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Control of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems

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Control of Volatile Organic Compound Leaks from Gasoline Tank Trucks and Vapor Collection Systems

Emission Standards and Engineering Division
Chemical and Petroleum Branch

U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Air, Noise, and Radiation
Office of Air Quality Planning and Standards
Research Triangle Park, North Carolina 27711

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OAQPS GUIDELINE SERIES

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ABBREVIATIONS AND CONVERSION FACTORS

EPA policy is to express all measurements in Agency documents in metric units. Dual units are sometimes given in the text for clarity. Listed below are abbreviations and conversion factors for English equivalents of metric units. Frequently used measurements are also presented in dual units below for the reader's convenience.

METRIC UNIT	ALTERNATE UNIT	CONVERSION
centimeter (cm)	inches	cm x 0.394 = in
Pascals (Pa)	atmospheres	Pa x 9.87 x 10^{-6} = atm
	inches of water	Pa x 4.02 x 10^{-3} = inches of water
liters (l)	gallons	l x 0.264 = gal

FREQUENTLY USED MEASUREMENTS

750 pascals ∿ 3 inches of water

1500 pascals ∿ 6 inches of water

4500 pascals ∿ 18 inches of water

6250 pascals ∿ 25 inches of water

2.5 cm ∿ 1 inch

.625 cm ∿ 1/4 inch

20,000 liters ∿ 5280 gallons

I. BACKGROUND

This guideline is related to the control of volatile organic compounds (VOC) from gasoline tank trucks and vapor collection systems at bulk terminals, bulk plants and service stations. Guideline documents have already been published on bulk plants,[1] bulk terminals[2] and service stations.[3] The intent of this guideline is to define leak tight conditions and related test procedures for vapor collection systems and tank trucks while loading and unloading at these facilities. VOC emitted from leaks in collection equipment are primarily C_4 and C_5 paraffins and olefins which are photochemically reactive (precursors to oxidants).

Methodology described in this guideline represents the presumptive norm or reasonably available control technology (RACT) that can be applied to an existing facility. RACT is defined as the lowest emission limit that a particular source is capable of meeting by the application of control technology that is reasonably available considering technological and economic feasibility. It may require technology that has been applied to similar, but not necessarily identical, source categories. It is not intended that extensive research and development be conducted before a given control technology can be applied to the source. This does not, however, preclude requiring a short-term evaluation program to permit the application of a given technology to a particular source. This latter effort is an appropriate technology-forcing aspect of RACT.

A. NEED TO REGULATE

Control techniques guidelines are being prepared for source categories that emit significant quantities of air pollutants in areas of the country where National Ambient Air Quality Standards (NAAQS) are not being attained. Vapor balance and processor systems have been applied to bulk plants, terminals, and service stations in many areas of the nation. Leaks from tank trucks and vapor collection systems should be minimized to ensure that vapor control systems at these systems function effectively.

B. CONTROL APPROACH

The approach described in this document is to ensure that good maintenance practices are followed. Maintenance would be enforced through the surveillance and periodic testing of suspect leak points. It should be noted that while some leak sources (such as vapor piping joints) may stay in leak tight condition for extended periods of time, others (such as pressure and vacuum vents, and hatch seals) may leak shortly after maintenance. It is expected that compliance with the suggested control measure will in some cases require replacement of truck pressure and vacuum vents and dome covers. In addition, a greater degree of surveillance and maintenance will be needed at bulk plants and terminals equipped with top loading (vapor head) systems than at those using bottom loading. Additional information on control techniques, costs, and monitoring procedures is presented in an EPA report.[4]

II. REGULATORY APPROACH

A. AFFECTED FACILITIES

The two separate affected facilities are gasoline tank trucks that are equipped for vapor collection and the vapor collection systems at bulk terminals, bulk plants, and service stations that are equipped with vapor balance and/or vapor processing systems.

B. RECOMMENDED REGULATION

B.1 Gasoline Tank Trucks

Gasoline truck tanks and their vapor collection systems shall not sustain a pressure change of more than 750 pascals (3 inches of H_2O) in 5 minutes when pressurized to 4500 pascals (18 inches of water) or evacuated to 1500 pascals (6 inches of water) using the test procedure described in Appendix A. In addition, there are to be no avoidable visible liquid leaks. Invariably there will be a few drops of liquid from disconnection of dry breaks in liquid lines even when well maintained; these few drops should be allowed.

B.2 Vapor Collection Systems

B.2.1 - During loading or unloading operations at service stations, bulk plants and bulk terminals, there shall be no reading greater than or equal to 100 percent of the lower explosive limit (LEL, measured as propane) at 2.5 centimeters around the perimeter of a potential leak source as detected by a combustible gas detector using the test procedure described in Appendix B. In addition, there are to be no avoidable visible liquid leaks. Invariably there will be a few liquid drops from the disconnection of well maintained bottom loading dry breaks and the raising of well maintained top loading vapor heads; these few drops should be allowed. The vapor collection system includes all piping, seals, hoses, connections, pressure-vacuum vents, and other possible leak sources between the truck and the vapor processing unit and/or the storage tanks and vapor holder; and

B.2.2 - The vapor collection and vapor processing equipment must be designed and operated to prevent gauge pressure in the tank truck from exceeding 4500 pascals (18 inches of water) and prevent vacuum from exceeding 1500 pascals (6 inches of water).

C. MONITORING REQUIREMENTS

C.1 Gasoline Tank Trucks

Gasoline truck tanks must be certified leak tight as described in Section B.1 annually.

In addition, truck tanks can be monitored by regulatory agencies as needed during loading and unloading using the combustible gas detection procedure described in B.2.1, provided that the requirements in Section B.2.2 are met. Trucks with leaks greater than or equal to 100 percent of the LEL are to be repaired within 15 days and be required to take and pass the pressure and vacuum test described in Section B.1 The truck tank and its vapor collection system includes all piping, seals, hoses, connections, hatch covers, pressure vacuum vents, vapor hoods and other possible leak sources on the truck tank.

C.2 Vapor Collection Systems

Vapor collection systems can be monitored by regulatory agencies as needed using the combustible gas detection procedure described in B.2.1.

D. RECORD KEEPING AND REPORTING REQUIREMENTS

D.1 Gasoline Tank Trucks

Each truck must have a sticker displayed on each tank indicating the identification number of the tank and the date each tank last passed the pressure and vacuum test described in Section B.1. This sticker must be located near the Department of Transportation Certification plate (DOT, Title 49, Part 178.340-10b).

D.2 Vapor Collection System

Bulk terminal, bulk plant and service station owners or operators must keep records for two years indicating the last time the vapor collection facility passed the requirements described in B.2 and identifying points at which VOC leakage exceeded the provisions of Section B.2.1.

E. OTHER CONSIDERATIONS

Presently, there is limited information available on the amount of monitoring necessary to ensure that leaks are kept to the limits described above. Therefore, regulations should allow for modifications in the monitoring schedule when experience proves it to be either inadequate or excessive. If, after over one year of monitoring, i.e., at least two complete annual checks, the operator of an affected facility feels that modifications of the requirements are in order, he may request in writing to the air pollution control officer that a revision be made. The submittal should include data that have been developed to justify any modifications in the monitoring schedule. On the other hand, if the air pollution control officer finds an excessive number of leaks during an inspection, or if the operator finds an excessive number of leaks during scheduled monitoring, consideration should be given to increasing the frequency of inspections.

III. COMPLIANCE TEST METHOD AND MONITORING TECHNIQUES

The measurement procedures that were developed for determining leak tightness of truck tanks and vapor control systems at bulk terminals, bulk plants, and service stations, are discussed in this section. The presentation covers the various methods considered with the advantages and disadvantages of each, testing problems encountered, and the accuracy, reliability, and allowable modifications of the recommended methods.

A. COMPLIANCE TEST METHOD DESCRIPTION

A.1 General Description and Background

The recommended compliance test method as detailed in Appendix A can be used to determine the leak-tightness of gasoline truck tanks. Pressure and vacuum are applied to the tanks of a gasoline delivery truck and the change in pressure/vacuum is recorded after a specified period of time. The recommended regulation in Section II.B.1 in effect defines a "leak tight condition" which is equivalent to 99 percent recovery efficiency during vapor transfer from a truck tank. The recommended compliance procedure is actually an equipment performance criteria rather than a true emission measurement test. However, emissions from a truck tank can be estimated from the known required degree of leak-tightness.

Developmental work on a leak test method was performed by the California Air Resources Board (CARB), San Diego Air Pollution Control District (SDAPCD), and Standard Oil of California, among others. Leak-tightness regulations have been in effect in California for over two years. The pressure and vacuum limits recommended in Section II.B.1 are based on a consensus of the above mentioned groups, and on an EPA field testing program which was conducted in order to evaluate the leak test method and performance criteria. The study shows that EPA's recommended performance criteria is realistic and achievable and the test method is inexpensive, reliable, and repeatable.[5]

A.2 Modifications

There are two areas of common modifications to the test procedure in Appendix A.

The recommended EPA compliance test procedure uses air to pressurize and evacuate the truck tank. In EPA field testing, this was found to be the most convenient and inexpensive procedure. However, some owners prefer loading and draining the tank with a liquid, usually diesel fuel or water, to create the required pressure and vacuum. This is an acceptable and equivalent alternative.

The EPA procedure also requires that gasoline vapors be purged from the truck tank before conducting the leak-tightness test. This is easily accomplished by carrying a diesel load immediately prior to the compliance test or blowing air into the tank with the dome lids open. Gasoline vapors in the tank cause testing inconsistencies. With volatile vapors, the tank pressure varies more readily with slight changes in temperature. However it is possible to test without purging the gasoline vapors if there is enough time for the vapors to stabilize and reach a constant temperature in the covered testing area. One can ensure that the vapors have stabilized and are not affecting the test results by conducting the test two times with the same results.

A.3 Effectiveness

The EPA field testing program[6] and a recent CARB study[7] both indicate that truck tanks rarely remain in a leak-tight condition within two or three months after the compliance test. After the initial leak-tightness compliance test, the leaks that occur are usually easily detectable and correctable with good normal maintenance. It is hoped that conducting unannounced spot-checks with monitoring procedures described in the following section, will encourage more frequent and effective maintenance.

B. DESCRIPTION OF MONITORING TECHNIQUES

B.1 Background

Monitoring techniques for leak detection were developed to ensure the continuing existence of leak-tight conditions between compliance tests. A test method was sought that would give pass/fail compliance information for leakage from truck tanks and vapor control systems at bulk terminals, bulk plants, and service stations. It was desired that the monitoring test method be low cost, quick, and used without disturbing normal operations. It is essential that leak detection by a monitoring technique be be equivalent to the leak-tightness criteria of the pressure/vacuum compliance test.

Several leak detection monitoring methods were investigated in EPA's field testing program: combustible gas detector, sonic detector, bubble indication, sensory detection (i.e., sound, sight, smell, touch), vapor to liquid volume ratio, quick leak decay, and bag capture. Bag capture and combustible gas detector were both found to be reliable, quick, low cost, and closely equivalent to the compliance criteria. The recommended method is the combustible gas detector procedure because it is more reliable and can be applied to top and bottom-loaded tanks. However, the bag capture procedure is an acceptable alternative for leak detection of bottom-loaded tanks. A discussion of the other non-recommended methods is included in an EPA contractor report.[8]

B.2 Description of Combustible Gas Detector Procedure

B.2.1 - Selection and applicability. The combustible gas detector is the recommended leak detection method because it is simple, quick, inexpensive, reliable, and non-subjective. It can be used for leak detection of truck tanks and vapor control systems without disturbing normal operations. Although a combustible gas detector is often considered a qualitative monitoring instrument, the detailed specifications of its use and operation, as defined in Appendix B, make this an acceptable procedure.

Leak detection of truck tanks by combustible gas detector correlates well with the pressure/vacuum compliance criteria in Section II.B.1, when a leak is defined as a meter reading greater than or equal to 100 percent LEL as propane. The monitoring procedure will correctly identify 42 percent of the non-complying tanks, while incorrectly identifying only 5 percent of the complying tanks.[9] The combustible gas detector procedure is purposely designed to detect gross violations of the leak-tightness performance criteria, but will not confirm compliance, i.e. tanks with marginal violations will evade detection.

B.2.2 - Equipment and operation specifications. In order to make leak detection by combustible gas detector more reliable and repeatable, equipment and operation specifications are tightly defined. For valid monitoring, it is important that the procedure is the same as the one used in EPA's field testing and data collection.

Equipment specifications require that the meter is calibrated to propane, inside probe diameter is 0.625 cm (1/4 inch), and response time for full-scale deflection with the sampling probe and line attached is less than 8 seconds. A standard calibration gas is needed to standardize the detector response. The selection of propane as the calibration gas is arbitrary. Propane was used for calibration in the data gathering tests, and it is probably the most readily available gas.

The probe diameter requirement allows some dilution air drawn in if the leak is very small, and thus the detector will not register a leak. If the same leak were sampled with a smaller diameter probe, the sample line would be filled with leaked vapors with no dilution, and a leak would be detected. Thus, a larger probe diameter ensures that only insignificant leaks are registered.

The response time requirement ensures that the meter pump is strong enough to draw the sample quickly through the sampling probe and line. This quick response is necessary since there is little time during a loading to check all potential sources of leakage.

Operation of the combustible gas detector for leak monitoring is also tightly defined to eliminate variability. However, any arbitrariness or sloppiness in the procedure is in favor of the truck tank owner. Operation specifications require measurement at 2.5cm (1 inch) distance from the leak source, positioning the probe in the path of (parallel to) the vapor flow, moving the probe slowly locating the point of highest meter response, and blocking wind interference when possible. Measurement at 2.5cm distance allows some dilution if only a very small leak exists. The distance can be maintained during monitoring by putting a 2.5cm extension on the probe tip. Maintaining this distance is essential or else insignificant leaks will be detected.

Higher meter readings will be obtained when the probe is properly positioned, moved slowly, and if care is taken to locate the center of a leak. These specifications were followed diligently in the testing which was used to develop the data base and correlation with the compliance test.

Any sloppiness in these areas would detect less leaks and be in favor of the truck. Furthermore, the field testing was conducted on windless, hot days. Winds would dilute the vapors before detection, and cooler temperatures would reduce the hydrocarbon concentration. Again, under these conditions, the meter would detect less leakage, and the variability in the method favors the truck tank owners.

B.2.3 - Modifications. It should be noted that the adequacy of the combustible gas detector method, and the LEL level where the method is usable, are based on the performance test criteria in Section II.B.1. If other criteria are used to define a leak-tight tank, the detector method will have to be re-evaluated to determine the applicable LEL level to be used for monitoring.

The combustible gas detector method can be made less stringent by simply increasing the sampling distance. However, this is not recommended since the purpose of monitoring is to ensure compliance, and the recommended procedure is closely equivalent to the leak-tightness performance test.

B.3 Description of Bag Capture Procedure

B.3.1 - Background. The bag capture procedure is an acceptable alternative method for leak monitoring of bottom-loaded truck tanks. The complete procedure is included in Appendix C. The procedure was developed by San Diego Air Pollution Control District, and has been in use for over two years. The volume of leakage is measured directly by placing calibrated bags over all dome covers. The volume of allowable leakage is calculated from the parameters of the pressure/vacuum compliance test (as shown in equation 7.1, Appendix C).

This procedure, like the combustible gas detector, is designed to detect gross violations while not detecting marginal violations. Again, any sloppiness or variability in the method is in the favor of the truck tank. Only leakage from dome covers, hatches, and relief valves is captured; leakage from the tank vapor collection system is not included. If the seal between the bag apparatus and tank is not tight enough, the leakage may be underestimated. Furthermore, the allowable volume of leakage is based on 4500 pascals (18 inches H_2O) pressure, which rarely occurs during loadings.

B.3.2 - Disadvantage and Advantages. This method does have serious drawbacks. It can only be applied to bottom-loaded tanks. Some tanks cannot be monitored because the equipment configuration prevents a tight seal. Also, not all potential leakage sources are monitored.

On the other hand, the method has some real advantages. The equipment is very inexpensive and easy to use. It can be applied regardless of the type of vapors inside. Emissions can be measured directly, instead of by estimation. In San Diego, with this method, a leak has never been incorrectly detected for a complying tank. Finally, the bag method can be modified to detect leaks for any degree of leak-tightness if the parameters of the performance test are altered.

Many agencies and companies resist the use of a combustible gas detector. The bag capture method is a good alternative. It is probably less stringent than the explosimeter, but it will still detect all gross violations.

C. VAPOR CONTROL SYSTEM MONITORING

C.1 Pressure and Vacuum Limits.

The regulation in Section II.B.2.2 requires that the pressure/vacuum in a vapor control system remain within the pressure/vacuum limits of the truck tank compliance test. This ensures that a vapor control system will not create a leak on a tank. During leak detection monitoring of the tanks, the pressure must remain within these limits or else the detection of any leak will be invalidated.

C.2 Leak Detection.

The combustible gas detector procedure in Appendix B can be applied to potential sources of leakage at terminal, plant, and service station vapor control systems. These points of leakage can be easily identified and corrected during normal maintenance, and once corrected remain in leak tight condition for extended periods of time.

This application of the combustible gas detector procedure is a qualitative measurement; there is no way to relate this leak detection to emission levels.

IV. REFERENCES

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2. "Control of Hydrocarbons From Tank Truck Gasoline Loading Terminals," U.S. EPA, Report No. EPA-450/2-77-026, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., October 1977.
3. "Design Criteria for Stage I Vapor Control Systems, Gasoline Service Stations," U.S. EPA, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., November 1975.
4. "Gasoline Tank Trucks and Bulk Plants: Evaluation of Vapor Leaks and Development of Monitoring Procedures," Pacific Environmental Services, Inc. prepared for U.S. EPA, Emission Standards and Engineering Division, Draft report, September 1978.
5. "Leak Testing of Gasoline Tank Trucks," Scott Environmental Technology, Inc., prepared for U.S. EPA, Emission Standards and Engineering Division, Draft report, August 10, 1978.
6. Reference 4, Op. Cit.
7. "Investigation of the Compliance of Vapor Recovery Equipment at Gasoline Bulk Terminals in the South Coast Air Quality Management District and Kern County Air Pollution Control District," State of California Air Resources Board, Report No. LE-78-003, November 8, 1978.
8. Reference 4, Op. Cit.
9. Reference 4, Op. Cit.

APPENDIX A

PRESSURE-VACUUM TEST PROCEDURES FOR LEAK TIGHTNESS OF TRUCK TANKS

1. PRINCIPLE

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.

2. APPLICABILITY

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

3. DEFINITIONS

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

3.2 Compartment. A liquid-tight division of a truck tank.

3.3 Truck tank vapor collection equipment. Any piping, hoses, and devices on the truck tank used to collect and route the gasoline vapors in the tank to the bulk terminal, bulk plant, or service station vapor control system.

4. APPARATUS

4.1 Pressure source. Pump or compressed gas cylinder of air or inert gas sufficient to pressurize the truck tank to 6250 pascals (25 inches H_2O) above atmospheric pressure.

4.2 Regulator. Low pressure regulator for controlling pressurization of the truck tank.

4.3 Vacuum source. Vacuum pump capable of evacuating the truck tank to 2500 pascals (10 inches H_2O) below atmospheric pressure.

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 inch H_2O) precision.

4.5 Test cap for vapor recovery hose fittings. This cap should have a tap for manometer connection and a fitting with shut-off valve for connection to the pressure/vacuum supply hose.

4.6 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.

4.7 Caps for liquid delivery line.

4.8 Pressure/vacuum supply hose.

5. PRETEST CONDITION

5.1 Purging of vapor. The truck 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 or heating fuel.

5.2 Location. The truck tank shall be tested where it will be protected from direct sunlight.

6. TEST PROCEDURE

6.1 The dome covers are to be opened and closed.

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

6.3 Attach the test cap to the vapor recovery line of the truck tank.

6.4 Connect compartments of the tank internally to each other if possible. (If not possible, each compartment must be tested separately.)

6.5 Connect the pressure/vacuum 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.

6.6 Open the shut-off valve in the vapor recovery hose cap. Applying air pressure slowly, pressurize the tank, or alternatively the first compartment, to 4500 pascals (18 inches H_2O).

6.7 Close the shut-off valve and allow the pressure in the truck tank to stabilize, adjusting the pressure if necessary to maintain 4500 pascals (18 inches H_2O). When the pressure stabilizes, record the time and initial pressure.

6.8 At the end of 5 minutes, record the time and final pressure.

6.9 Disconnect the pressure source from the pressure/vacuum supply hose, and slowly open the shut-off valve to bring the tank to atmospheric pressure.

6.10 Connect the vacuum source to the pressure/vacuum supply hose.

6.11 Slowly evacuate the tank, or alternatively the first compartment, to 1500 pascals (6 inches H_2O).

6.12 Close the shut-off valve and allow the pressure in the truck tank to stabilize, adjusting the pressure if necessary to maintain 1500 pascals (6 inches H_2O) vacuum. When the pressure stabilizes, record the time and initial pressure.

6.13 At the end of 5 minutes, record the time and final pressure.

6.14 Repeat steps 6.5 through 6.13 for each compartment if they were not interconnected.

7. ALTERNATIVE TEST METHODS

Techniques, other than specified above, may be used for purging and pressurizing the truck tanks, if prior approval is obtained from the air pollution control officer. Such approval will be based upon demonstrated equivalency with the above method.

APPENDIX B

GASOLINE VAPOR LEAK DETECTION PROCEDURE BY COMBUSTIBLE GAS DETECTOR

1. PRINCIPLE

A combustible gas detector is used to indicate any incidence of leakage from gasoline truck tanks and vapor control systems. This qualitative monitoring procedure is an enforcement tool to confirm the continuing existence of leak-tight conditions.

2. APPLICABILITY

This method is applicable to determining the leak-tightness of gasoline truck tanks during loading without taking the truck tank out of service. The method is applicable only if the vapor control system does not create back-pressure in excess of the pressure limits of the truck tank compliance leak test. For vapor control systems, this method is applicable to determining leak-tightness at any time.

3. DEFINITIONS

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

3.2 Truck tank vapor collection equipment. Any piping, hoses, and devices on the truck tank used to collect and route the gasoline vapors in the tank to the bulk terminal, bulk plant, or service station vapor control system.

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

4. APPARATUS AND SPECIFICATIONS

4.1 Manometer. Liquid manometer, or equivalent, capable of measuring up to 6250 pascals (25 inches H_2O) gauge pressure with $\pm$25 pascals (0.1 inch H_2O) precision.

4.2 Combustible gas detector. A portable hydrocarbon gas analyzer with associated sampling line and probe.

4.2.1 Safety. Certified as safe for operation in explosive atmospheres.

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

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

5. TEST PROCEDURE

5.1 Pressure. Place a pressure tap in the terminal, plant, or service station vapor control system, as close as possible to the connection with the truck tank. Record the pressure periodically during testing.

5.2 Calibration. Calibrate the combustible gas detector with 2.2 percent propane by volume in air for 100 percent LEL response.

5.3 Monitoring procedure. During loading or unloading, check the periphery of all potential sources of leakage of the truck tank and of the terminal, plant, or service station vapor collection system with a combustible gas detector.

5.3.1 Probe distance. The probe inlet shall be 2.5 cm from the potential leak source.

5.3.2 Probe movement. Move the probe slowly (2.0 cm/second). If there is any meter deflection at a potential leak source, move the probe to locate the point of highest meter response.

5.3.3 Probe position. As much as possible, the probe inlet shall be positioned in the path of (parallel to) the vapor flow from a leak.

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

5.4 Recording. Record the highest detector reading and location for each incidence of leakage.

APPENDIX C

LEAK DETECTION PROCEDURE FOR BOTTOM-LOADED TRUCK TANKS BY BAG CAPTURE METHOD

1. PRINCIPLE

The volume of leakage from a truck tank during loading is measured directly by placing calibrated bags over all potential sources of leakage. This quantitative monitoring procedure is an enforcement tool to confirm the continuing existence of leak-tight conditions.

2. APPLICABILITY

This method is applicable to determining the leak-tightness of truck tanks during bottom-loading without taking the truck tank out of service. The method is applicable only if the vapor control system does not create back-pressure in excess of the pressure limits of the truck tank compliance leak test. This method cannot be applied to truck tanks during top-loading, vapor collection equipment on truck tanks, or vapor control systems at terminals, plants, or service stations.

3. DEFINITIONS

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

3.2 Compartment. A liquid-tight division of a truck tank.

3.3 Truck tank vapor collection equipment. Any piping, hoses, and devices on the truck tank used to collect and route the gasoline vapors in the tank to the bulk terminal, bulk plant, or service station vapor control system.

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

4. APPARATUS

4.1 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) precision.

4.2 Plastic bag. An air-tight bag, large enough to cover the truck tank's dome cover. One bag is needed for each compartment.

4.3 Bicycle tire. A bicycle innertube, or similar apparatus, modified to the appropriate diameter to fit over the truck tank's dome cover and lie flat on the top of the truck tank. One tire is needed for each compartment.

4.4 Dry gas meter.

4.5 Pump.

4.6 Calibration platform. A platform constructed such that air can be introduced through hole in the center of platform, and large enough for bicycle tire to lie flat on it.

5. BAG VOLUME CALIBRATION

5.1 Attach bag to innertube and seal with tape or other applicable sealant to ensure no leakage around interface.

5.2 Fill innertube with water.

5.3 Place bag apparatus on the calibration platform so that the air inlet is situated under the bag.

5.4 Remove air from bag.

5.5 Connect pump to dry gas meter and dry gas meter to inlet on the calibration platform.

5.6 Pump air into bag until bag is full. Record the volume from the dry gas meter and indicate volume on bag.

6. TEST PROCEDURE

6.1 Place a pressure tap in the terminal, plant, or service station vapor control system, as close as possible to the connection with the truck tank. Record the pressure periodically during testing.

6.2 During loadings, place a bag apparatus over the dome cover of each compartment in the truck tank being filled.

6.3 Remove air from bags.

6.4 Check to ensure there is a tight seal between the base of the bag apparatus and the top of the truck tank.

6.5 During loading, estimate volume of vapors collected in bags. If a bag fills before loading is complete, empty bag and resume testing.

6.6 Estimate total volume of vapors collected in the bags, making allowances in the volumes for tank domes or other equipment

6.7 Record capacity of truck tank.

6.8 Determine allowable volume of vapor leakage from truck tank as in Section 7.

6.9 Determine total loading time. This includes only time when filling is actually occurring, not breaks during the loading operation.

7. CALCULATIONS

7.1 Equation. The allowable volume of leakage from a truck tank can determined from equation 7-1.

$$V_L = (0.5V)\left(\frac{T}{t_p}\right)\left(1 - \frac{P_f}{P_i}\right) \qquad \text{(Equation 7-1)}$$

Where: V_L = allowable volume of leakage (liters)

V = capacity volume of tank (liters)

P_i = initial pressure for the compliance pressure test (absolute units)

P_f = final pressure for the compliance pressure test (absolute units)

t_p = time limit for pressure drop for the compliance pressure test (minutes)

T = total time for loading (minutes)

7.2 Example. A 20,000 liter tank is filled to capacity in 10 minutes. The compliance pressure test has an allowable pressure drop in 5 minutes from 4500 pascals (18 inches H_2O gauge, 425 inches H_2O absolute) to 3750 pascals (15 inches H_2O gauge, 422 inches H_2O absolute). The allowable volume of leakage is 140 liters.

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16. ABSTRACT

This report provides the necessary guidance for development of regulations to limit emissions of volatile organic compounds (VOC) from gasoline tank trucks and vapor collection systems at bulk terminals, bulk plants and service stations. The intent of this guidance is to define leak tight conditions and related test procedures for vapor collection systems and tank trucks while loading and unloading gasoline at these facilities. The control approach described in this document is improved maintenance and would be enforced through the surveillance and periodic testing of leak points. This guidance includes a recommended regulation and testing procedures.

17. KEY WORDS AND DOCUMENT ANALYSIS

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