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VAPOR CONTROLS FOR VEHICLE TANK REFUELING AT RETAIL GASOLINE SERVICE STATIONS

by

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SUMMARY

Retail gasoline service stations constitute a large source of uncontrolled VOC emissions. Emission sources include underground storage tank filling and breathing losses, spills, and vehicle tank refueling losses. Current VOC regulations for nonattainment areas require the control of VOC losses from underground storage tank filling, commonly called Stage I controls. In areas where this level of control does not clearly demonstrate attainment will be achieved, additional VOC regulations may be required.

The VOC losses from vehicle tank refueling at retail gasoline service stations, can be controlled. Known as Stage II controls, vapor-balance, vapor-aspirator, or vacuum-assisted systems can be used. Field tests demonstrate that efficiencies are 95 percent for vapor-balance system, 96 percent for vapor aspirator, and 97+ percent for vacuum-assisted system. The vapor recovered is equal to the vapor controlled with the vapor-balance and vapor-aspirator systems, whereas only half of the vapor controlled by a vacuum-assisted system is recovered, as part of this stream is incinerated.

Economic analyses of the three systems show the vapor-balance system to be the most affordable. The addition of a vapor-balance system to retail stations would add an average of 0.2 cent per gallon to the cost of gasoline (in September 1982 dollars). The analyses also indicate that control of stations with a monthly throughput of 30,000 gallons or less may not be cost-effective.

The Philadelphia Air Quality Control Region should pattern its regulations after the California and District of Columbia regulations. These are the only two areas that currently require Stage II controls. Both require vapor-balance systems with a 90 percent vapor control efficiency; an initial system certification that includes a 90-day performance/reliability test; and operation and maintenance guidelines calling for monitoring by appropriate indicating gauges, alarms, and/or detection devices. Some of the problems

have resulted from poor equipment maintenance and improper operation by self-service customers.

SECTION 1

INTRODUCTION

Over the past several years the Office of Air Quality Planning and Standards (OAQPS) of the U.S. Environmental Protection Agency (EPA) has developed a series of Control Techniques Guidelines (CTGs) for volatile organic compounds (VOCs) to assist state and local agencies in developing regulations for VOC control. Although the CTGs covered major VOC source categories from an overall nationwide perspective, several VOC source categories that are not covered by CTG documents are major contributors to the ozone problem within a given area.

Air pollution control agencies in the Philadelphia Air Quality Control Region (AQCR) have asked for guidance in determining if VOC controls are available for non-CTG sources and information to assist them in developing appropriate regulations. One such VOC source is vehicle tank refueling operations at retail gasoline service stations.

1.1 SOURCES AND AMOUNTS OF EMISSIONS

This report deals only with emissions that occur during retail vehicle refueling. Other emissions sources are either already effectively regulated or are not economically feasible to control (such as underground tank breathing losses). During refueling, the volume of gasoline vapor displaced in the nearly empty vehicle tank equals that of the liquid gasoline added. In areas of the country where the underground gasoline tank filling operations are controlled by vapor balance, vehicle refueling emissions account for 84 percent of the remaining uncontrolled VOC emissions.

Because gasoline is subject to Federal and state taxes, public records provide a good estimate of the number of retail gasoline service stations and pumps in the Philadelphia AQCR. Data was not available for wholesale consumption. These public records show that the area has about 4500 stations with

24,000 pumps. Table 1 summarizes this information. Table 2 lists the emission sources at retail gasoline service stations and their uncontrolled emission rates.

TABLE 1. GASOLINE STATIONS AND PUMPS IN PHILDELPHIA AQCR[a]

Area	Number of facilities	Number of pumps[a,b]
PENNSYLVANIA		
Philadelphia County	1,311	5,544
Montgomery County	546	3,855
Bucks County	452	3,199
Del County	331	2,764
Chester County	316	1,867
NEW JERSEY		
Camden County	305	2,090
Gloucester County	137	499
Mercer County	97	743
Trenton City	44	228
Hamilton Township	67	505
Salem County	150	576
Burlington County[b,c]	275	1480
DELAWARE		
New Castle County[c,d]	400	2,000
TOTAL	4,431	25,350

[a]Reference 1.

[b]Data on the number of pumps is approximate. In many cases, agencies list only aggregate figures on the number of pumps; thus diesel and kerosene pumps are included. In all cases, however, agencies estimated that only a very small proportion of the pumps are kerosene or diesel.

[c]The figure given is an estimate based on the ratio of pumps to stations in all other areas in Pennsylvania and New Jersey.

[d]Only statewide data were available from the Delaware Department of Weights and Measures. The Delaware Division of Natural Resources and Environmental Control provided the estimates for New Castle County.

TABLE 2. POTENTIAL VOC EMISSIONS FROM SERVICE STATIONS[2]
(lb/1000 gal throughput)

Source	VOC emissions
Underground tank breathing	1.0
Underground tank filling:	
Splash type	11.5
Submerged type	7.5
Vapor balance type	0.3
Spillage	0.7
Vehicle refueling	9.0
Total without control	22.2

Retail service stations are ranked in size according to monthly gasoline sales and to the number of gasoline dispenser nozzles at the station. According to national data,[2,3] the monthly throughput at retail stations ranges from 15,000 to 180,000 gallons per month, and the number of dispenser nozzles varies from 2 to 15. The typical service station has six dispenser nozzles, three 10,000-gallon underground storage tanks, and a monthly throughput ranging from 39,000 to 60,000 gallons.[3] Table 3 presents estimated uncontrolled emissions from vehicle refueling at various sized service stations.

TABLE 3. UNCONTROLLED VOC EMISSIONS FROM VEHICLE REFUELING AT VARIOUS SIZED RETAIL GASOLINE SERVICE STATIONS[3]

	Station throughput, gal/mo					
	15,000	30,000	60,000	90,000	120,000	180,000
Number of dispenser nozzles	2	3	6	9	12	15
Uncontrolled VOC emissions						
Pounds per month	135	270	540	810	1,080	1,620
Tons per year	0.81	1.62	3.24	4.86	6.48	9.72

SECTION 2

EMISSION CONTROL TECHNIQUES

Several methods are available for capturing gasoline vapor at the vehicle fuel tank during refueling. In all cases, the captured vapor is either routed back to the undergound fuel storage tank or to a thermal incinerator.

2.1 VAPOR-BALANCE SYSTEM

The vapor balance system is the simplest method for vapor capture and control. As shown in Figure 1, the dispensing nozzle is sealed against the vehicle fill neck by a faceplate attached to a flexible rubber boot. As the displaced vapor from the fuel tank is captured, it flows via the nozzle and a vapor hose back to the underground storage tank from which gasoline is being pumped to the vehicle. Figure 2 presents schematics of two configurations. Sensors in the vapor-return line detect any blockage due to liquid entrainment or condensation. To prevent loss of vapor due to poor fit, manufacturers often incorporate a no-seal, no-flow technology into the nozzle, which prevents the flow of gasoline until the nozzle boot makes a proper seal against the vehicle fill neck. The OPW division of Dover Corporation of Cincinnati, Ohio, and EMCO-Wheaton of Conneaut, Ohio, manufacture the vapor-balance systems that are in service in the District of Columbia and Southern California. These two companies also manufacture most of the gasoline nozzles used in other systems.[3] Both companies estimate that it would take three to four months to manufacture enough nozzles to supply the AQCR (personal communication from T. Atha, OPW, December 19, 1983 and D. Funk, EMCO-Wheaton, December 19, 1983).

2.2 VAPOR ASPIRATOR SYSTEM

An aspirator is sometimes used to capture vapor from vehicle fuel tanks. The aspirator creates a slight vacuum (3 to 5 mm Hg) in the vapor line.[3] As shown in Figure 3, a portion of the pumped gasoline flow is diverted through

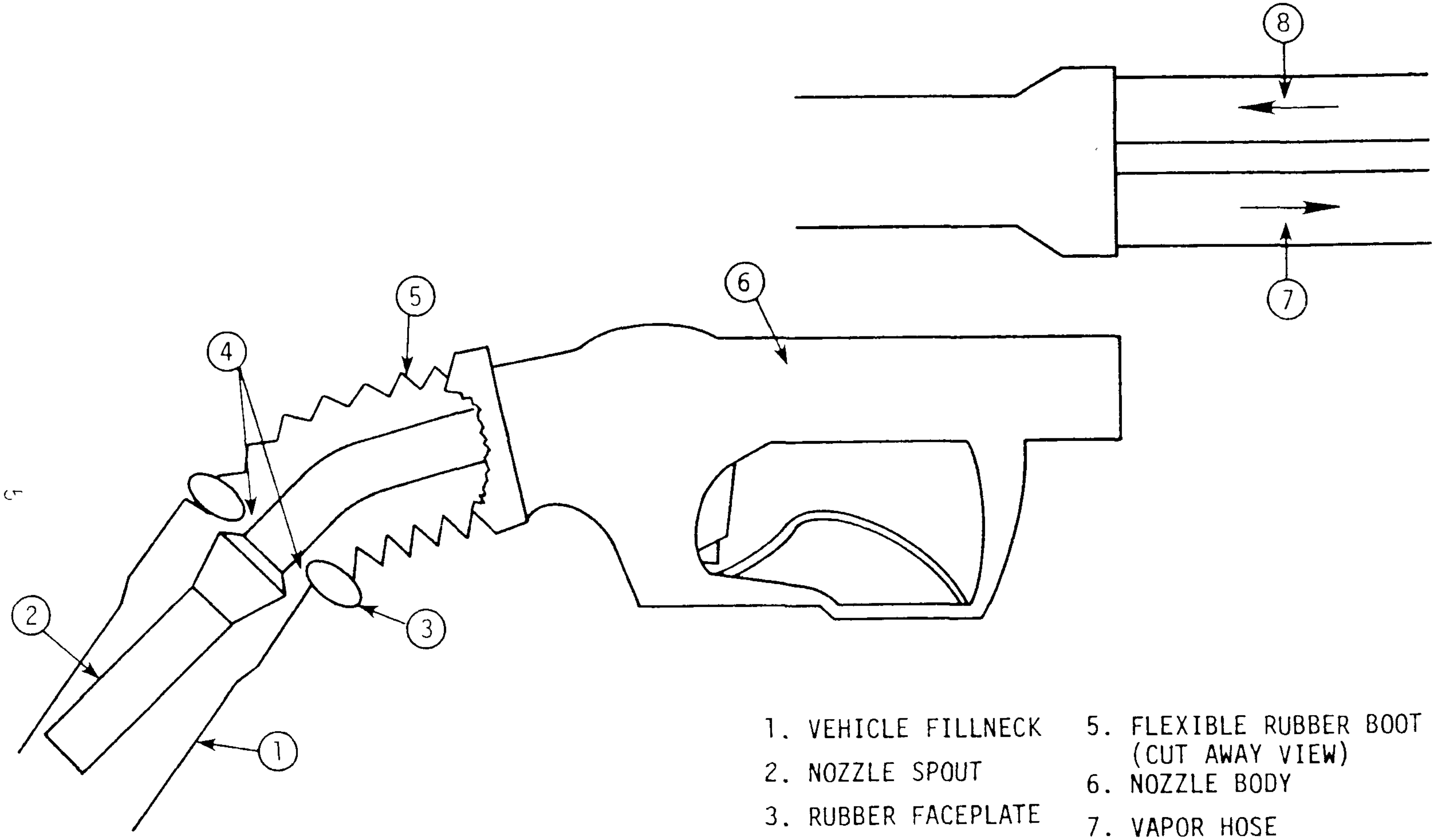

Figure 1. Balance system vapor recovery nozzle.[3]

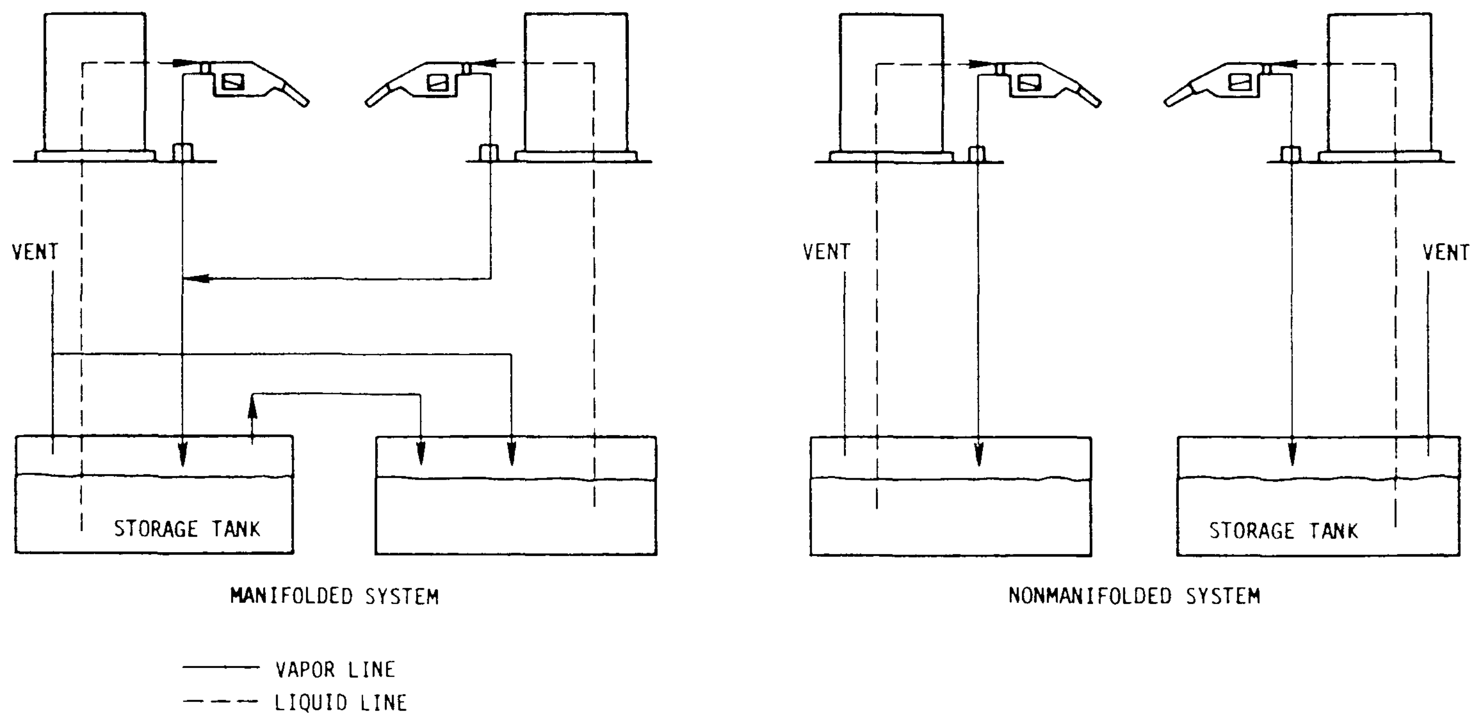

Figure 2. Vapor balance systems.[3]

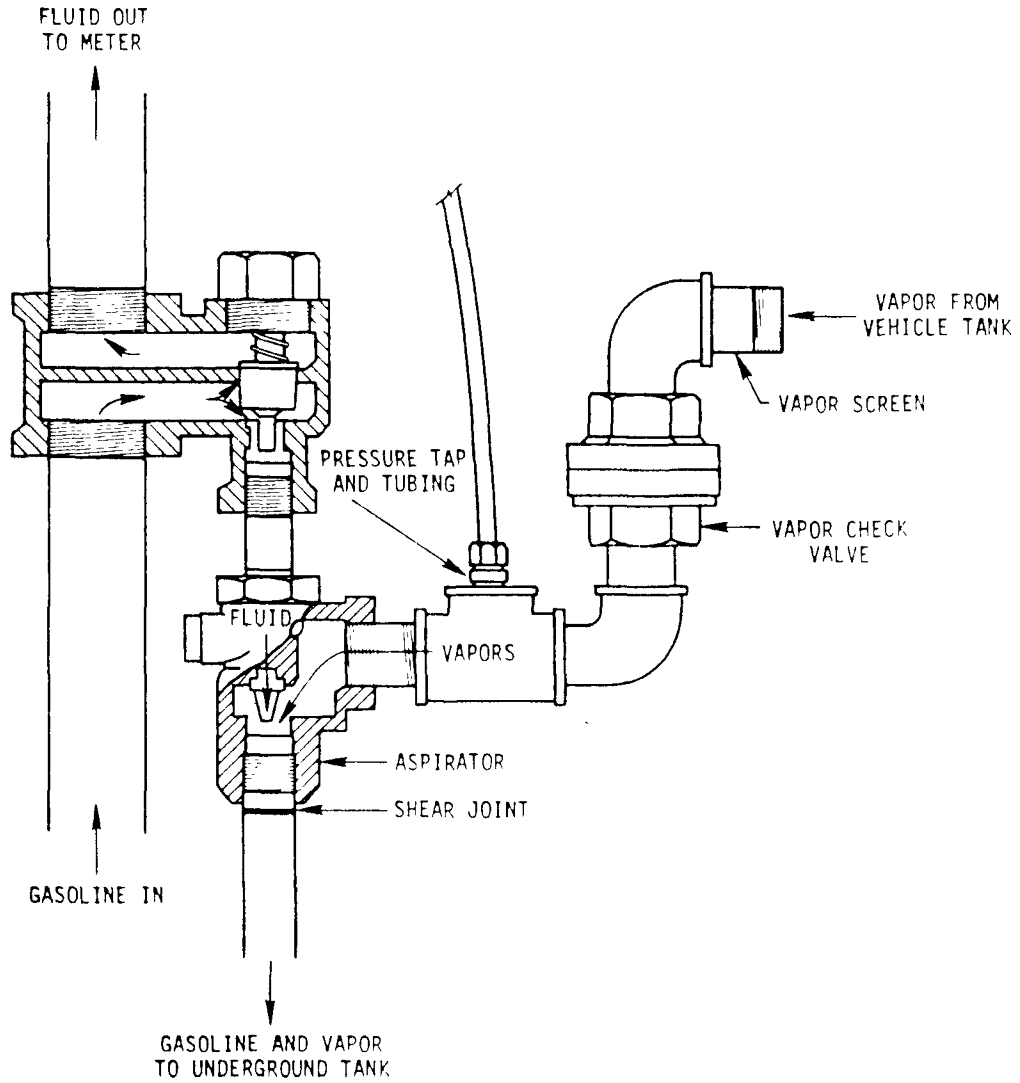

Figure 3. Aspirator-assisted system.[3]
Source: Red Jacket Division of Weil-McLain Co., Inc., Davenport, Iowa

an aspirator to create the vacuum. The displaced vapors return to the gasoline storage tank. The generation of the vacuum is a function of the gasoline flow rate through the aspirator. Thus, as higher liquid gasoline flow rates displace more vapor, the diverted gasoline stream flow rate to the aspirator is commensurately higher. This creates a larger vacuum, which permits more vapor capture. As in the vapor-balance system, the vapor line must be equipped with liquid blockage sensors to detect blockage from entrained or condensed liquid. Healey Systems of Cambridge, Massachusetts, recently introduced a vacuum aspirator system into the Southern California market. Vacuum-aspirator systems by Red Jacket Systems of Davenport, Iowa, are currently in service in California, but the company is no longer producing the units.

2.3 VACUUM-ASSISTED SYSTEM

This system incorporates a blower in the vapor return line to generate a slightly higher vacuum (25 to 50 mm Hg) than the aspirator system.[3] Figure 4 is a schematic diagram of this system. As a result of the larger vacuum, air and gasoline vapor are drawn in around the vehicle fill neck, which eliminates the need for a seal between the gasoline nozzle and the vapor collection boot. Air that enters the system creates a vapor volume larger than the volume of liquid gasoline dispensed from the underground storage tank, however, and this excess air and gasoline vapor volume must be processed before it is released to the atmosphere. The system includes a thermal incinerator, which is used to oxidize the captured vapors.

The system operates automatically. Fuel-dispensing operations activate the inline blower. Pressure sensors in the underground storage tank regulate the amount of air and gasoline vapor routed to the incinerator. When the tank pressure increases to a set level, the vapor stream is diverted from the storage tank to the incinerator. When tank pressure decreases to a preset load, the air-vapor stream is routed back to the storage tank and the flow to the incinerator stops. Hassteck Systems of San Diego, California, and Hirt Combustion of Montebella, California, produce the vacuum-assisted systems currently in service in California.[3]

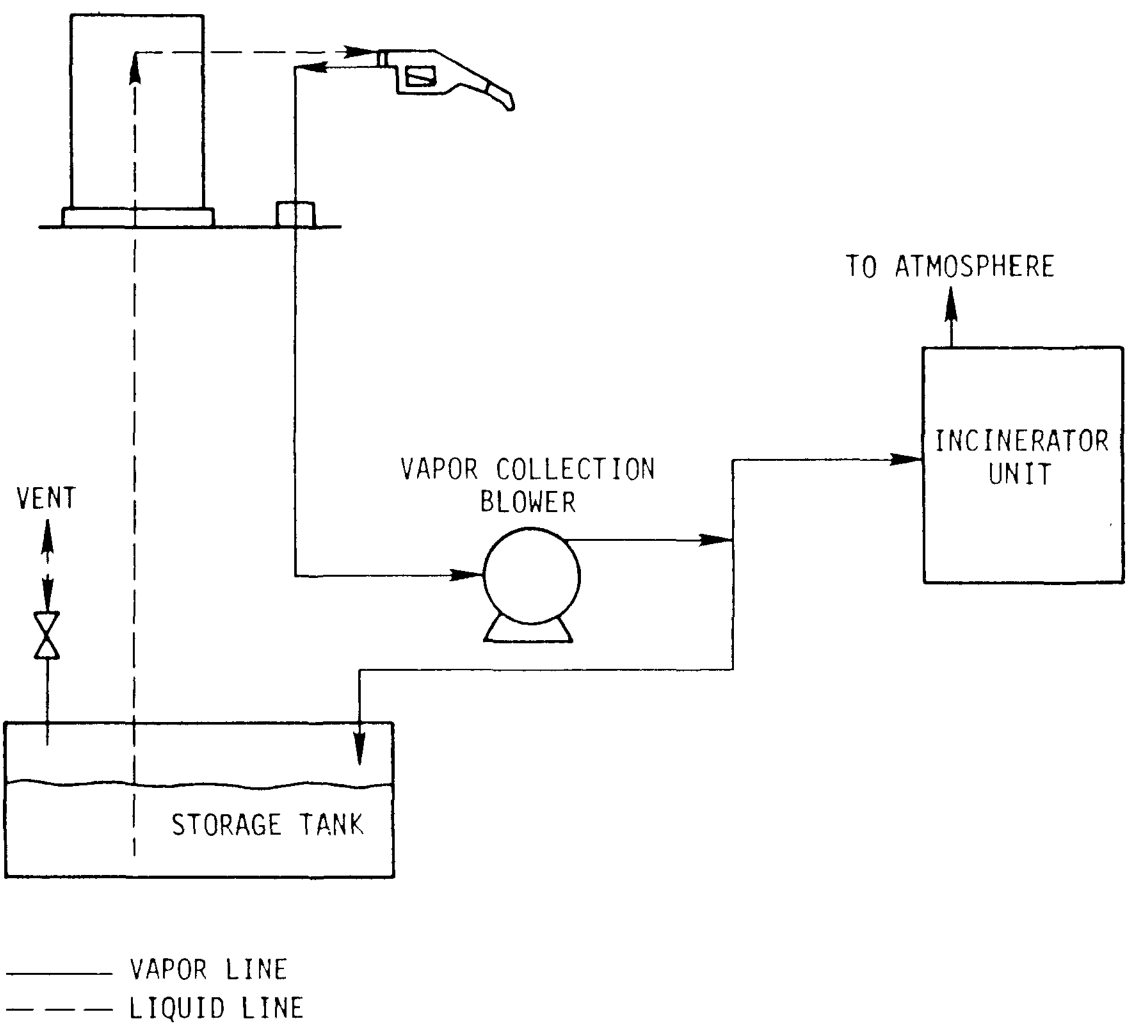

Figure 4. Vacuum-assisted system with incinerator.[3]

2.4 EFFICIENCIES OF THE VARIOUS CONTROL SYSTEMS

Control system efficiencies vary with the method of vapor collection. The efficiency of the vapor-balance method, the simplest system used, depends upon the seal between the nozzle boot and the vehicle tank fill neck. Reported efficiencies (based on field tests) range from 94 to 98 percent and average 96 percent (personal communication from C. Jones, District of Columbia Bureau of Air and Water Quality, October 11, 1983). If the design of the vapor-balance system is such that gasoline is dispensed only with a positive seal, a 96 percent collection efficiency is possible. Microswitches in the nozzle seal prevent the gasoline pump from operating unless the seal is positive.

A positive seal between the dispenser nozzle and tank fill neck is not as critical for the aspirator or vacuum-assisted control systems because these systems can tolerate air inleakage. Based on tests, system efficiencies for aspirator systems range from 94 to 99 percent. Vacuum-assisted control systems operate at efficiencies well in excess of 95 percent, with an average of 97 percent (personal communication from C. Jones, District of Columbia Bureau of Air and Water Quality, October 11, 1983).

Although manufacturers of systems in service in Southern California warrant 95 percent efficiency, the current estimate for units in service and in good condition is 90 percent.[3] The State of California is planning additional tests to determine field performance.

For this report, system evaluations were performed at the following selected design efficiencies:

Control system	Control efficiency, %
Vapor-balance	90
Vapor-aspirator	95
Vacuum-assisted	97

2.5 VAPOR CONTROL SYSTEMS IN THE DISTRICT OF COLUMBIA AND SOUTHERN CALIFORNIA

The District of Columbia has approximately 215 service stations, and all but one of these use vapor-balance control. That one uses vacuum assistance. Oil companies use vapor balance because it is the cheapest; however, the District is considering amending regulations to require vacuum assistance in all stations that have 14 or more nozzles.

The vapor-balance systems are manufactured by EMCO-Wheaton of Conneaut, Ohio, and the OPW Division of Dover Corporation, Cincinnati, Ohio. Since the District of Columbia area has six distributors, parts are readily available.

The following are some of the operational problems that have been encountered in vapor-balance systems:

1. The rubber parts of the system, particularly the bellows, are very susceptible to damage.

2. If hoses become kinked or ripped, vapor will not have a good route for return to the tank.

3. Hoses returning to the tank must be self-draining and free of liquid.

4. The equipment must be properly operated to achieve the attainable control efficiency. About two-thirds of the gasoline sold in the District of Columbia is self-service, and educating the self-service customer is a big problem. Brochures giving instructions on the operation of self-service pumps have been mailed with water bills, and the District is considering making it mandatory for stations to post instructions on the pumps.

The District initially inspects the gasoline service stations to see that the control equipment is installed and conducts followup inspections to check that the control equipment is still in place. Spot checks are also made to assure that the control equipment is kept in good working order.

About 80 percent of the 8000 to 9000 gasoline service stations in the Southern California Air Quality Management District (SCQAMD) have either OPW or EMCO-Wheaton vapor-balance control systems. Spare parts for these systems are readily available.

The SCQAMD considers system maintenance and quality control to be the major problems. They (like the District of Columbia) find the rubber boot material to be susceptible to detoriation, cutting, and tearing. The SCQAMD also found educating the self-service customer on the proper use of the equipment to be a problem. Instructional signs with toll-free telephone numbers are posted on all pumps.

The equipment is warranted to achieve 95 percent control. There are no data based on actual field performance; however, a test program is being initiated.

The control equipment is inspected when first installed. Although SCQAMD's goal is to inspect every station twice a year, this is not always achieved.

During an inspection, pumps are tagged as being out of order if a tear of one inch or greater is found in the bellows. If two or more pumps are tagged at a service station during an inspection, a violation is issued that results in a fine or other court action. In September 1983, SCQAMD made 892 inspections and examined about 7000 nozzles. Three hundred and sixty-five were tagged as out of order, and 85 violations were issued.

SECTION 3

COST/ECONOMIC ANALYSIS

This section presents an economic analysis of each of the three control systems.

3.1 MODEL STATIONS

According to survey data,[3] service stations are rated in size according to their monthly throughput of dispensed gasoline. Sizes range from a minimum of 15,000 gallons per month to a maximum of 180,000 gallons per month. We estimated costs for six model stations within this range as:

Small station	15,000 and 30,000 gal/mo
Medium station	60,000 and 90,000 gal/mo
Large station	120,000 and 180,000 gal/mo

A typical station, based on the national projection of gasoline sales and number of service stations,[3] is expected to have a monthly throughput of approximately 50,000 gallons in 1983. Thus, our model station with a throughput of 60,000 gallons per month would approximate the national average.

3.2 ASSUMPTIONS

To derive capital and operation and maintenance costs for the various vapor control systems, we made the following assumptions:

1. The typical and model station sizes derived from national data represent service station sizes in the Philadelphia AQCR.

2. Capital investment and indirect operating costs can be converted to September 1982 costs by use of the Plant Cost Index from Chemical Engineering magazine.

3. Direct annual operating costs for each vapor control system are primarily for system maintenance and can be converted to September 1982 by use of the Hourly Earnings Index from Chemical Engineering magazine.

4. The annual credits for recovered gasoline are based on the September 1982 prices for wholesale gasoline.

5. The economic impact of station downtime due to equipment malfunction is minor.

3.3 CAPITAL INVESTMENT

The capital investment required for a vapor control system varies with the throughput and the physical layout of the station and the type of vapor recovery system used. The investment costs include equipment, necessary piping and instrumentation, and all installation charges. Table 4 presents the average investment costs for vapor-recovery systems.[3,4] Actual costs for an individual station may vary from these averages by as much as 30 percent because of such site-specific requirements as piping and excavation. Necessary modifications to underground piping systems can drastically affect the capital investment; the additional cost could be as high as $3000. In California, about half of the vapor-aspirator systems required modifications costing from $7,000 to $11,000. The vacuum-assisted systems required modification costing from $9,000 to $12,000 (personal communication from C. Jones, District of Columbia Bureau of Air and Water Quality, October 11, 1983).

3.4 ANNUAL COSTS

Table 5 shows the annual costs for the three control systems, including direct operating costs, indirect costs, and gasoline recovery credits.[5]

Direct operating costs for vapor-balance and vapor-aspirator systems cover the maintenance and materials required to keep the gasoline nozzles in good operating condition. For the vacuum-assisted system, direct costs also cover incinerator maintenance and the electrical energy required to operate the blower.

Indirect costs include a capital recovery charge and an allowance for property taxes, insurance, and administrative costs. The annual capital recovery charge (based on a 10-year system life and 10 percent interest) is 16.275 percent of the capital investment.[6] The allowance for taxes, insurance, and administrative costs is 4 percent of the capital investment.[3]

Installation costs for the same task vary greatly. For example, installation costs of the EMCO-Wheaton nozzle varied from $27 to $120 per nozzle,

TABLE 4. CAPITAL INVESTMENT COSTS FOR VARIOUS VAPOR CONTROL SYSTEMS FOR VEHICLE TANK REFUELING.[3]
(Thousands of September 1982 dollars)

Size of service station		Type of vapor control system		
Monthly throughput, gallons	Number of nozzles	Vapor balance	Aspirator-assisted	Vacuum-assisted
15,000	2	6.5	7.8	14.8
30,000	3[a]	6.8	8.5	15.8
60,000	6[a]	9.5	12.8	18.4
90,000	9[a]	11.9	16.0	21.1
120,000	12	14.5	19.9	24.6
180,000	15	17.5	24.3	28.5

[a]Values shown for 3-, 6-, and 9-nozzle stations are within an average of 10 percent of the costs developed by California Air Resources Board (Reference 4).

TABLE 5. ANNUAL COSTS AND COST-EFFECTIVENESS OF VAPOR CONTROL SYSTEMS FOR VEHICLE TANK REFUELING.

Type control system	Station size: Monthly throughput, gallons	Station size: Number of nozzles	Control system efficiency, %	Gasoline recovered, tons/yr	Annual costs, dollars: Direct charges[a]	Annual costs, dollars: Indirect charges[b]	Annual costs, dollars: Gasoline recovery credit	Annual costs, dollars: Net total	Cost-effectiveness, $/ton gasoline removed
Vapor balance	15,000	2	90	0.73	420	1320	310	1430	1960
	30,000	3		1.46	510	1380	630	1260	860
	60,000	6		2.91	790	1930	1250	1470	510
	90,000	9		4.38	1070	2470	1890	1650	380
	120,000	12		5.83	1350	2940	2520	1770	305
	180,000	15		8.75	1630	3550	3770	1410	160
Average									370
Aspirator-assisted	15,000	2	95	0.77	420	1580	330	1670	2170
	30,000	3		1.54	500	1720	680	1540	1000
	60,000	6		3.08	700	2600	320	1970	640
	90,000	9		4.61	910	3240	2000	2150	470
	120,000	12		6.15	1120	4030	2660	2490	400
	180,000	15		9.24	1330	4930	3990	2270	250
Average									460
Vacuum-assisted	15,000	2	97	0.40	650	3000	170	3480	4460
	30,000	3		0.79	710	3200	350	3560	2250
	60,000	6		1.57	850	3730	670	3910	1250
	90,000	9		2.36	1010	4280	1020	4270	900
	120,000	12		3.14	1160	4990	1360	4700	760
	180,000	15		4.72	1300	5780	2040	5040	530
Average									970

[a] Updated costs from Reference 5.

[b] Estimated as 20.275 percent of capital investment.

[c] Gasoline recovered is priced at $1.21 per gallon with a specific gravity of 0.67.[7]

and the costs of underground piping modifications for Red Jacket systems varied from $3000 to $8000.

Gasoline recovery credits are based on a September 1982 wholesale gasoline price of $1.21 per gallon.[8] This price takes into account the Federal tax of $0.05/gal and a State tax of $0.10/gal. Actual State gasoline taxes range from $0.08/gal in New Jersey to $0.12/gal plus a 6 percent tax on the oil company in Pennsylvania.

3.5 COST-EFFECTIVENESS

The cost-effectiveness of the control systems was determined by dividing the annual costs for each system by the amount of VOC removed each year. (For the vacuum-assisted system, the gasoline removed per year is twice the amount recovered.) This gives cost per ton of VOC controlled. The results presented in Table 5 show that:

1. The vapor-balance control system is the most cost-effective system over the entire range of service stations.
2. The control costs for the smaller-capacity service stations are two to four times higher than those for larger-capacity stations.
3. The average cost-effectiveness of a vapor-balance control system over the size range of stations considered is $370 per ton of gasoline recovered.

3.6 ECONOMIC IMPACT OF CONTROLS

The cost of a vapor control system in a retail gasoline outlet will be passed on to the customer as a slight increase in the price of gasoline. The cost increase per gallon for each control system option was calculated by dividing the annual cost by the annual gasoline throughput. The results shown in Table 6 indicate that except for the smaller-sized stations, the additonal cost to the consumer averages less than 0.5 cent per gallon of gasoline. These costs are confirmed by two previous studies: one in California[5] and one for the District of Columbia.[3]

TABLE 6. ECONOMIC EFFECT OF VAPOR CONTROLS ON GASOLINE PRICES

Control system	Monthly station throughput, gallons	Annual cost, Sept. 1982 dollars	Added cost, cents/gallon
Vapor-balance	15,000	1,430	0.79
	30,000	1,260	0.35
	60,000	1,470	0.20
	90,000	1,650	0.15
	120,000	1,770	0.12
	180,000	1,410	0.07
Aspirator-assisted	15,000	1,670	0.93
	30,000	1,540	0.43
	60,000	1,970	0.27
	90,000	2,150	0.20
	120,000	2,490	0.17
	180,000	2,270	0.11
Vacuum-assisted	15,000	3,480	1.90
	30,000	3,560	0.99
	60,000	3,910	0.54
	90,000	4,270	0.40
	120,000	4,790	0.33
	180,000	5,040	0.23

SECTION 4

REGULATORY ANALYSIS

The findings of the analyses of the various vapor control systems available for retail gasoline service stations lead to the following conclusions:

1. At least a 90 percent reduction of gasoline vapor losses from vehicle refueling is possible at retail service stations. Tests to be conducted by the Southern California Air Quality Management District may provide a more definitive answer.

2. The vapor-balance control system is the most cost-effective system available.

3. Use of the vapor-balance control system results in an average incremental overhead expense of approximately 0.2 cent per gallon of gasoline.

4.1 DRAFT REGULATION

The following are proposed draft regulations for the Phildelphia AQCR for emissions resulting from the transfer of gasoline to vehicular fuel tanks:

Control of Evaporative Losses From the Filling of Vehicular Fuel Tanks

A(1) No person shall cause, suffer, or allow the transfer of gasoline to any vehicular fuel tank from any stationary storage container unless the transfer is made through a fill nozzle designed, operated, and maintained so as:

a. To prevent the discharge of gasoline vapors to the atmosphere from either the vehicle filler neck or the filler nozzle;

b. To direct the displaced vapor from the vehicular fuel tank to a vapor-balance or equivalent system that recovers or destroys at least 90 percent by weight of the organic compounds in the displaced vapors collected; and

c. To prevent overfilling of vehicular fuel tanks and spillage.

(2) A control system meeting the specifications set forth in Subsection B and used in compliance with Subsection C of this Section shall be judged to be in compliance with the requirements set forth in Subsection A(1) of this Section.

B A vapor-balance system shall have the following:

(1) A vapor-tight return hose to conduct the vapors displaced from the vehicular fuel tank to the gasoline storage tank(s) at the dispensing facility;

(2) A vapor-tight seal to prevent the escape of gasoline vapors into the atmosphere from the interface between the fill nozzle and the filler neck of the vehicular fuel tank;

(3) On and after September 1, 1984, or on and after the date a fill nozzle is removed from service for repair, replacement, or rebuilding, or on and after the date a new fill nozzle is brought into service, whichever date is earliest:

a. The fill nozzle shall have a built-in no-seal/no-flow feature designed to prevent the discharge of gasoline from the nozzle unless the seal described in Paragraph B(2) above is engaged;

b. The fill nozzle shall have a built-in feature designed to shutoff the flow of gasoline automatically when the pressure in the vehicular fuel tank exceeds 10 inches of water gauge; and

c. The vapor return line shall be equipped with a device that automatically shuts off the flow of gasoline through the fill nozzle when gasoline circulates back from the fill nozzle through the vapor hose to the facility's gasoline storage tank;

(4) On and after September 1, 1984, or on and after the date a new gasoline dispensing system is brought into service, whichever date is earlier:

a. The vapor-return hose shall be no longer than 9 feet in length unless the hose is attached to a device designed to keep the hose out of the way of vehicles (when the nozzle is not in use) and to drain the hose of any collected or condensed gasoline; and

b. The gasoline-dispensing system shall be equipped with a device designed to prevent the dispensing of gasoline at any rate greater than 8 gallons per minute;

(5) All tanks, pumps, hoses, and delivery lines of the control system shall be in compliance with all existing regulations for the storage and transfer of gasoline to and from fuel storage tanks; and

(6) Until December 1, 1983, the Air Pollution Control Officer is authorized to grant any person a waiver from the deadlines contained in clauses (3) and (4) of this paragraph: Provided, that the person granted such a waiver enters into a legally binding agreement with the Air Pollution Control Officer providing for:

a. Compliance no later than July 1, 1985, with respect to all gasoline-dispensing facilities under his control; and

b. A schedule for phasing in such compliance.

C No person shall cause, suffer, or allow anyone to use a fill nozzle that is part of the vapor-balance system unless the system is maintained in good repair and unless proper operating practices, including but not limited to the following, are adhered to:

(1) Draining any collected or condensed gasoline from the vapor return hose as often as is necessary, but at least once each operating day;

(2) Waiting as long as is necessary, but at least 10 seconds after shutoff of the fuel, before disconnecting the nozzle from the fill neck to balance the pressure between the vehicular fuel tank and the facility's gasoline storage tank; and

(3) After each fuel delivery, placing the vapor return hose where vehicles will not drive over it.

D If it is demonstrated to the satisfaction of the Air Pollution Control Officer that the vehicle fill neck configuration, location, or other design feastures of a class of vehicles make it impractical to comply with the provisions of Subsection A of this Section, the provisions of this Section shall not apply to such vehicles. In no case, however, shall such configuration exempt any gasoline-dispensing facility with a monthly throughput greater than 30,000 gallons from installing and using in the most effective manner a system required by Subsection A of this Section.

E No person shall cause, suffer, or allow the transfer of gasoline to any vehicular fuel tank from any stationary storage tank unless the transfer is made through a fill nozzle designed to shutoff the transfer of gasoline automatically when the vehicular fuel tank is full or nearly full.

F No person shall cause, suffer, or allow any additional transfer of gasoline to any vehicular fuel tank from a stationary storage tank after the dispensing system has automatically shutoff the transfer of gasoline because the vehicular fuel tank is full or nearly full.

G The operator of a gasoline-dispensing facility shall take such actions as may be necessary to insure that all parts of the system that the facility uses for compliance with this Subsection are maintained in good repair; and to ensure that any person (whether attendant, customer, or other) who uses the facility does so in accordance with proper operating practices and otherwise in compliance with the requirements of this Subsection. For purposes of this Subsection, "operator" means any person who leases, operates, manages, supervises, or controls, directly or indirectly, a gasoline-dispensing facility.

H This Regulation does not apply to gasoline dispensing stations with a monthly throughput of 30,000 gallons or less.

4.2 REGULATION IN OTHER AREAS

Two areas of the country currently regulate VOC emissions from vehicle refueling operations: the District of Columbia and the State of California. These areas use vapor balance systems almost exclusively.[3,5]

California has had vehicle refueling regulations since 1977. Appendix A presents a copy of California's law that requires the air quality management districts to adopt rules and regulations. The District of Columbia passed its law in February 1981, and full compliance is required by February 1, 1983. Appendix B presents a copy of the District of Columbia's vehicle refueling VOC control requirements. Appendix C presents certification procedures for gasoline recovery systems in California.

4.3 FIRE AND EXPLOSION HAZARDS

Safety from fire and explosion is a major consideration in the installation and operation of a vapor control system.

Storage tanks must be vented vertically at least 12 feet above grade to prevent accumulation of hydrocarbon vapors at ground level or in buildings. Vapor-return lines are to be sloped toward storage tanks for proper drainage, and all vapor lines must be pressure-tested after installation. Flame arrestors are required on all vents.

For compliance with local and national safety and fire code requirements, all vapor control systems must be approved by the appropriate authorities (normally the city or state fire marshall) before they are used.

4.4 COMPLIANCE AND MONITORING TECHNIQUES

Prior to their installlation, vapor control systems chosen by individual gasoline service stations should be certified by the manufacturer to meet the capture requirement. Because two areas of the country already require vapor controls, manufacturers may submit engineering and test data demonstrating compliance to the Philadelphia AQCR air pollution control agencies for approval. The data should comply with test procedures similar to those presented in

Appendix C, California's Test Procedures for Determining the Efficiency of Gasoline Vapor Recovery Systems at Service Stations. If certification testing is required, the procedures propose a 90-day reliability test period.

These procedures also require the identification of specific maintenance requirements and schedules to ensure continued operation in compliance with applicable standards. These maintenance requirements should appear in operating manuals that provide clear instruction to the system operator. Critical operating parameters that affect system operation, such as maximum dispensing rates, liquid-to-vapor flow ratios, and operating pressures, should be monitored with indicating gauges, alarms, and/or detection devices. These monitoring devices will warn the system operator when the vapor control system is malfunctioning. During inspections or permit reviews, the air pollution authority can verify that required maintenance is performed and that monitoring devices register within the operating range for system parameters.

This two-step compliance requirement (initial certification and operation and maintenance guidelines) should ensure that a high percentage of vapor control systems remain in compliance.

REFERENCES

1. Information obtained by EPA Region III from county and city offices of weights and measures.

2. U.S. Environmental Protection Agency. Compilation of Air Pollutant Emission Factors, Supplement No. 7. AP-42, April 1977. p. 4.4-11.

3. Norton, R. L., et. al. Pacific Environmental Services, Hydrocarbon Control Strategies for Gasoline Marketing Operations. EPA-450/3-78017, April 1978.

4. Personal communication from F. R. Perry, California Air Resources Board, Engineering Evaluation Branch, to S. Trenck, California Legislative Representative, October 11, 1979, (letter with data tabulations).

5. Hilousby, R. Phase II Vapor Recovery Evaluation Program. South Coast Air Quality Management District.

6. Neveril, R. B. Capital and Operating Costs of Selected Air Pollution Control Systems. EPA-450/5-80002, December 1978.

7. Wambsgans, D. E., et. al. Stage II Vapor Recovery Study - Phase I. Bureau of Air and Water Quality, District of Columbia. October 20, 1982.

8. Oil and Gas Journal, September 6, 1982. This is specific for Philadelphia.

APPENDIX A

STATE OF CALIFORNIA ASSEMBLY BILL NO. 127

Assembly Bill No. 127

CHAPTER 902

An act to amend Sections 41954, 41956, and 41958 of, to add Sections 41956.1, 41960.1, 41960.2, and 41960.4 to, and to add and repeal Section 41960.3 of, the Health and Safety Code, relating to air pollution, and declaring the urgency thereof, to take effect immediately.

[Approved by Governor September 27, 1981. Filed with Secretary of State September 28, 1981.]

LEGISLATIVE COUNSEL'S DIGEST

AB 127, Kelley. Air pollution: gasoline vapor control.

(1) Existing law requires the State Air Resources Board to adopt standards, rules, and regulations to carry out the provisions of state law relating to air pollution control. The state board is required to adopt performance standards for gasoline vapor control systems during gasoline marketing operations and to certify any gasoline vapor control system meeting its performance standards. The State Fire Marshal, the Division of Industrial Safety of the Department of Industrial Relations, and the Division of Measurement Standards of the Department of Food and Agriculture are also required to adopt rules and regulations on various aspects of gasoline vapor control systems and components and to certify compliance with their respective rules and regulations.

Subject to the powers and duties of the state board, air pollution control districts and air quality management districts are required to adopt and enforce rules and regulations which assure that reasonable provision is made to achieve and maintain state ambient air quality standards for the area under their jurisdiction and to enforce all applicable provisions of state law. A district may adopt stricter procedures and performance standards for gasoline vapor control systems than those adopted by the state board, except that gasoline vapor control systems installed and operating in compliance with requirements of the Bay Area Air Quality Management District are exempt from retrofitting requirements until September 26, 1981.

This bill would do the following:

(a) Require the state board, within 90 days after the effective date of the bill, to adopt additional performance standards, after public hearings, to assure that the gasoline vapor control systems used in motor vehicle fueling operations do not cause excessive spillage.

(b) Require the Division of Measurement Standards, within 120 days after the effective date of the bill, to adopt additional performance standards, and standardized certification and compliance test procedures, to prevent gasoline recirculation by gasoline vapor control systems used in motor vehicle fueling operations.

(c) Exempt any gasoline vapor control systems or their components from revised standards for a period of 4 years from the effective date of the revised standards, except for a system or component which creates a hazard to public health and welfare or results in gasoline recirculation.

(d) Require that certification testing of a system or component with respect to gasoline recirculation be conducted by an independent testing laboratory.

(e) Establish procedures for marking a system or component out of order and prohibit use of the component until it has been repaired, replaced, or adjusted, and it has been reinspected or authorized for use pending reinspection.

(f) Require each district which requires installation of vapor control systems to establish a toll free telephone number for complaints, to diligently investigate or refer the complaints, and to send a copy of the complaint and response to the state board.

(g) Require the state board, on or before January 1, 1983, to file a report with the Legislature concerning complaints and actions taken.

(h) Require the operator of each service station using gasoline vapor control systems in motor vehicle fueling operations to post operating instructions for the system in the gasoline dispensing area.

(i) Exempt, until the time that more than one system is certified by the state board and the Division of Measurement Standards, vapor control systems established and operating in compliance with requirements of the Bay Area Air Quality Management District from stricter district requirements for retrofitting the systems with new or additional equipment for achieving greater vapor recovery efficiency.

(2) Article XIII B of the California Constitution and Sections 2231 and 2234 of the Revenue and Taxation Code require the state to reimburse local agencies and school districts for certain costs mandated by the state. Other provisions require the Department of Finance to review statutes disclaiming these costs and provide, in certain cases, for making claims to the State Board of Control for reimbursement.

This bill would provide that no appropriation is made by this act for the purpose of making reimbursement pursuant to the constitutional mandate or Section 2231 or 2234, but would recognize that local agencies and school districts may pursue their other available remedies to seek reimbursement for these costs.

(3) This bill, in compliance with Section 2231.5 of the Revenue and Taxation Code, would also repeal, as of January 1, 1987, the provisions contained in the bill for which state reimbursement is required.

(4) The bill would take effect immediately as an urgency statute.

The people of the State of California do enact as follows:

SECTION 1. Section 41954 of the Health and Safety Code is amended to read:

41954. (a) The state board shall, by March 1, 1976, adopt procedures for determining the compliance of any system designed for the control of gasoline vapor emissions during gasoline marketing operations, including storage and transfer operations, with performance standards which are reasonable and necessary to achieve or maintain any applicable ambient air quality standard.

(b) Within 90 days after the effective date of this subdivision, the state board shall, after public hearing, adopt additional performance standards which are reasonable and necessary to assure that systems for the control of gasoline vapors resulting from motor vehicle fueling operations do not cause excessive gasoline liquid spillage when used in a proper manner. To the maximum extent practicable, the additional performance standards shall allow flexibility in the design of gasoline vapor recovery systems and their components.

(c) The state board shall certify any gasoline vapor control system, upon its determination that the system, if properly installed and maintained, will meet the requirements of subdivision (a). The state board shall enumerate the specifications used for issuing such certification. After a system has been certified, if circumstances beyond control of the state board cause the system to no longer meet the required specifications, the certification may be revoked or modified.

(d) The state board may test, or contract for testing, gasoline vapor control systems in order to certify them.

(e) The state board shall charge a reasonable fee for certification, not to exceed its estimated costs therefor. Payment of the fee shall be a condition of certification.

(f) No person shall install a gasoline vapor control system unless it has been certified by the state board.

(g) To the extent authorized by other provisions of law, any district may adopt stricter procedures and performance standards than those adopted by the state board pursuant to subdivision (a).

(h) With respect to those vapor recovery systems subject to certification by the state board, there shall be no criminal or civil proceedings commenced or maintained for failure to comply with any statute, rule, or regulation requiring a specified vapor recovery efficiency if the vapor control equipment which has been installed to comply with applicable vapor recovery requirements has been:

(1) Certified by the state board at an efficiency equal to or greater than the efficiency required by applicable statutes, rules, and regulations; and

(2) Installed, operated, and maintained in accordance with the instructions of the equipment manufacturer.

(i) Notwithstanding subdivision (g), until the time that more than one system, including at least one balance-type system, is certified under the standards adopted by the state board pursuant to subdivision (c) and by the Division of Measurement Standards pursuant to subdivision (c) of Section 41956, gasoline vapor control systems which have been installed and are operating in compliance with the requirements of the Bay Area Air Pollution Control District shall be exempt from any requirements for retrofitting such systems with new or additional equipment for the purpose of achieving greater vapor recovery efficiency. All necessary replacement parts shall be those certified by the state board. In all other areas of the state, the state board may implement its regulations adopted pursuant to subdivision (a).

(j) On or after July 1, 1980, but not later than January 1, 1981, the state board shall report to the Legislature on the actual in-use efficiency and durability of all gasoline vapor recovery systems certified pursuant to subdivision (a). If the air quality benefits of systems certified by the state board for a vapor recovery efficiency of 95 percent or greater are not as great as the technical reports of the state board currently indicate, the state board shall reconsider, at a formal public hearing, its regulations relative to installation of such systems.

SEC. 2. Section 41956 of the Health and Safety Code is amended to read:

41956. (a) As soon as possible after the effective date of this section, the State Fire Marshal and the Division of Measurement Standards, after consulting with the state board, shall adopt rules and regulations for the certification of gasoline vapor control systems and components thereof.

(b) The State Fire Marshal shall be the only agency responsible for determining whether any component or system creates a fire hazard. The division shall be the only agency responsible for the measurement accuracy aspects, including gasoline recirculation of any component or system.

(c) Within 120 days after the effective date of this subdivision, the Division of Measurement Standards, shall, after public hearing, adopt rules and regulations containing additional performance standards and standardized certification and compliance test procedures which are reasonable and necessary to prevent gasoline recirculation in systems for the control of gasoline vapors resulting from motor vehicle fueling operations.

SEC. 3. Section 41956.1 is added to the Health and Safety Code, to read:

41956.1. (a) Whenever the state board, the Division of Measurement Standards of the Department of Food and Agriculture, or the State Fire Marshal revises performance or certification standards, any systems or components thereof certified under procedures in effect prior to the adoption of revised standards and installed prior to the effective date of the revised standards may continue to be used in gasoline marketing operations for a period of four years after the effective date of the revised standards. However, all necessary repair or replacement parts or components shall be certified and may meet the most recent certification and performance standards once compatible repair or replacement parts become commercially available.

(b) Notwithstanding subdivision (a), whenever the State Fire Marshal determines a system or component thereof creates a hazard to public health and welfare, he may prevent use of the particular system or component.

(c) Notwithstanding subdivision (a), the Division of Measurement Standards may prohibit the use of any system or component thereof if it determines on the basis of test procedures adopted pursuant to subdivision (c) of Section 41956, that use of the system or component will result in gasoline recirculation.

SEC. 4. Section 41958 of the Health and Safety Code is amended to read:

41958. To the maximum extent practicable, the rules and regulations adopted pursuant to Sections 41956 and 41957 shall allow flexibility in the design of gasoline vapor control systems and their components. The rules and regulations shall set forth the performance standards as to safety and measurement accuracy and the minimum procedures to be followed in testing the system or component for compliance with the performance standards.

The State Fire Marshal, the Division of Industrial Safety, and the Division of Measurement Standards shall certify any system or component which complies with their adopted rules and regulations. Any one of the state agencies may certify a system or component on the basis of results of tests performed by any entity retained by the manufacturer of the system or component or by the state agency. The requirements for the certification of a system or component shall not require that it be tested, approved, or listed by any private entity, except that certification testing regarding recirculation of gasoline shall include testing by an independent testing laboratory.

SEC. 5. Section 41960.1 is added to the Health and Safety Code, to read:

41960.1. (a) All vapor control systems for the control of gasoline vapors resulting from motor vehicle fueling operations shall be operated in accordance with the applicable standards established by the State Fire Marshal or the Division of Measurement Standards pursuant to Sections 41956 to 41958, inclusive.

(b) When a sealer or any authorized employee of the Division of Measurement Standards determines, on the basis of applicable test procedures of the division, adopted after public hearing, that an individual system or component for the control of gasoline vapors resulting from motor vehicle fueling operations does not meet the applicable standards established by the Division of Measurement Standards, he or she shall take the appropriate action specified in Section 12506 of the Business and Professions Code.

(c) When a deputy State Fire Marshal or any authorized employee of a fire district or local or regional firefighting agency determines that a component of a system for the control of gasoline vapors resulting from motor vehicle fueling operations does not meet the applicable standards established by the State Fire Marshal, he or she shall mark the component "out of order." No person shall use or permit the use of the component until the component has been repaired, replaced, or adjusted, as necessary, and either the component has been inspected by a representative of the agency employing the person originally marking the component, or the person using or permitting use of the component has been expressly authorized by the agency to use the component pending reinspection.

SEC. 6. Section 41960.2 is added to the Health and Safety Code, to read:

41960.2. (a) All installed systems for the control of gasoline vapors resulting from motor vehicle fueling operations shall be maintained in good working order in accordance with the manufacturer's specifications of the system certified pursuant to Section 41954.

(b) The state board shall identify equipment defects in systems for the control of gasoline vapors resulting from motor vehicle fueling operations which substantially impair the effectiveness of the systems in reducing air contaminants.

(c) When a district determines that a component contains a defect specified pursuant to subdivision (b), the district shall mark the component "Out of Order". No person shall use or permit the use of the component until the component has been repaired, replaced, or adjusted, as necessary, and the district has reinspected the component or has authorized use of the component pending reinspection.

(d) Where a district determines that a component is not in good working order but does not contain a defect specified pursuant to subdivision (b), the district shall provide the operator with a notice specifying the basis on which the component is not in good working order. If, within seven days, the operator provides the district with adequate evidence that the component is in good working order, the operator shall not be subject to liability under this division.

SEC. 7. Section 41960.3 is added to the Health and Safety Code, to read:

41960.3. (a) Each district which requires the installation of systems for the control of gasoline vapors resulting from motor vehicle fueling operations shall establish a toll free telephone number for use by the public in reporting problems experienced with the systems. Districts within an air basin or adjacent air basin may enter into a cooperative program to implement this requirement. All complaints received by a district shall be recorded on a standardized form which shall be established by the state board, in consultation with districts, the State Fire Marshal, and the Division of Measurement Standards.

The operating instructions required by Section 41960.4 shall be posted at all service stations at which systems for the control of gasoline vapors resulting from motor vehicle fueling operations are installed and shall include a prominent display of the toll free telephone number for complaints in the district in which the station is located.

(b) Upon receipt of each complaint, the district shall diligently either investigate the complaint or refer the complaint for investigation by the state or local agency which properly has jurisdiction over the primary subject of the complaint. When the investigation has been completed, the investigating agency shall take such remedial action as is appropriate and shall advise the complainant of the findings and disposition of the investigation. A copy of the complaint and response to the complaint shall be forwarded to the state board.

(c) On or before January 1, 1983, the state board shall file a report with the Legislature which shall be referred to the appropriate committees, as determined by the Speaker of the Assembly or the President Pro Tempore of the Senate. The report shall contain the number and type of complaints, actions taken in response to the complaints, and a description of the processing of the complaints. The report shall also contain recommendations of the state board, based on its review of the complaints and their dispositions, of any additional actions which could be taken by the Legislature, or a state or local agency having jurisdiction over aspects of gasoline vapor recovery to eliminate problems identified by complainants.

This section shall remain in effect only until January 1, 1987, and as of such date is repealed, unless a later enacted statute, which is chaptered before January 1, 1987, deletes or extends such date.

SEC. 8. Section 41960.4 is added to the Health and Safety Code, to read:

41960.4. The operator of each service station utilizing a system for the control of gasoline vapors resulting from motor vehicle fueling operations shall conspicuously post operating instructions for the system in the gasoline dispensing area. The instructions shall clearly describe how to fuel vehicles correctly with vapor recovery nozzles utilized at the station and shall include a warning that repeated attempts to continue dispensing, after the system having indicated that the vehicle fuel tank is full, may result in spillage or recirculation of gasoline.

SEC. 9. Notwithstanding Section 6 of Article XIII B of the California Constitution and Section 2231 or 2234 of the Revenue and Taxation Code, no appropriation is made by this act for the purpose of making reimbursement pursuant to these sections. It is recognized, however, that a local agency or school district may pursue any remedies to obtain reimbursement available to it under Chapter 3 (commencing with Section 2201) of Part 4 of Division 1 of that code.

SEC. 10. This act is an urgency statute necessary for the immediate preservation of the public peace, health, or safety within the meaning of Article IV of the Constitution and shall go into immediate effect. The facts constituting the necessity are:

In order to make needed changes in gasoline vapor recovery system regulations, it is necessary that this act take effect immediately.

APPENDIX B

DISTRICT OF COLUMBIA - REGULATION FOR THE CONTROL OF EVAPORATIVE LOSSES FROM THE FILLING OF VEHICULAR FUEL TANKS

"(d) Control of Evaporative Losses from the Filling of Vehicular Fuel Tanks:

"(1)(A) No person shall cause, suffer, or allow the transfer of gasoline to any vehicular fuel tank from any stationary storage container unless the transfer is made through a fill nozzle designed, operated and maintained to:

"(i) Prevent the discharge of gasoline vapors to the atmosphere from either the vehicle filler neck or the fill nozzle.

"(ii) Direct the displaced vapor from the vehicular fuel tank to a system wherein at least 90 percent by weight of the organic compounds in the displaced vapors are recovered or destroyed.

"(iii) Prevent vehicular fuel tank overfills and spillage.

"(B) A vapor-balance system meeting the specifications set forth in subsection (d)(2) and used in compliance with subsection (d)(3) of this section shall be deemed to be in compliance with the requirements set forth in subsection (d)(1)(A) of this section.

"(2) A vapor balance system shall have the following:

"(A) A vapor-tight vapor return hose to conduct the vapors displaced from the vehicular fuel tank to the gasoline dispensing facility's gasoline storage tank(s).

"(B) A vapor-tight seal to prevent the escape of gasoline vapors into the atmosphere from the interface between the fill nozzle and the filler neck of the vehicular fuel tank.

"(C) On and after October 1, 1982, or on and after the date a fill nozzle is removed from service for repair and/or replacement and/or rebuilding, or on and after the date a new fill nozzle is brought into service, whichever date is earlier:

"(i) the fill nozzle shall have a built-in no-seal no-flow feature designed to prevent the discharge of gasoline from the nozzle unless the seal described in paragraph (2)(B) above, is engaged;

"(ii) the fill nozzle shall have a built-in feature designed to automatically shut-off the flow of gasoline when the pressure in the vehicular fuel tank exceeds 10 inches of water gauge; and

"(iii) the vapor return line shall be equipped with a device that will automatically shut-off the flow of gasoline through the fill nozzle when gasoline circulates back from the fill nozzle through the vapor hose to the facility's gasoline storage tank.

"(D) On and after October 1, 1982, or on and after the date a new gasoline dispensing system is brought into service, whichever date is earlier:

"(i) the vapor return hose shall be no longer than 9 feet in length unless the hose is attached to a device designed to keep the hose out of the way of vehicles (when the nozzle is not in use) and to drain the hose of any collected or condensed gasoline; and

(ii) the gasoline dispensing system shall be equipped with a device designed to prevent the dispensing of gasoline at any rate greater than 8 gallons per minute.

"(E) Until December 1, 1981, the Mayor is authorized to grant any person a waiver from the deadlines contained in clauses (C) and (D) of this paragraph: Provided, That the person granted such waiver enters into a legally binding agreement with the Mayor providing for:

"(i) compliance no later than July 1, 1982, with respect to all gasoline dispensing facilities under his control; and

"(ii) a schedule for phasing in such compliance.

"(3) No person shall cause, suffer, or allow the use by any person of a fill nozzle which is a part of the vapor-balance system unless the system is maintained in good repair, and unless proper operating practices, including, but not limited to the following practices are followed:

"(A) Draining the vapor return hose as often as is necessary, but at least once each operating day, of any collected or condensed gasoline.

"(B) Waiting as long as is necessary, but at least ten seconds after the shut-off of the fuel, before disconnecting the nozzle from the fill neck, in order to balance the pressure between the vehicular fuel tank and the facility's gasoline storage tank.

"(C) After each fuel delivery, placing the vapor return hose on an area where vehicles will not ride over the vapor return hose.

"(4) If it is demonstrated to the satisfaction of the Mayor, that it is impractical to comply with the provisions of subsection (d)(1) of this section, as a result of the vehicle fill neck configuration, location, or other design features of a class of vehicles, the provisions of this section shall not apply to such vehicles. However, in no case shall such configuration exempt any gasoline dispensing facility from installing and using in the most effective manner, a system required by subsection (d)(1) of this section.

"(5) No person shall cause, suffer, or allow the transfer of gasoline to any vehicular fuel tank from any stationary storage tank, unless the transfer is made through a fill nozzle designed to automatically shut-off the transfer of gasoline when the vehicular fuel tank is full or nearly full.

"(6) No person shall cause, suffer, or allow any additional transfer of gasoline to any vehicular fuel tank from a stationary storage tank after the dispensing system has automatically shut-off the transfer of gasoline by virtue of the vehicular fuel tank being full or nearly full.

"(7) The operator of a gasoline dispensing facility shall take such actions as may be necessary to insure that all parts of the system used at the facility for compliance with this subsection (d) are maintained in good repair, and to insure that any person, whether attendant, customer, or other, who uses the facility, does so in accordance with proper operating practices and otherwise in compliance with the requirements of this subsection (d). For purposes of this subsection (d), "operator" means any person who leases, operates, manages, supervises, or controls, directly or indirectly, a gasoline dispensing facility.";

APPENDIX C

STATE OF CALIFORNIA AIR RESOURCES BOARD - CERTIFICATION PROCEDURES FOR GASOLINE VAPOR RECOVERY SYSTEMS AT SERVICE STATIONS

TABLE OF CONTENTS

METHOD 2-2

State of California

AIR RESOURCES BOARD

Certification Procedures for Gasoline Vapor Recovery Systems at Service Stations

Adopted: March 30, 1976

Amended: August 25, 1977

Amended: December 4, 1981

Note: *To assist the user, the most recent amendments to these procedures are set forth in italics.*

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State of California

AIR RESOURCES BOARD

Certification Procedures for Gasoline Vapor Recovery Systems at Service Stations

I. General Applicability

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

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

II. Definitions

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

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

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

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

E. Automatic Nozzle - ~~A nozzle which will dispense fuel without being hand held.~~ *A hose nozzle valve provided with automatic closing features to safeguard its use.*

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

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

Where t_s = System Time, Hours

t_d = System Down-Time, Hours

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

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

I. Spitback - A loss of more than one milliliter of liquid gasoline occurring during the dispensing of gasoline into the vehicle fuel tank.

J. Spillage - A loss of more than one milliliter of liquid gasoline from the gasoline nozzle occurring as a result of preparing to fuel a vehicle or at the end of a fueling operation in returning the nozzle to the dispenser.

III. General Standards

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

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

IV. Performance Standards

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

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

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

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

D. *No more than ten spitbacks or twenty instances of spillage per 100 vehicle fuelings shall occur during the testing in accordance with the procedures in Section 3.0 of the "Test Procedures for Determining the Efficiency of Gasoline Vapor Recovery Systems at Service Stations" as incorporated in Title 17, Section 94000 of the California Administrative Code. In addition, the Executive Officer shall certify only those systems which he or she determines: (i) will not increase the quantity of liquid lost through spitback or spillage over that quantity typical of non-vapor recovery systems, (ii) can be expected to perform with such durability and reliability that excessive spitbacks or spillage will not be caused by failure of critical system components, and (iii) incorporate provisions to prevent a buildup, during fueling of the vehicle, of pressure in the vehicle fuel tank sufficient to cause forceful ejection of gasoline. This determination shall be based on data obtained during the testing in accordance with Section 3 of the Test Procedures referred to above, failure mode testing, evaluation of reliability and durability of the system, and such other performance testing as the Executive Officer deems necessary.*

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

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

G. -F. Prior to certification of the system, the manufacturer of the system shall submit the system to the California Occupational Safety and Health Administration (Cal OSHA) for determining compliance with appropriate safety regulations.

This may be conducted concurrently with certification testing by the Air Resources Board. Compliance with Cal OSHA requirements shall be a precondition to certification by the Air Resources Board.

V. General Requirements Applicable to Certification of all Control Systems

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

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

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

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

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

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

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

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

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

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

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

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

F. Whenever these Certification Procedures are amended to include additional performance standards or other requirements for certification of systems, any system which is certified as of the effective date of the additional standards or requirements shall remain certified for a period of six months from such date, or until the Executive Officer has determined whether the system conforms to the additional standards or requirements, whichever occurs first. However, if during this period the system manufacturer does not comply with such conditions as the Executive Officer deems necessary to *assure prompt evaluation of the system pursuant to the additional standards or requirements, the Executive Officer may revoke the prior certification.*

In determining whether a previously certified system conforms with any additional performance standards or other requirements adopted subsequent to certification of the system, the Executive Officer may consider any appropriate data obtained in the previous certification testing or evaluation of the system in lieu of new testing or evaluation.

VI. Application for Certification

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

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

1. A detailed description of the configuration of the vapor recovery system including but not limited to the following:
   a. The underground piping configuration and specifications (pipe sizes, lengths, fittings, material(s), etc.);
   b. Gasoline dispensing nozzle to be used for Phase II;

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

d. Allowable pressure drops through the system.

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

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

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

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

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

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

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

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

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

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

VII. Fees and Testing

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

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

VIII. Certification

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

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

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

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

METHOD 2-1

State of California

AIR RESOURCES BOARD

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

Adopted: December 9, 1975

Amended: March 30, 1976

Amended: December 4, 1981

Note: To assist the user, the most recent amendments to these procedures are set forth in italics. Revisions have been made to Section 1. Introduction only. The remaining sections of the test procedures are unchanged.

State of California

AIR RESOURCES BOARD

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

1. Introduction

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

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

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

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

The sample of vehicles to be used for testing control systems shall be comprised of vehicles representative of the on-the-road vehicle population in terms of vehicle miles travelled. ~~During the vehicle test, no more than ten spitbacks will be allowed per 100 vehicles tested, a spitback being a forceful ejection of liquid gasoline occuring during the actual fueling operation with the amount of liquid lost greater than a few milliliters. Any systems which the Executive Officer determines increases the quantity of liquid lost through spitback or spillage over that quantity typical of non-vapor recovery systems will be disapproved.~~

The test will be conducted during the normal operation of the service station. For vehicle fueling at a self-service station, the customers shall fuel the vehicles; at a full-service station, the service station attendant shall fuel the vehicles during the test period. No more than 30 days prior to the 100 vehicle efficiency test, the entire vapor recovery system is to be tested for leaks in accordance with the criteria specified in Title 19 Chapter 1 Subchapter 11.5 Section 1918.35 (j) and 1918.56 (j), in the State Fire Marshal's regulations, in addition the total ullage space shall not be more than

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

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

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

2.1 Principle and Applicability

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

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

2.2 Apparatus

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

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

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

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

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

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

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

(h) Explosimeter

(i) Barometer

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

(k) Thermometer

* The use of the word thermocouple is to imply temperature sensing device throughout this procedure.

♦ The use of the word manometer is to imply pressure sensing device throughout this procedure.

2.3 Procedure

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

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

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

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

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

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

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

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

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

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

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

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

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

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

(o) Record volume of gasoline that is delivered.

(p) Record final reading of gas meter.

2.4 Calculations

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

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

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

P_b = Barometric Pressure, in. Hg.

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

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

i . = The vent under consideration

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

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

Where:

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

G_t = Volume of gasoline delivered, gal.

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

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

P_b = Barometric pressure, in. Hg.

0.1337 = Conversion factor gallons to Ft^3.

(c) Collection efficiency

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

Where E is the efficiency of control in percent.

V_t = Form (b) above

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

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

V_{vsi} = From (a) above.

3. Vehicle Fueling Test Procedure

3.1 Principle and Applicability

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

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

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

3.2.1 Apparatus

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

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

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

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

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

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

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

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

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

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

(j) Two pressure transducers ($\pm$ .5 psi) with recorder.

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

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

(l) Barometer.

(m) Thermometer.

(n) Explosimeter.

(o) Containers for RVP samples.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3.2.3 Calculations

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

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

Where:

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

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

P_b = Average barometric pressure, in. Hg.

ΔH_r = Average manometer pressure, in. H_2O.

T_r = Average temperature in the nozzle vapor line, ^oR taken at meter inlet.

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

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

Where:

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

C_r = Average fractional concentration of hydrocarbons, decimal fraction.

V_{rs} = From (a) above.

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

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

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

Where:

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

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

P_b = Average barometric pressure, in. Hg.

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

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

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

Where:

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

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

V_{as} = From (c) above.

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

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

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

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

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

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

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

Where:

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

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

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

i = Individual fueling.

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

(f) Efficiency of fueling control system.

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

Where:

E_r = Efficiency of vehicle fueling control system, percent.

W_r = From (b) above.

W_a = From (d) above.

W_x = From (e) above.

i = Individual fueling.

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

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

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

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

3.3 Calibrations

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

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

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

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

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

3.4 Acceptance of Systems

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

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

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

(b) The method of calculating the pressure drop.

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

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

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

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

(g) Allowable delivery rates.

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

3.5 Test Sample

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

3.6 Test Procedures for Determining Incinerator Emissions

3.6.1 Principle and Applicability

3.6.1.1 Hydrocarbon and carbon dioxide concentrations in the exhaust gases, and gas volume and HC concentrations in the inlet vapor, and ambient CO_2 concentrations are measured. These values are used to calculate the incinerator HC control efficiency and mass emission rate based on a carbon balance.

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

3.6.2 Test Scope and Conditions

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

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

3.6.3 Test Equipment

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

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

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

3.6.3.4 Other equipment is specified in Section 3.2.11

3.6.4 Test Procedure

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

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

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

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

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

3.6.5 Calculations:

3.6.5.1 Symbols

CO_2	=	Carbon dioxide concentration in the exhaust gas (ppmv).
CO_{2a}	=	Average carbon dioxide concentration in the ambient air (ppmv)
HC_i	=	Hydrocarbon concentration in the inlet gas to the burner (ppmv as propane)
HC_e	=	Hydrocarbon concentration in the exhaust (ppmv as propane).
L_d	=	Gasoline liquid volume dispensed during test period (gallons).
P_i	=	Static pressure at inlet meter (in H_g).
T_i	=	Temperature of gas at inlet meter (^oF).

V_i = Inlet gas volume (ft^3)

F = Dilution Factor

$51.6x10^{-6}$ = Correction factor for grams of hydrocarbon per gas volume parts per million propane ($\frac{g}{(SCF)\,(ppmv)}$)

3 = Number of carbon atoms per propane molecule.

3.6.5.2(a) Calculate the standard total gas volume (V_s) at the burner inlet for each test. (Standard temperature 60^{0}F, standard pressure 29.92 in Hg)

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

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

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

(c) A carbon dilution factor, F, can be calculated for the incinerator using the inlet and outlet CO_2 concentrations, the inlet and outlet HC concentrations and the ambient CO_2 concentration. The important criterion for this calculation is that all the significant carbon sources be measured. The values used in the calculation should reoresent 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 $(m/L)_1$, values be calculated for each period in question. $F = \frac{HC_i}{HC_e + \frac{CO_{2e} - CO_{2a}}{3}}$ ---(3)

(d) The mass emission rate $(m/L)_e$ is calculated using the inlet $(m/L)_i$ from equation (3) and the carbon dilution factor from equation (4) The exhaust HC concentration will vary with time and operation of the system. It is likely that, in addition to an overall average mass emission rate using an average HC_i, several peak values of $(m/L)_e$ will be required as discussed above. If some correlations between HC_i and HC_e occurs over the burning cycle of the system, this calculation should be used to show the change in mass emission rate. $(m/L)_e = F \left(\frac{HC_e}{HC_i}\right) (m/L)_i$ (g/gal) (5)

(e) Mass control efficiency (%/E) can be calculated for an average value over each test interval. It represents the reduction of hydrocarbon mass achieved by the incinerator system and this efficiency can vary depending on the loading cycle or the inlet loading. $\%E = 100 \left[1 - (F) \frac{(HC_e)}{(HC_i)}\right]$ (6)

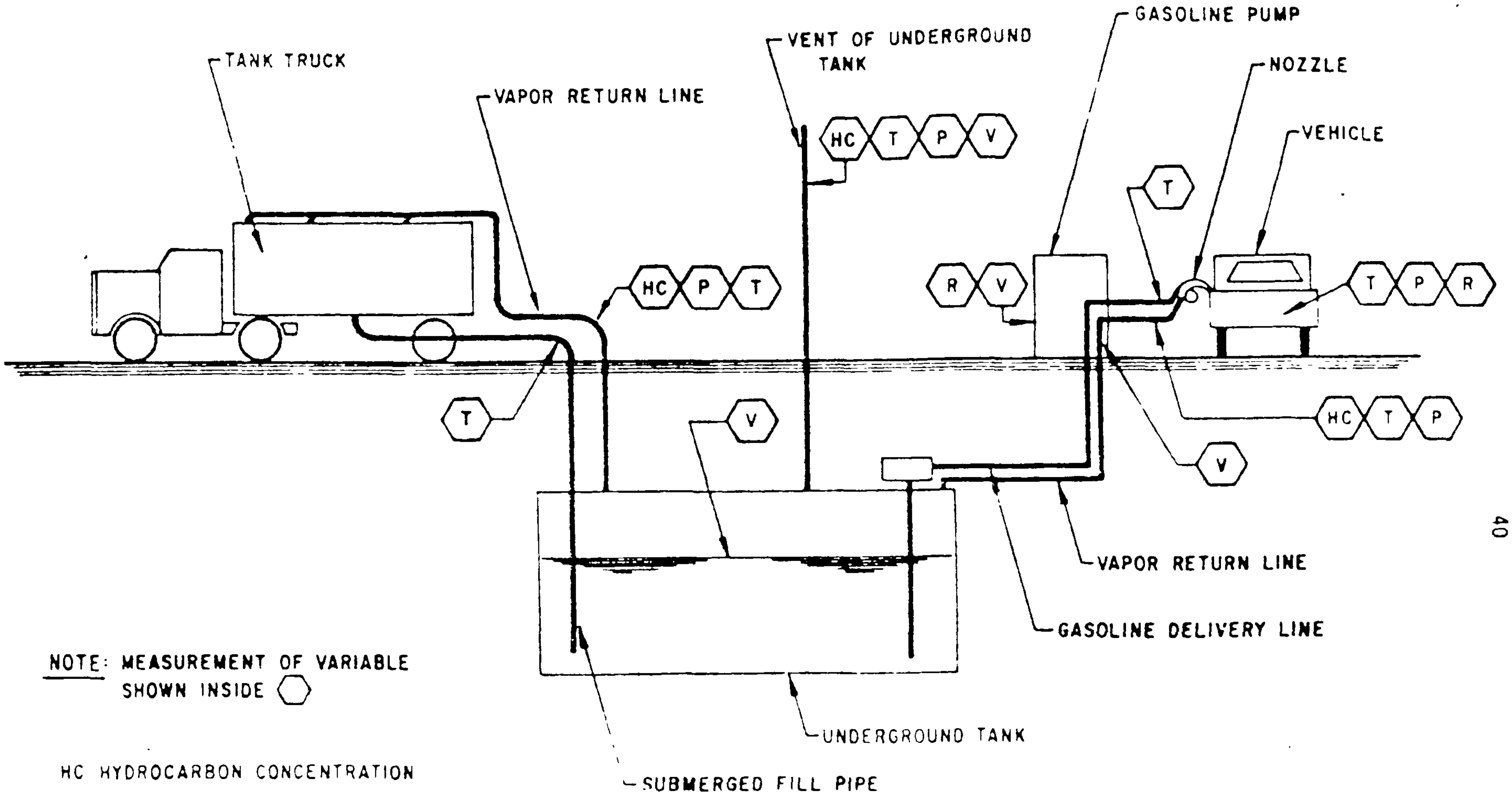
3.6.6 Calibrations

3.6.6.1 Total Hydrocarbon Analyzers: Flame ionization detectors or equivalent total hydrocarbon analyzers are acceptable

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

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

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



NOTE: MEASUREMENT OF VARIABLE SHOWN INSIDE ⬡

HC HYDROCARBON CONCENTRATION

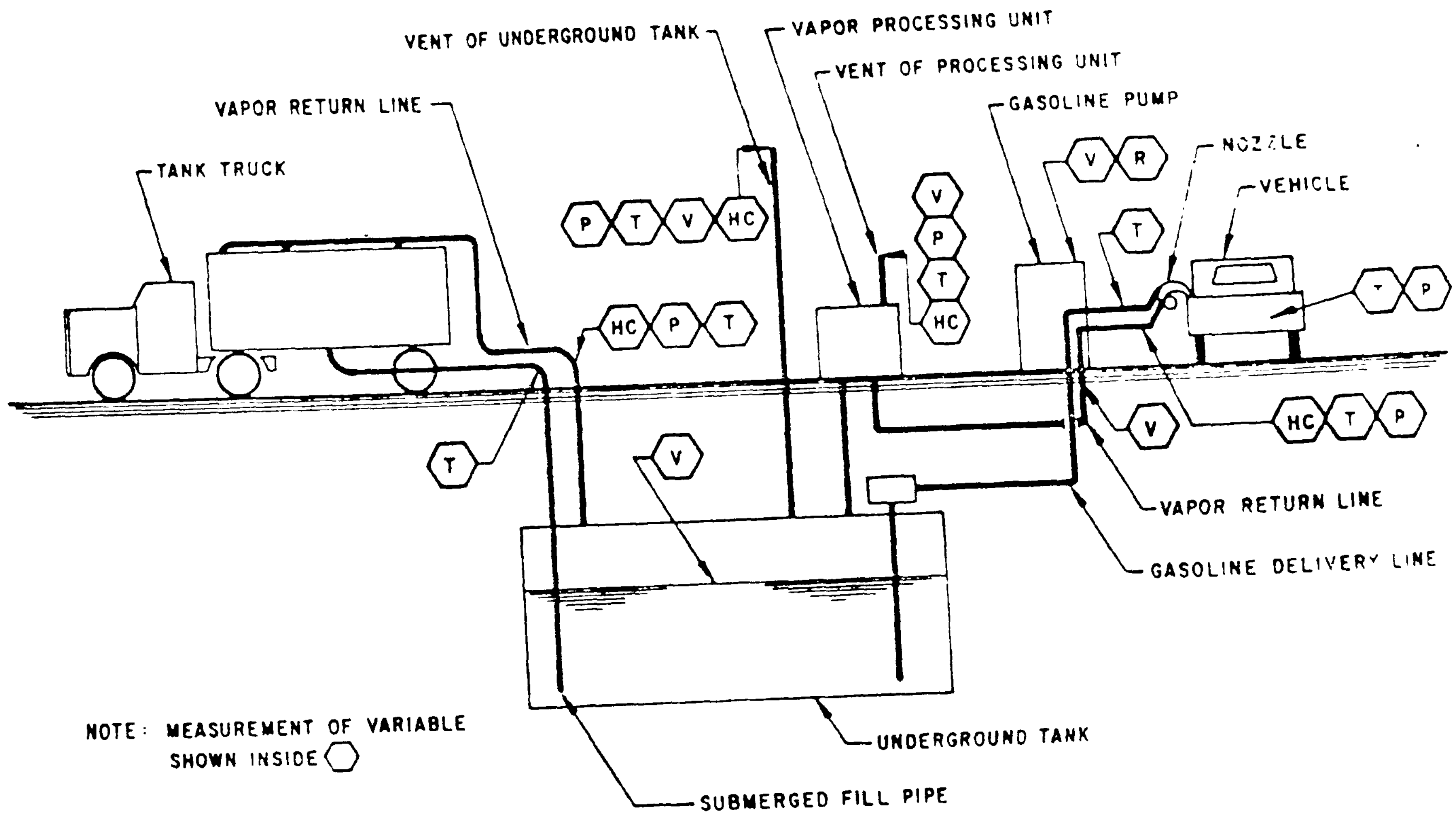
P PRESSURE

R REID VAPOR PRESSURE

T TEMPERATURE

V VOLUME

FIGURE I DISPLACEMENT SYSTEM



NOTE: MEASUREMENT OF VARIABLE SHOWN INSIDE ⬡

HC = HYDROCARBON CONCENTRATION

P = PRESSURE

R = REID VAPOR PRESSURE

T = TEMPERATURE

V = VOLUME

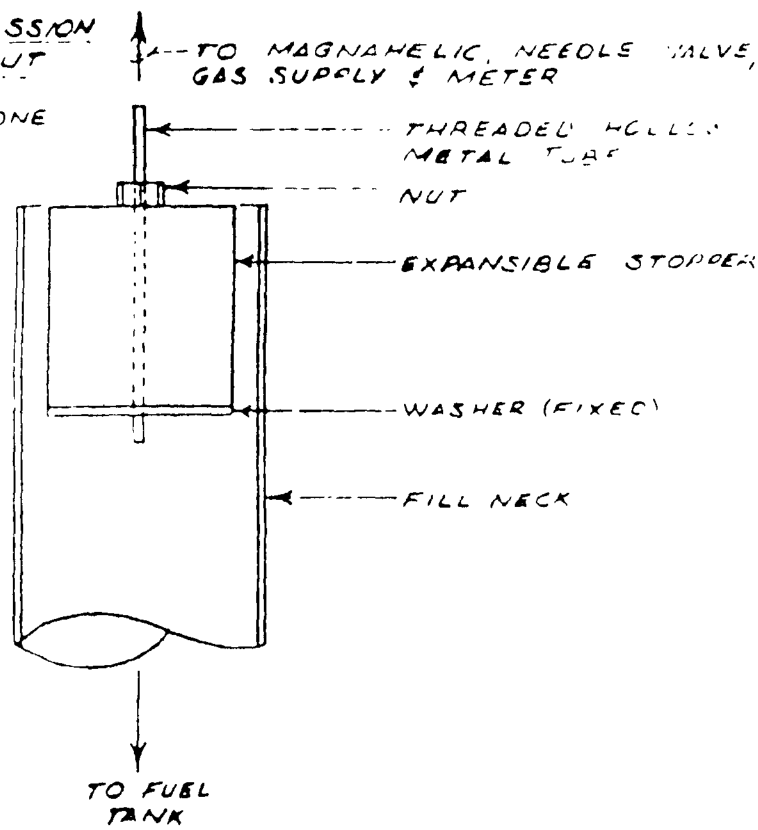
FIGURE II VACUUM ASSISTED SECONDARY

FIGURE 3

PRE-FUELING LEAK CHECK DEVICE

1. BEFORE COMPRESSION TIGHTENING OF NUT

SCALE — NONE



2. AFTER COMPRESSION TIGHTENING OF NUT

SCALE — NONE

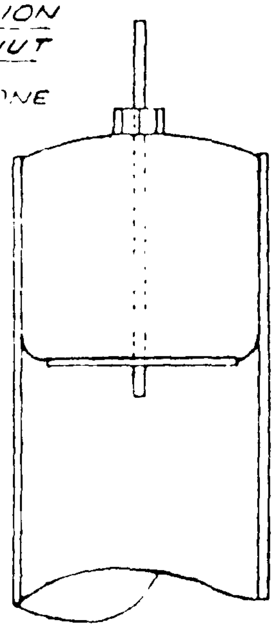


TABLE I

Test Sample for Determining the Efficiency of Phase Two Systems by Model Year, Vehicle Miles Travelled and Manufacturer

Model Year	Percent Distribution by VMT	Automobile Manufactured: General Motors	Ford Motor Company	Chrysler Corporation	American Motors Corporation	Imports
Pre 1970	12	5	3	2	0	2
1970	5	2	1	1	0	1
1971	7	2	2	1	0	2
1972	9	3	2	1	0	3
1973	10	4	3	1	0	3
1974	12	4	3	1	0	3
1975	15	5	4	1	1	5
1976	17	5	4	2	1	5
1977	12	4	2	1	0	5
1978	1	0	0	0	0	0

October 1977

APPENDIX D

SOUTH COAST AIR QUALITY MANAGEMENT DISTRICT RULE NO. 461

RULE 461 - GASOLINE TRANSFER AND DISPENSING (Amended January 16,1981)

(a) Gasoline Transfer Into Stationary Storage Containers (Phase I) A person shall not transfer, or permit the transfer or provide equipment for the transfer of gasoline from any tank truck, trailer or railroad tank car into any stationary storage container with a capacity of more than 950 liters (251 gallons) unless the transfer is made to a storage container equipped as required in Rule 463(a) or unless all of the following conditions are met:
   (1) such container is equipped with a permanent submerged fill pipe, and
   (2) such container is equipped with a "CARB certified" vapor recovery system, and
   (3) all vapor return lines are connected between the tank truck, trailer or railroad tank car and the stationary storage container, and
   (4) the vapor recovery system is operating in accordance with the manufacturer's specifications and the delivery vehicle is maintained in a vapor-tight condition, in accordance with Rule 462(c).

(b) Gasoline Transfer Into Vehicle Fuel Tanks (Phase II) A person shall not transfer, permit the transfer or provide equipment for the transfer of gasoline from a stationary storage container subject to the provisions of paragraph (a), or from a storage container to which gasoline has been transferred from another container subject to the provisions of paragraph (a), into any motor vehicle fuel tank of greater than 19 liters (5 gallons) capacity unless:
   (1) the dispensing unit used to transfer the gasoline from the stationary storage container to the motor vehicle fuel tank is equipped with a "CARB certified" vapor recovery system, and
   (2) the vapor recovery system is operating in accordance with the manufacturer's specifications.

(c) Additional Requirements
   (1) Vapor recovery or vapor processing systems used to comply with the provisions of this rule shall comply with all safety, fire, weights and measures, and other applicable codes or regulations.
   (2) Vapor recovery systems required under paragraph (a) or paragraph (b) shall at all times be maintained in accordance with the manufacturer's specifications and the CARB certification. In the event that the vapor recovery system is not capable of being operated in accordance with the manufacturer's specifications or CARB certification the following appropriate action shall be taken:
      (A) For a breakdown (as defined in Rules 102 and 430) of the central vapor incineration or processing unit, all the provisions of Rule 430 governing breakdown procedures, reporting requirements and operational limitations shall apply.
      (B) For problems associated with any vapor recovery, storage, or dispensing equipment, other than a breakdown of the central vapor incineration or processing unit, provisions of Rule 430 (b) and (d) shall apply.

As applied to gasoline transfer and dispensing operations, the term "end of cycle" shall refer to the close of business on the date the breakdown occurs.

(3) A person shall not perform or permit the "pump-out" (bulk transfer) of gasoline from a storage container subject to paragraph (a) unless such bulk transfer is performed in the manner prescribed for a Class V facility under Rule 462 (vapor balancing), except that vapor balance is not required where the container is to be removed or filled with water for testing.

(4) Where any stationary storage container or dispensing equipment was exempt from the provisions of paragraph (a) or paragraph (b) of this rule prior to January 16, 1981, but is now required to comply with paragraph (a) or paragraph (b), the owner/operator of such container shall achieve compliance in accordance with the schedule set forth in paragraph (e).

(5) A person shall not store, or allow the storage of, gasoline in any stationary storage container with a capacity of more than 950 liters (251 gallons) unless such container:

(A) complies with Rule 463(a); or

(B) is equipped with a permanent submerged fill pipe and a "CARB certified" vapor recovery system.

(d) Exemptions

The provisions of this rule shall not apply to the transfer of gasoline:

(1) Into or from any stationary container having a capacity of 1,080 liters (550 gallons) or less, installed for gasoline storage prior to March 1, 1977.

(2) Into or from any stationary container having a capacity of 7,570 liters (2,000 gallons) or less which:

(A) was installed for gasoline storage prior to March 5, 1975, and

(B) is equipped with a permanent submerged fill pipe, and

(C) is not part of a facility which has any storage container subject to paragraph (a) of this rule.

(3) Into any underground storage container installed prior to March 5, 1975, where the fill line between the fill connection and container is offset, as defined in subparagraph (f)(7), or where the top of the container is 3.7 meters (12 feet) or more below ground level.

(4) Into or from any stationary container which is used primarily for the fueling of implements of husbandry, as such vehicles are defined in Division 16 (Section 36000, et seq.) of the California Vehicle Code, if such container is equipped with a submerged fill pipe. As used in this subparagraph (d)(4), "primarily" shall mean more than 75% of the monthly throughput from the container or dispenser.

(5) Into or from any stationary container used exclusively for fueling agricultural wind machines.

(6) Into any stationary container installed or under construction prior to January 9, 1976, which is exclusively receiving gasoline from any loading facility which is a Class IV facility under Rule 462, if such container is equipped with a permanent submerged fill pipe.

(7) From any mobile container used exclusively for refueling of vehicles or aircraft, and from any vehicle fueling hydrant system which was in operation prior to January 5, 1979.

(8) Into motor vehicles from any gasoline dispensing facility in existence prior to March 5, 1975, which is located in a structure where and the bottom of the dispensers is at a lower elevation than the top of the gasoline storage containers.

(9) Into or from any one or two stationary containers comprising a single facility which is located in Coachella Valley Area, was in operation prior to January 16, 1981, and is used exclusively for non-retail sales; provided that each container has a capacity of 3,880 liters (1,025 gallons) or less and, if greater than 2,080 liters (550 gallons), is equipped with a permanent submerged fill pipe.

(10) Into or from any stationary container located in the Joshua Tree Area or the Palo Verde Area, if such container is equipped with a permanent submerged fill pipe.

(e) Compliance Schedule

The owner/operator of any gasoline storage and dispensing facility subject to subparagraph (c)(4) of this rule shall comply with the rule in accordance with the following schedule:

(1) Submit : March 1, 1981
(2) Negotiate: May 1, 1981
(3) Initiate : August 1, 1981
(4) Complete : September 1, 1981
(5) Assure : October 1, 1981

(f) Definitions

For the purpose of this rule, the following definitions are included:

(1) "Gasoline vapors" means the organic compounds in the displaced vapors, including any entrained liquid gasoline.

(2) A "motor vehicle" is any self-propelled vehicle registered or which requires registration for use on the highway.

(3) A "gasoline storage and dispensing facility" means an aggregate of one or more stationary storage containers, any of which is subject to the provisons of paragraphs (a) or (b) of this rule, together with dispensers and control equipment required by the rule.

(4) For purposes of subparagraph (c)(4) and paragraph (e), an owner/operator will be considered to be any individual, corporation or organization which is obligated to pay for required vapor control systems whether through ownership, lease arrangement or other contractual obligation.

(5) A "CARB certified" vapor recovery system is any Phase I or Phase II vapor recovery system which has been certified by the California Air Resources Board as capable of recovering or processing displaced gasoline vapors to an efficiency of ninety-five (95) percent or greater.

A CARB certified "Teed" Phase I system shall also be considered to meet this definition if it was in operation prior to January 16, 1981, or is installed thereafter to comply with paragraph (c)(4) of this rule.

(6) A "submerged fill pipe" is any fill pipe, the discharge opening of which is entirely submerged when the liquid level above the bottom of the container is:
   (A) 15.2 cm. (6 inches), for containers filled from the top, or
   (B) 45.7 cm. (18 inches), for containers filled from the side.

(7) An "offset fill line" is any liquid fill line which contains one or more pipe bends, and the horizontal distance between the truck delivery connection and the storage container fill opening is 6.1 meters (20 feet) or greater.

(8) The following terms, when used in a compliance schedule mean :
   (A) "Submit" means submit to the Executive Officer a final control plan which describes at a minimum the steps that will be taken to achieve compliance with the provisions of this rule.
   (B) "Negotiate" means negotiate and sign all necessary contracts for vapor control systems, or issue orders for the purchase of component parts to accomplish the required vapor control.
   (C) "Initiate" means initiate on-site construction or installation of vapor control equipment.
   (D) "Complete" means complete on-site construction or installation of vapor control equipment.
   (E) "Assure" means assure final compliance with the provisions of this rule.