down toward the bottom of the tank must meet the requirements of (6).

(8) Horizontal tanks with side fill which do not meet the requirements of (6) but which have an elbow extending toward the bottom shall meet the requirements of (5).

(9) Remember gasoline is explosive, dangerous, toxic and non-spark measuring devices shall be used. Close all openings which were opened to conduct the test. A clean rag should be available for wiping during the test process to prevent gasoline burns to hands, etc.

(10) Good judgment relative to safety and courtesy is a must at all times.