California Environmental Protection Agency

Air Resources Board

STAFF REPORT
INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING

PUBLIC HEARING TO CONSIDER ADOPTION OF A REGULATION FOR THE CERTIFICATION, PERFORMANCE STANDARD, AND TEST PROCEDURE FOR LOW PERMEATION GASOLINE DISPENSING FACILITY HOSES

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LOW PERMEATION GASOLINE DISPENSING FACILITY HOSES

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EXECUTIVE SUMMARY

The Air Resources Board (ARB) staff is proposing a regulation (Appendix A) to control reactive organic gases (ROG) emitted from gasoline dispensing facility (GDF) hoses. These hoses are used for dispensing gasoline to vehicles and equipment at GDFs. The proposed regulation would reduce gasoline permeation emissions from GDF hoses. By 2014, the proposed regulations will require that existing hoses be replaced with hoses that reduce permeation. Technology to control hose permeation well be similar to those used to control permeation emissions from small off-road engines (SORE) and portable outboard marine tanks (OMT).

If left uncontrolled, 1.5 tons per day (tpd) of gasoline vapors or ROG will be emitted from GDF hoses in California in 2014. This is equivalent to 172,000 gallons of gasoline evaporating into the air each year. Assuming $3.50 per gallon of gasoline, the amount of fuel lost through permeation has a value of $600,000 per year. The proposed regulation would reduce 2014 hose permeation emissions by 1.4 tpd of ROG, a reduction of over 90 percent. The cost effectiveness of implementing the regulation will be $1.08 per pound of ROG reduced, based on 168,000 GDF hoses being replaced at a net cost of $1.1 million.

There currently is no permeation standard for reducing emissions from GDF hoses at either the State or federal level. Staff has been working with fuel hose manufacturers, material manufacturers, the U.S. Environmental Protection Agency (U.S.EPA) and Underwriters Laboratories (UL) to develop the proposed performance standard. ARB staff proposes permeation emissions from GDF hoses to be limited to 10 grams per meter squared per day ($g/m^2/day$) when tested at a constant temperature of 38℃ (100.4℉) with test fuel (CE-10).

The proposed regulation affects GDF hoses that are part of an ARB certified vapor recovery system, pursuant to CP-201 (*Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities).* Staff is proposing an effective date for the regulation of January 1, 2010. The effective date starts the four-year-clock for all existing GDFs, not undergoing major modification of their facilities, to replace existing GDF hoses with low permeation GDF hoses by no later than January 1, 2014.

Staff is proposing an operative date of January 1, 2011. The operative date is the date on which new GDFs, or existing GDFs undergoing major modifications, are required to use ARB certified low permeation GDF hoses. The reason for the difference is to allow balance GDF hose manufacturers an extra year to develop and certify low permeation GDF hoses. It should be noted that current regulations require existing facilities to use low permeation hoses upon replacement whenever ARB determines that such hoses are compatible and commercially available.

The proposed certification process for GDF hoses uses an UL test procedure to evaluate conformance with the proposed performance standard, or as an alternative, the use of an equivalent new ARB test procedure. These are listed below:

- UL Subject 330A, *Outline for Investigation for Permeation of Hose Assemblies for Dispensing Flammable Liquids.*
- TP-201.8, *Determination of the Permeation Rate from a Gasoline Dispensing Facility Hose.*

The proposed permeation test procedures will ensure the GDF hoses meet the proposed performance standard.

ARB staff conducted three public workshops for stakeholders to address technical and policy issues. The workshops were held between November 2003 and July 2008. Also, since April 2007, staff has been working with stakeholders, including the U.S.EPA, in a UL sponsored focus group to develop the proposed permeation test procedures. This group conducted over 20 meetings. ARB staff chaired the focus group, and the meetings offered an additional forum to address stakeholder concerns. In working with the various stakeholders, ARB staff believes that the most significant issues raised by stakeholders have been resolved.

During the development of the proposed regulation, ARB staff considered the climate change impacts of ROG. ROGs can absorb infrared radiation, and the more complex a ROG, the greater its ability to absorb infrared radiation and contribute to global warming. Unlike oxides of nitrogen, ROGs generally do not initiate climate responses of the opposite sign (i.e., they are generally net warmers). However, ROGs have the added complication that there are many different types with different behavior in the atmosphere, making quantifying their warming impact difficult to predict. ROGs influence climate through indirect effects via their production of organic aerosols and their involvement in photochemistry (i.e., production of ozone, and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality). Typically, the indirect effect is the dominant path by which ROG contribute to global warming. Overall, strategies for reducing ROG emissions are beneficial from a climate change perspective. The Intergovernmental Panel on Climate Change has provided global warming potentials for a relative small set of ROG species, so it is not possible to quantify this benefit.

I INTRODUCTION AND BACKGROUND

A) Introduction

This section of the staff report summarizes the legal authority, discusses the gasoline vapor control strategy, provides an overview of gasoline dispensing facility (GDF) hoses, includes a discussion of the proposed regulation for GDF hoses, and describes the public participation process.

B) Legal Authority

1) State Law

Section 38560 of the Health and Safety Code (Appendix B) mandates that ARB adopt rules and regulations to achieve greenhouse gas emission reductions from sources or categories of sources. Section 38560.5 of the Health and Safety Code requires ARB to publish a list of discrete early action greenhouse gas emission reduction measures and to adopt regulations to implement such measures.

Section 41954 of the Health and Safety Code (Appendix B) requires ARB to adopt procedures and performance standards for controlling gasoline emissions from gasoline marketing operations, including transfer and storage operations to achieve and maintain ambient air quality standards. This section also authorizes ARB, in cooperation with air pollution control and air quality management districts (districts), to certify vapor recovery systems that meet the performance standards and specifications. Section 39607(d) of the Health and Safety Code requires ARB to adopt test procedures to determine compliance with ARB's and districts' non-vehicular standards. State law (Health and Safety Code Section 41954) requires districts to use ARB test procedures for determining compliance with performance standards and specifications established by ARB.

To comply with State law, the Board has adopted the certification and test procedures found in title 17, Code of Regulations, Sections 94110 to 94016 and 94101 to 94165. The regulations reference procedures for certifying vapor recovery systems and test procedures for verifying compliance with performance standards and specifications.

2) Federal Requirements

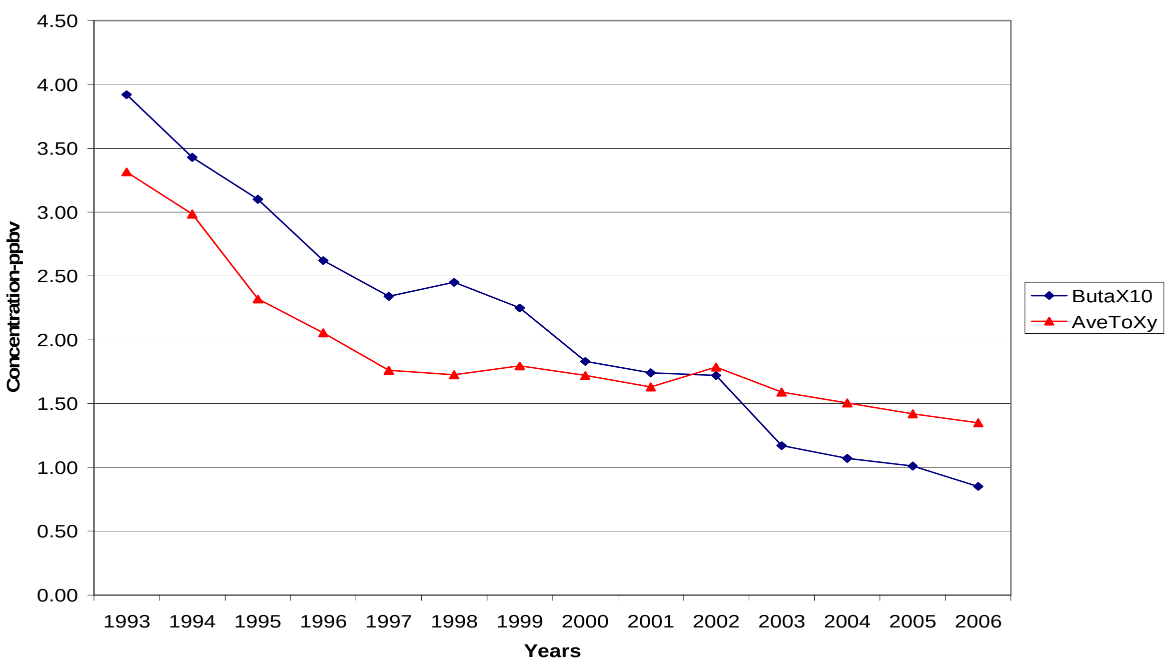
There are no comparable federal regulations that certify low permeation GDF hoses; however, changes to ARB Enhanced Vapor Recovery (EVR) certification requirements may have a national and international impact. ARB certification is required by most other states and some countries that mandate the installation of vapor recovery systems at gasoline dispensing facilities.

C) Gasoline Vapor Control Strategy

ARB has been actively engaged in the control of evaporative gasoline emissions since 1975 when the Board adopted the first certification and test procedures for vapor recovery systems installed at GDFs. Since then the Board has adopted requirements controlling evaporative gasoline emissions for other non-road emission categories such as Portable Fuel Containers (PFC), Small Off-Road Engines (SORE), Enhanced Vapor Recovery (EVR), Aboveground Storage Tanks (AST), and Outboard Marine Tanks and Components (OMT). Gasoline-fueled on-road vehicles are also required to utilize highly effective evaporative emission controls.

Evaporative emissions in California are suspected to be significant based on ambient air quality data collected by the ARB's Monitoring and Laboratory Division. Figure I – 1 shows 1,3-butadiene, generally associated with vehicular exhaust and other combustion sources, has declined approximately 80 percent over the 14 year period shown. If we add the average of two compounds, xylene and toluene, which are found in both exhaust emissions and gasoline vapors, we see a decreasing trend which closely parallels 1,3-butadiene for the first five years. However, when we look at the last nine years of ambient air quality data, it is clear that xylene and toluene are not being controlled as effectively as 1,3-butadiene. Staff believes this strongly suggests that evaporative gasoline emissions are not being controlled as effectively as are the corresponding exhaust emissions. Therefore, staff has embarked on an aggressive program to develop additional controls for evaporative gasoline emissions.

Figure I – 1, Exhaust and Evaporative Gasoline Emission Trends Based on Ambient Concentration Data



Starting in 1999, ARB adopted several regulations to further reduce emissions from evaporative sources. These regulations include PFC, EVR, SORE, AST, and OMT. These categories are shown as Completed Regulations in Table I – 1. To continue to reduce evaporative emissions, ARB staff is looking to identify additional emission source categories. These are shown as Prospective Regulations in Table I – 1. ARB staff is currently working to develop emissions inventories and regulations for these sources. These source categories will be presented to the Board for consideration in coming years.

Table I – 1, Completed and Prospective ARB Gasoline Vapor Control Regulations (excluding on-road engines)

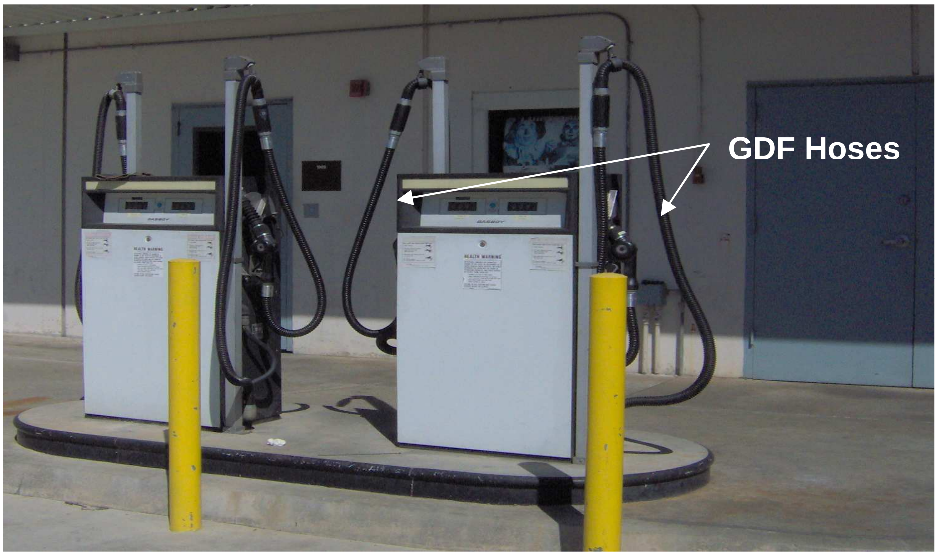
Completed and Prospective Regulations				
Name of Regulation	Adoption Yr	Implementation Yr	Uncontrolled Emissions (tpd)	Emission Reductions (tpd)
Completed Regulations				
Portable Fuel Container (PFC) Original Reg	1999	2001	101	70
Enhanced Vapor Recovery (EVR) USTs	2000	2001-2009	53	25
Small Off Road Engines (SORE)	2003	2006	58	32
PFC Amendments	2005	2007	32	18
EVR for ASTs	2006	2008	4	1–2
Portable Outboard Marine Tanks and Components (OMT)	2008	2011	5.6	4.2
Subtotal				**151**
Prospective Regulations				
GDF Hose Permeation	2008	2014	1.5	1.4
Pleasure Craft (Spark Ignited Personal Watercraft and Marine Vessels)	2009	2011	42	37
Off-Highway Recreational Vehicles (Off-Road Motorcycles./ATV)	2009	2012	13	9
RV Fueling Stations	2009	2012	tbd*	tbd*
Portable Fueling Stations	2009	2012	tbd*	tbd*
Mobile Fuelers	2010	2013	tbd*	tbd*
Truck/Trailer Auxiliary Fuel Tanks	2011	2013	tbd*	tbd*
Subtotal				**47**
Total				**198**

* tbd = to be determined

D) Low Permeation GDF Hose Overview

GDF hoses and hose assemblies are used for dispensing gasoline to automobiles and equipment at GDFs, see Figure I – 2. Depending upon the facility design, GDF hoses can range in length from approximately 8 to 18 feet and vary in size with inner diameters ranging from approximately 0.75 to 1.5 inches. Hoses are generally made from rubber or in some cases thermo plastic materials and are commonly reinforced internally with metal wires or braiding which also provide electrical conductivity for safety purposes.

Figure I – 2, GDF Hoses



Most GDF hoses used in California are part of an ARB certified vapor recovery system. Because of this, most GDF hoses used in California must be vapor recovery hoses. Vapor recovery hoses differ from conventional fuel delivery hoses in that they have two paths: one for fuel delivery and the other for return of vapor from the vehicle's gasoline tank. There are two different types of vapor recovery hoses: vacuum assist and balance. Vacuum assist hoses are similar to non-vapor recovery GDF hoses in that the liquid fuel is carried against the inside of the outer hose wall. Balance hoses are different, carrying fuel vapor against the outer hose wall (Figure I – 3).

Figure I – 3, Cutaways of Vapor Recovery GDF Hose Assemblies Showing Vapor and Liquid Paths

Gasoline vapor emissions from GDF hoses are the result of permeation of fuel and vapor through plastic or rubber materials. Staff conducted a survey of local districts that indicated there were over 168,000 GDF hoses in use at affected GDFs in California in 2007 (Appendix C).

E) Applicability of Proposed Regulation

The proposed regulation will require the use of low permeation GDF hoses at California GDFs employing Underground Storage Tanks (UST). Under the proposed regulation, ARB will issue an Executive Order, pursuant to Certification Procedure CP-201 (Appendix D) certifying a GDF hose as meeting the proposed performance standard. Compliance with the proposed performance standard will be determined in accordance with Underwriters Laboratory (UL) Subject 330A, or Test Procedure TP-201.8 (Appendix E). Other required performance specifications or standards currently required in CP-201 that are applicable to GDF hoses also apply.

F) Public Process

1) Web Site

Staff established the GDF Hose Emissions web site (http://www.arb.ca.gov/vapor/gdfhe/gdfhe.htm) providing stakeholders with information regarding the Low Permeation GDF Hose program as well as updates to the proposed regulation. Stakeholders included on the vapor recovery e-mail list server are notified whenever new information is posted. As of September 2008, there are over 2300 subscribers to this list.

2) Public Workshops

ARB staff conducted three public workshops for stakeholders to address technical and policy issues and to define regulatory development timelines. The dates and locations of the workshops are listed in Table I – 2. Interested stakeholders participated in the workshops in person or via conference call. Workshop presentations and associated documents were posted on the web site prior to the workshop dates.

Table I – 2, Public Workshops

DATE	LOCATION
November 13, 2003	Sacramento
September 28, 2006	Sacramento
July 2, 2008	Sacramento

3) Participation in UL Standards Development Process for the Creation of a Permeation Test Procedure for GDF Hoses

ARB staff has been working with stakeholders and UL toward the development of a permeation test procedure for GDF hoses. This working body is a Task Group which is chaired by ARB staff. The Task Group participants include GDF hose manufacturers, material suppliers, UL, and the U.S.EPA. The Task Group is also developing a proposal to amend UL 330 to include the permeation test procedure for low permeation GDF hoses. UL 330 is the standard for Hose and Hose Assemblies for Dispensing Flammable Liquids. Including the permeation test procedure within UL 330 will provide a standardized mechanism for certification of low permeation GDF hoses by other regulatory bodies outside of California. The Task Group began its work in April 2007 and has held more than 20 meetings. The Task Group has conducted multiple tests of low permeation GDF hoses toward the development of the permeation test procedure. These Task Group meetings have offered participating stakeholders a regular forum to offer comments and ask questions regarding ARB staff's progress on the development of the proposed regulation.

II NEED FOR GDF HOSE RULEMAKING

A) Introduction

This section of the staff report discusses the reasons and justification for the proposed regulation, including the State Implementation Plan, consistency with other State requirements, and climate change issues.

B) State Implementation Plan

All areas that are designated non-attainment for the National Ambient Air Quality Standards are required by the federal Clean Air Act to submit a State Implementation Plan (SIP) containing strategies to improve air quality and achieve the National Ambient Air Quality Standards. In 2007, ARB adopted the California comprehensive SIP for ozone. The 2007 SIP includes State measures to control evaporative emissions from a wide variety of off-road sources. In particular, the 2007 SIP proposes the establishment of a permeation standard for GDF hoses to reduce ROG emissions by 70 to 98 percent, depending on which technology is used. The percent reduction range is based on previous standards for low permeation vehicle fuel hoses and initial ARB and industry testing results. The 2007 SIP does not quantify the emission reductions for this measure because the emissions inventory for this category was under evaluation at the time.

C) Consistency with other California Regulations

Other California regulations, such as SORE and OMT, specify low permeation fuel hose performance standards. Those regulations require that the fuel delivery hoses have a permeation rate of less than 15 $g/m^2/day$ when tested at a constant temperature of 40℃ (104℉). When adjuste d for temperature, these standards are very similar to the proposed regulation which will require a permeation rate no greater than 10 $g/m^2/day$ when tested at a constant temperature of 38℃ (100.4℉).

D) Climate Change Considerations

ROGs can absorb infrared radiation, and the more complex a ROG, the greater its ability to absorb infrared radiation and contribute to global warming (Collins, 2002). Unlike oxides of nitrogen, ROGs generally do not initiate climate responses of the opposite sign (i.e., they are generally net warmers). However, ROGs have the added complication that there are many different types with different behavior in the atmosphere, making quantifying their warming impact difficult. ROGs influence climate through indirect effects via their production of organic aerosols and their involvement in photochemistry (i.e., production of ozone, and in prolonging the life of methane in the atmosphere, although the effect varies depending on local air quality). Typically, the indirect effect is the dominant path by which ROG contribute to global warming. Overall, strategies for reducing ROG emissions are beneficial from a climate change perspective. The Intergovernmental Panel on Climate Change (2007) has provided global warming potentials for a relative small set of ROG species, so it is not possible to quantify this benefit.

III SUMMARY OF PROPOSAL

A) Introduction

This section of the staff report discusses the development of the emissions inventory for GDF hoses (which constitutes the basis for the proposed performance standard), the proposed performance standard, the availability of technology to meet the proposed performance standard, and new certification and test procedures.

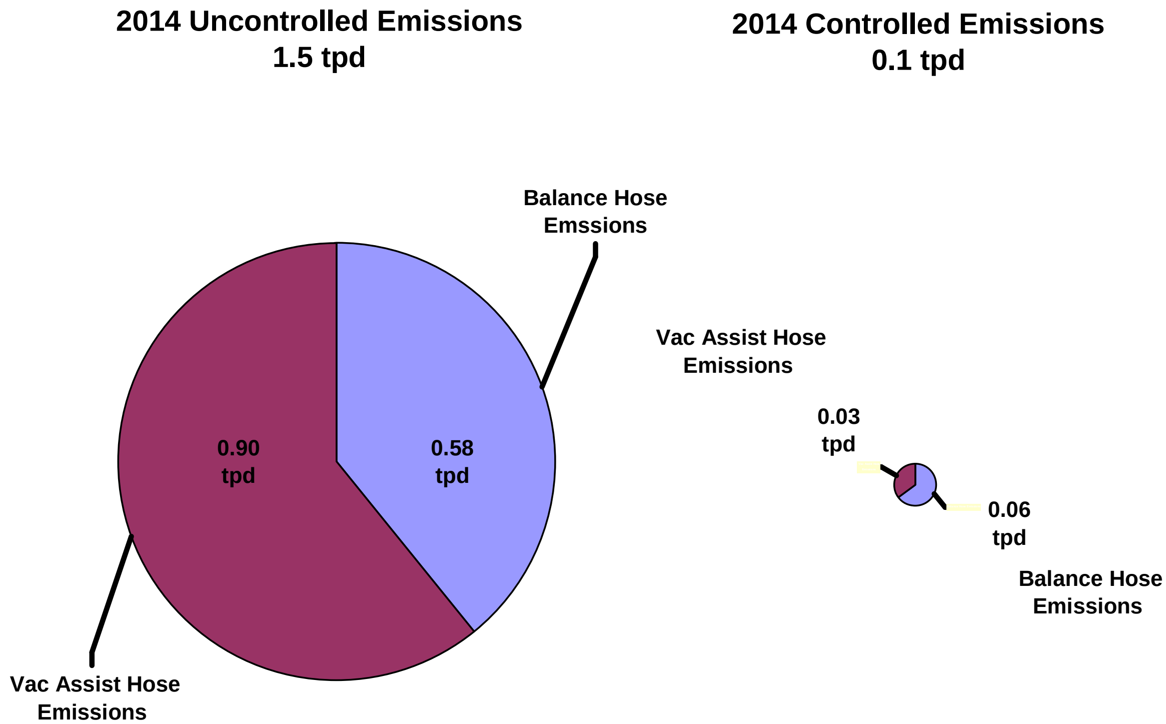
B) Emissions Inventory

Staff developed an emissions inventory for GDF hoses by applying GDF hose population data to ARB GDF hose permeation test data.

In January 2008, staff conducted a survey of districts to determine the population of vapor recovery hoses at permitted GDFs. From the survey response, staff estimates that there are approximately 173,000 vapor recovery hoses in use at permitted GDFs in California. Approximately 5,000 of these hoses are in use at GDFs employing ASTs. This proposed regulation applies only to GDF hoses at USTs therefore, approximately 168,000 hoses are affected. Based upon District permit requests, staff believes that the 2014 hose population will be evenly split between balance and vacuum assist GDF hoses at approximately 84,000 each. For further details of how staff derived these numbers, see Appendix C.

Staff conducted two separate tests to determine GDF hose gasoline permeation rates. The first test was conducted in 2004 (Appendix F) and the second test was conducted in 2008 (Appendix G). In addition, an analysis was performed in 2008 for balance GDF hoses to account for permeation due to gasoline vapor in the outer path of the hose (Appendix H). Based upon these tests and the analysis, staff estimates the uncontrolled ROG emissions for 2014 will be approximately 1.5 tpd. Staff estimates that if the proposed regulation is adopted, the controlled 2014 ROG emissions will be approximately 0.1 tpd. Figure III – 1 compares the 2014 uncontrolled emissions to the 2014 controlled emissions.

Figure III – 1, Uncontrolled Emissions vs. Controlled Emissions in 2014



C) Proposed Performance Standard

The proposed performance standard will limit emissions due to permeation from GDF hoses to 10 $g/m^2/day$ when exposed to test fuel (CE-10) at a constant temperature of 38.0℃ (100.4℉). Staff determined the proposed standard will result in emission reductions of approximately 94 percent by 2014. For vacuum assist hoses, the proposed regulation requires manufacturers of GDF hoses to use similar technologies now required in other source categories such as SORE and OMT. For balance hoses, the proposed regulation will require new product designs. The proposed implementation dates of the performance standard are as follows:

(i) Staff is proposing an effective date for the regulation of January 1, 2010. The effective date starts the four-year-clock for all existing GDFs, not undergoing major modification of their facilities, to replace existing GDF hoses with ARB certified low permeation GDF hoses by no later than January 1, 2014.

(ii) Staff is proposing an operative date of January 1, 2011. The operative date is the date on which new GDFs, or existing GDFs undergoing major modifications, are required to use ARB certified low permeation GDF hoses. The reason for the difference between effective and operative dates is to allow balance GDF hose manufacturers an extra year to develop and certify a low permeation balance GDF hose.

D) Availability of Technology

The performance standard in the proposed regulation has been developed through testing and observations of low permeation GDF hose prototypes. Through cooperative testing at UL, staff has observed low permeation GDF hoses that will meet the proposed performance standard for vacuum assist GDF hoses. Vacuum assist hoses use technology that can be transferred from other ARB regulations such as SORE and OMT. However, GDFs using balance systems require new hose designs due to different variations from conventional fuel delivery hoses. No prototype has yet been tested or observed for low permeation balance GDF hoses.

Staff has discussed the feasibility of producing low permeation balance GDF hoses with several hose manufacturers. Hose manufacturers have provided estimates on the cost to develop balance hoses to meet the proposed performance standard. Staff has determined that a low permeation balance GDF hose could be designed to meet the proposed performance standard. This is because many samples of low permeation hoses and hose materials exist and hose manufacturers have until January 1, 2011 (the proposed operative date) to certify.

E) New Certification and Test Procedure

1) Amendment of CP- 201, Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities

The certification procedure, CP-201 (Appendix D) establishes the criteria and test procedures used by ARB to evaluate and certify vapor recovery systems for use at California GDFs. Because GDF hoses are part of a vapor recovery system, staff proposes to amend CP-201 to specify the criteria and test procedures that will be used by ARB to evaluate and certify GDF hoses. Staff proposes that an Executive Order will be issued for a GDF hose that demonstrates compliance with all applicable certification requirements included in CP-201. GDF hoses must have an Executive Order to be used as part of an ARB certified vapor recovery system within California.

2) New Gasoline Dispensing Facility Hose Permeation Test Procedure

GDF hoses are different from standard fuel delivery hoses in both size and complexity. In addition to having diameters that are significantly larger

(3/4 to 1 1/2 inches) than other low permeation fuel delivery hoses (typically 1/4 to 3/8 inches), most GDF hoses used in California must be vapor recovery hoses. Vapor recovery hoses have two paths: one for fuel delivery and the other for vapor return. Due to the increased size and complexity related to these features of GDF hoses, staff developed a new test procedure to measure permeation emissions from these hoses. Specifically, ARB staff worked with UL staff and other stakeholders within a UL sponsored focus group to develop a test procedure to determine permeation emission rates from GDF hoses. Staff has also developed its own test procedure, TP-201.8 (Appendix E), which alternatively may be used to satisfy the certification testing requirements of CP-201. The alternative test procedures allow manufacturers to certify for California only or, if they choose to certify for California and other states that may adopt similar controls.

(i) UL Low Permeation Gasoline Dispensing Facility Hose Test Procedure

Staff proposes that data collected in accordance with UL Subject 330A, Outline for Investigation for Permeation of Hose Assemblies for Dispensing Flammable Liquids, may be used to satisfy low permeation certification testing requirements of CP-201. However, ARB must be made a beneficiary of the related testing data within the contract between UL and its client that is seeking ARB certification. The proposed test procedure is a bench test in which the permeation rate is determined by the rate of weight loss from a test sample throughout the test period.

(ii) TP-201.8, Determination of the Permeation Rate from a Gasoline Dispensing Facility Hose

Staff proposes that, as an alternative to UL testing, test procedure TP-201.8 (Appendix E) may be used to determine the permeation rate from GDF hoses as required in Certification Procedure CP-201. The proposed test procedure is a bench test in which the permeation rate is determined by the rate of weight loss from a test sample throughout the test period. Staff has determined that this method is equivalent to UL Subject 330A, Outline for Investigation for Permeation of Hose Assemblies for Dispensing Flammable Liquids.

IV ENVIRONMENTAL AND ECONOMIC IMPACT

A) Introduction

This section of the staff report discusses the environmental and economic impacts of the proposed regulation. The environmental impact is determined by the GDF hose population, baseline emissions and emission reductions. Economic impacts consider cost savings from preventing fuel losses due to permeation losses from hoses, staff assumptions related to the costs of complying with the proposed performance standard, and cost effectiveness. The section also includes a discussion of the fiscal impacts to the State, and a discussion of environmental justice issues.

B) Environmental Impact

1) GDF Hose Population

In January 2008, ARB staff conducted a survey of districts within California to determine the population of vapor recovery hoses at permitted GDFs. From the survey response, staff estimates that there are approximately 173,000 vapor recovery hoses in use at permitted GDFs in California. Staff estimates that approximately 168,000 of these hoses will be affected by the proposed regulation. Based upon District permit requests for GDFs to comply with the April 2009 EVR Phase II requirements, staff estimates the 2014 hose population will be evenly split between vacuum assist and balance GDF hoses, at approximately 84,000 each. For further details of how staff derived these numbers, see Appendix C.

2) Baseline Emissions

The 2014 baseline GDF vapor recovery hose emissions were developed from ARB permeation test data of GDF hoses (Appendices F and G), a District GDF vapor recovery hose population survey (Appendix C), and an analysis of vapor permeation from balance GDF hoses (Appendix H). Staff estimates there will be about 1.5 tpd of ROG emissions from GDF hoses in California in 2014 if left uncontrolled. Test data suggests the 1.5 tpd of ROG may be low (Appendix F). Staff plans to do further emissions inventory testing to determine if there are higher emission rates than those used for these estimates. Table IV – 1 summarizes the 2014 Statewide uncontrolled GDF hose emissions.

Table IV – 1, 2014 Statewide Uncontrolled GDF Hose Emissions

Emission Source	Uncontrolled Emissions (tpd)
Vacuum Assist GDF Hoses	0.90
Balance GDF Hoses	0.58
Total GDF Hose Emissions	**1.48**

3) Emission Reductions

The staff proposed regulation will reduce ROG emissions from GDF hoses by 1.4 tpd in 2014 compared to the uncontrolled emissions of 1.5 tpd. The 2014 controlled emissions are estimated to be 0.1 tpd of ROG. This is a reduction of about 94 percent. Table IV – 2 summarizes the 2014 Statewide controlled GDF hose emissions.

Table IV – 2, 2014 Statewide Controlled GDF Hose Emissions

Emission Source	Controlled Emissions (tpd)
Vacuum Assist GDF Hoses	0.03
Balance GDF Hoses	0.06
Total GDF Hose Emissions	**0.09**

C) Economic Impact

Staff expects the proposed regulation will not impose an unreasonable cost burden on retail businesses located in California. Manufacturers are located outside California and are currently providing low permeation hoses for other source categories that are compliant with similar performance standards for about half of the hose population. Staff has determined that the Statewide annual net cost of the proposed regulation for GDF owners and operators within California will be approximately $1.1 million. It is expected that this cost will be passed on to consumers. Staff has determined that this would results in a cost increase to consumers of less than 0.01 cents per gallon. Details can be found in Appendix I.

1) Compliance Costs

ARB staff surveyed GDF hose manufacturers to determine the retail cost increase per GDF hose for compliance with the proposed performance standard will be approximately $10 for vacuum assist GDF hoses and $29 for balance GDF hoses (Appendix J). Staff determined from interviews with manufacturers that GDF hoses have an average life span of approximately two years.

Staff proposes that certification testing data be collected at a UL testing facility, or at an ARB facility. If certification is conducted at an ARB facility, the procedure may cost the hose manufacturers approximately $40,000. Considering the production of several hundred thousand hoses sold over approximately a 10-year period, staff estimates the certification costs would add approximately $0.20 to the retail cost of each hose. This estimate is about two percent of manufacturer's projected GDF hose per average unit cost increase. These costs are factored into the cost effectiveness of the proposed regulation.

2) Cost Savings from Preventing Fuel Losses

Staff estimates annual fuel losses due to permeation from a GDF hose averages 1.24 gallons for a vacuum assist GDF hose, and 0.80 gallons for a balance GDF hose. At a price of $3.50 per gallon, the annual cost associated with the fuel lost is about $4.35 for a vacuum assist hose and $2.80 for a balance hose, respectively. Assuming there are 168,000 hoses In California, this amounts to more than $600,000 from lost fuel. Staff estimates that with the 94 percent reduction of emissions expected by the proposed regulation, there will be a cost savings of approximately $566,000. The methodology used to estimate the cost savings associated with these recovered losses is detailed in Appendix K.

3) Cost Effectiveness

The total annual compliance cost from the proposed regulation is estimated to be $1.10 million. This includes cost increases to GDF owners for improved low permeation GDF hoses ($1.66 million) and cost savings due to reduced gasoline loses ($566,000) as shown in Appendix K. It is anticipated that there will be no additional compliance or permitting costs to districts with respect to the proposed regulation. districts will only be verifying, during periodic inspections, that the GDF hoses have been certified by ARB.

ARB staff estimates that the proposed regulation will result in a reduction of approximately 1.01 million pounds of ROG per year. The cost effectiveness is estimated to be about $1.08 per pound of ROG reduced.

The cost effectiveness analysis (Appendix K) is based on the following items:

(i) Fuel savings based on a cost of $3.50 per gallon;

(ii) Cost of the proposed regulation which is based on the total number of GDF hoses sold; and,

(iii) Pounds of ROG reduced from the proposed performance standard over a year.

Table IV – 3 summarizes the cost effectiveness of the proposed regulation.

Table IV – 3, Cost Effectiveness of Proposed Regulation

Yearly Cost and Cost-Savings of Low Permeation GDF Hoses				
Compliance Cost	Cost Savings ($3.50/gal)	Net Cost	ROG Reduced (lbs)	Cost Effectiveness ($/lb ROG)
$1,657,742	$566,033	$1,091,709	1,012,238	$1.08

D) Fiscal Impacts

Staff does not expect the proposed regulation to impose any significant cost on implementing State government agencies. Manufacturers are located outside California and are currently providing low permeation hoses for other source categories that are compliant with similar performance standards for about half of the hose population. The staff analysis of fiscal impacts can be found in Appendix I.

1) Impacts on California Businesses

Section 11346.3 of the Government Code requires State agencies to assess the potential for adverse economic impacts on California business enterprises and individuals when proposing to adopt or amend any administrative rule. The assessment shall include a consideration of the impact of the proposed regulation on California jobs, business expansion, elimination or creation, and the ability of California business to compete.

Staff finds that there are no significant economic impacts to business within California due to the proposed performance standard or implementation schedule. Businesses potentially affected by the proposed regulation include manufacturers of GDF hoses and GDF owners. The proposed regulation will impose additional certification costs on GDF vapor recovery hose manufacturers. The potential impact on a GDF owner is an increase in the initial cost of the GDF hoses partially offset by a fuel savings over the life of the GDF hoses. The cost for an average system is $62.50. These costs and savings are discussed in the economic impact section above. The proposed regulation is not expected to have an adverse impact on the status of California businesses. Manufacturers of GDF hoses are located outside of the State and are expected to pass cost increases on to GDF owners. Both consumers and GDF owners will benefit from the fuel savings and reduced air pollution associated with reduced fuel losses. It is expected that consumers will realize about 60 percent of the direct savings and GDF owners will realize 40 percent of the savings.

2) Costs to State and Local Agencies

Section 11346.5 of the Government Code requires State agencies to estimate the cost or savings to any State agency, local agency, or school district in accordance with instructions adopted by the Department of Finance. The estimate shall include any non-discretionary cost or savings to local agencies and the cost or savings in federal funding to the State.

There are no significant costs to any State agency, local agency, or school district imposed by the proposed regulation. Staff does not expect an adverse impact on other State or local agencies. The increase in the cost of GDF hoses to State and local agencies, like the California Department of General Services or local law enforcement and rescue agencies will be minor and partially offset by the fuel savings associated with new GDF hoses.

3) Economic Impacts of Alternatives

Health and Safety Code Section 57005 requires the ARB to perform an economic impact analysis of submitted alternatives to a proposed regulation before adopting any major rule. A major rule is defined as a rule that will have a potential cost to California business enterprises in an amount exceeding ten million dollars in any single year. The proposed regulation does not exceed this threshold.

E) Environmental Justice

State law defines environmental justice as the fair treatment of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, rules, and policies (Senate Bill 115, Solis; Stats 1999, Ch. 690; Government Code § 65040.12(e)). The Board has established a framework for incorporating environmental justice into ARB programs consistent with the directives of State law.

The policies developed apply to all communities in California, but recognize that environmental justice issues have been raised more often in the context of low income and minority communities, which sometimes experience higher exposures to some pollutants as a result of the cumulative impacts of air pollution from multiple mobile, commercial, industrial, area wide, and other sources. Over the past twenty years, the ARB, districts, and federal air pollution control programs have made substantial progress towards improving the air quality in California. However, some communities continue to experience higher exposures than others as a result of the cumulative impacts of air pollution from multiple mobile and stationary sources and thus may suffer a disproportionate level of adverse health effects. Since the same Ambient Air Quality Standards apply to all regions of the State, all communities, including environmental justice communities, will benefit from the air quality benefits associated with this proposal. Alternatives to the proposed recommendations, such as not implementing the proposal, would affect all communities throughout the State.

V ALTERNATIVES

A) Introduction

In accordance with Government Code Section 11346.5, subdivision (a)(13), ARB must determine that no reasonable alternative it considered or that has otherwise been identified and brought to ARB's attention would be more effective in carrying out the purpose of the proposed regulation or would be as effective and less burdensome to affected private persons than the proposed regulation. This section of the staff report discusses alternatives to the proposed regulation.

No alternative approach to reduce emissions from GDF hoses was identified. The only alternative is maintaining the status quo through no action.

B) No Action

There currently exists no State or federal regulation designed to reduce emissions from GDF hoses. Therefore, the no action would likely produce no improvement in air quality. Staff rejected this alternative as it does not produce air quality benefits and does not address the permeation of gasoline from GDF hoses.

VI MAJOR ISSUES IDENTIFIED AND DISCUSSED

A) Introduction

During ARB workshops and UL Task Group meetings details of the proposed regulation and emission test results were presented to the stakeholders for review and comment. Staff accepted comments and recommendations from stakeholders, identified specific issues of concern and addressed those issues to the extent possible. Although ARB has addressed most of these concerns (Appendix L) there is some concern by the manufacturers of balance GDF hoses that the proposed regulation will require new designs.

B) Balance System Hoses

No low permeation prototype has been demonstrated for balance GDF hoses. Many samples of low permeation materials and hoses have been shown to staff by both material and GDF hose manufacturers. Most low permeation hose technologies observed by staff have multiple extruded layers. Permeation is reduced by one of these layers specifically chosen for its permeation reducing qualities. The outer hose of a balance GDF hose assembly encompasses a metal helix causing the hose to have a corrugated shape. This current design complicates the extrusion process for applying a barrier material.

Staff has discussed the feasibility of producing low permeation balance GDF hoses with several hose manufacturers. Staff has received estimates from manufacturers for the cost to develop hoses to meet the proposed performance standard (Appendix I).

In working with hose and design experts, staff expects that low permeation balance GDF hoses will meet the proposed performance standard. Samples of low permeation hoses and hose materials exist. Hose manufacturers have provided an estimate of potential costs for implementing this technology. The need for developing a balance hose is the reason that staff is proposing an operative date of January 1, 2011.

VII RECOMMENDATION

Staff recommends that the Board approve the proposed regulation to amend sections 94011 of title 17, California Code of Regulations; Certification Procedure 201, Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities; and add new Test Procedure 201.8, Determination of the Permeation Rate from a Gasoline Dispensing Facility Hose.

VIII REFERENCES

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Nulman, M., Olejnik, A., Samus, M., Fead, E., Rossi, G., Fuel Permeation Performance of Polymeric Materials Analyzed by Gas Chromatography and Sorption Techniques. Society of Automotive Engineering, Technical Paper 981360.

IX APPENDICES

A) Proposed Regulation Order to Require Low Permeation Gasoline Dispensing Facility (GDF) Hoses Amended Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities

B) Regulatory Authority: Vapor Recovery Health and Safety Code Statutes

C) Gasoline Dispensing Facility (GDF) Vapor Recovery Hose Population Report

D) Proposed Amendment to CP-201: Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities

E) Proposed Gasoline Dispensing Facility Hose Test Procedure: TP-201.8 Determination of the Permeation Rate from a Gasoline Dispensing Facility Hose

F) GDF Hose Permeation Study Review (October 2007)

G) Gasoline Dispensing Facility (GDF) Balance Hose Permeation Study

H) Gasoline Dispensing Facility (GDF) Balance Hose Vapor Quality and Permeation Analysis

I) Gasoline Dispensing Facility (GDF) Hose Regulation Economic and Fiscal Impact Analysis

J) Gasoline Dispensing Facility (GDF) Low Permeation Hose Upgrade Cost Report

K) Low Permeation Gasoline Dispensing Facility (GDF) Hose Cost Effectiveness Report

L) GDF Hose Stakeholder Concerns and Responses

APPENDIX A

Proposed Regulation Order to Require Low Permeation Gasoline Dispensing Facility (GDF) Hoses Amended Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities

[Note: The text is shown in ~~strikeout~~ to indicate that it is proposed for deletion and <u>underline</u> to indicate that it is proposed for addition.]

PROPOSED REGULATION ORDER

Note: ~~Strikeout~~ indicates deleted text; underline indicates inserted text.

Amend Title 17, California Code of Regulations, Section 94011 to read:

§ 94011. Certification of Vapor Recovery Systems of Dispensing Facilities.

The certification of gasoline vapor recovery systems at dispensing facilities (service stations) shall be accomplished in accordance with the Air Resources Board's CP-201, "Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities" which is herein incorporated by reference. (Adopted: December 9, 1975, as last amended ~~May 25, 2006~~ *[date of amendment to be inserted]*.

The following test procedures (TP) cited in CP-201 are also incorporated by reference.

TP-201.1 – "Volumetric Efficiency for Phase I Systems" (Adopted: April 12, 1996, as last amended October 8, 2003)

TP-201.1A – "Emission Factor For Phase I Systems at Dispensing Facilities" (Adopted: April 12, 1996, as last amended February 1, 2001)

TP-201.1B – "Static Torque of Rotatable Phase I Adaptors" (Adopted: July 3, 2002, as last amended October 8, 2003)

TP-201.1C – "Leak Rate of Drop Tube/Drain Valve Assembly" (Adopted: July 3, 2002, as last amended October 8, 2003)

TP-201.1D – "Leak Rate of Drop Tube Overfill Prevention Devices" (Adopted: February 1, 2001, as last amended October 8, 2003)

TP-201.1E – "Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves" (Adopted: October 8, 2003)

TP-201.1E CERT– "Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves" (Adopted: May 25, 2006)

TP-201.2 – "Efficiency and Emission Factor for Phase II Systems" (Adopted: April 12, 1996, as last amended October 8, 2003)

TP-201.2A – "Determination of Vehicle Matrix for Phase II Systems" (Adopted: April 12, 1996, as last amended February 1, 2001)

TP-201.2B – "Flow and Pressure Measurement of Vapor Recovery Equipment" (Adopted: April 12, 1996, as last amended October 8, 2003)

TP-201.2C – “Spillage from Phase II Systems” (Adopted: April 12, 1996, as last amended February 1, 2001)

TP-201.2D – “Post-Fueling Drips from Nozzle Spouts” (Adopted: February 1, 2001, as last amended October 8, 2003)

TP-201.2E – “Gasoline Liquid Retention in Nozzles and Hoses” (Adopted: February 1, 2001)

TP-201.2F – “Pressure-Related Fugitive Emissions” (Adopted: February 1, 2001, as last amended October 8, 2003)

TP-201.2G – “Bend Radius Determination for Underground Storage Tank Vapor Recovery Components” (Adopted: October 8, 2003, as last amended May 25, 2006)

TP-201.2H – “Determination of Hazardous Air Pollutants from Vapor Recovery Processors” (Adopted: February 1, 2001)

TP-201.2I – “Test Procedure for In-Station Diagnostic Systems” (Adopted: October 8, 2003, as last amended May 25, 2006)

TP-201.2J – “Pressure Drop Bench Testing of Vapor Recovery Components” (Adopted: October 8, 2003)

TP-201.3 – “Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities” (Adopted: April 12, 1996, as last amended March 17, 1999)

TP-201.3A – “Determination of 5 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities” (Adopted: April 12, 1996)

TP-201.3B - "Determination of Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities with Above-Ground Storage Tanks" (Adopted: April 12, 1996)

TP-201.3C – “Determination of Vapor Piping Connections to Underground Gasoline Storage Tanks (Tie-Tank Test)” (Adopted: March 17, 1999)

TP-201.4 – “Dynamic Back Pressure” (Adopted: April 12, 1996, as last amended July 3, 2002)

TP-201.5 – “Air to Liquid Volume Ratio” (Adopted: April 12, 1996, as last amended February 1, 2001)

TP-201.6 – “Determination of Liquid Removal of Phase II Vapor Recovery Systems of Dispensing Facilities” (Adopted: April 12, 1996, as last amended April 28, 2000)

TP-201.6C – "Compliance Determination of Liquid Removal Rate" (Adopted: July 3, 2002)

TP-201.7 – “Continuous Pressure Monitoring” (Adopted: October 8, 2003)

TP-201.8 – “Determination of the Permeation Rate from a Gasoline Dispensing Facility Hose” (Adopted: *[date of adoption to be inserted]*)

NOTE: Authority cited: Sections 25290.1.2, 38560, 38560.5, 39600, 39601, 39607 and 41954, Health and Safety Code. Reference: Sections 25290.1.2, 38560, 38560.5, 39515, 41952, 41954, 41956.1, 41959, 41960 and 41960.2, Health and Safety Code.

APPENDIX B

Regulatory Authority:
Vapor Recovery Health and Safety Code Statutes

H&S 25290.1.2

25290.1.2(a) The board and the State Air Resources Board, under the direction of the California Environmental Protection Agency, shall certify to the best of their knowledge, that the equipment that meets the requirements of Section 94011 of Title 17 of the California Code of Regulations for enhanced vapor recovery systems at gasoline dispensing facilities, as implemented by the State Air Resources Board, also meets the requirements of this chapter. The board and the State Air Resources Board shall make this certification collaboratively, using existing resources.

(b) The board and the State Air Resources Board, under the direction of the California Environmental Protection Agency, when making the certification specified in subdivision (a), shall consult with interested parties, including local implementing agencies, underground storage tank system owners and operators, equipment manufacturers, underground storage tank system installers, and environmental organizations.

(c) The board and the State Air Resources Board shall post the certification and any supporting documentation on their Web sites.

(d) This section shall be implemented by the executive directors of the board and of the State Air Resources Board, or by their designees.

SEC.4. Section 25299.51 of the Health and Safety Code is amended to read:

25299.51.The board may expend the money in the fund for all the following purposes:

(a) In addition to the purposes specified in subdivisions (c), (d), and (e), for the costs of implementing this chapter and for implementing Section 25296.10 for a tank that is subject to this chapter.

(b) To pay for the administrative costs of the State Board of Equalization in collecting the fee imposed by Article 5 (commencing with Section 25299.40).

(c) To pay for the reasonable and necessary costs of corrective action pursuant to Section 25299.36, up to one million five hundred thousand dollars ($1,500,000) per occurrence. The Legislature may appropriate the money in the fund for expenditure by the board, without regard to fiscal year, for prompt action in response to any unauthorized release.

(d) To pay for the costs of an agreement for the abatement of, and oversight of the abatement of, an unauthorized release of hazardous substances from underground storage tanks, by a local agency, as authorized by Section 25297.1 or by any other provision of law, except that, for the purpose of expenditure of these funds, only underground storage tanks, as defined in Section 25299.24, shall be the subject of the agreement.

(e) To pay for the costs of cleanup and oversight of unauthorized releases at abandoned tank sites. The board shall not expend more than 25 percent of the total amount of money collected and deposited in the fund annually for the purposes of this subdivision and subdivision (h).

(f) To pay claims pursuant to Section 25299.57.

(g) To pay, upon order of the Controller, for refunds pursuant to Part 26 (commencing with Section 50101) of Division 2 of the Revenue and Taxation Code.

(h) To pay for the reasonable and necessary costs of corrective action pursuant to subdivision (f) of Section 25296.10, in response to an unauthorized release from an underground storage tank subject to this chapter.
(i) To pay claims pursuant to Section 25299.58.
(j) To pay for expenditures by the board associated with discovering violations of, and enforcing, or assisting in the enforcement of, the requirements of Chapter 6.7 (commencing with Section 25280) with regard to petroleum underground storage tanks.

H&S 41950 Vapor Recovery Systems for Stationary Gas Tanks

41950. (a) Except as provided in subdivisions (b) and (e), no person shall install or maintain any stationary gasoline tank with a capacity of 250 gallons or more which is not equipped for loading through a permanent submerged fill pipe, unless such tank is a pressure tank as described in Section 41951, or is equipped with a vapor recovery system as described in Section 41952 or with a floating roof as described in Section 41953, or unless such tank is equipped with other apparatus of equal efficiency which has been approved by the air pollution control officer in whose district the tank is located.

(b) Subdivision (a) shall not apply to any stationary tanks installed prior to December 31, 1970.

(c) For the purpose of this section, "gasoline" means any petroleum distillate having a Reid vapor pressure of four pounds or greater.

(d) For the purpose of this section, "submerged fill pipe" means any fill pipe which has its discharge opening entirely submerged when the liquid level is six inches above the bottom of the tank. "Submerged fill pipe," when applied to a tank which is loaded from the side, means any fill pipe which has its discharge opening entirely submerged when the liquid level is 18 inches above the bottom of the tank.

(e) Subdivision (a) shall not apply to any stationary tank which is used primarily for the fueling of implements of husbandry.

(Added by Stats. 1975, Ch. 957.)

H&S 41951 Definition of Pressure Tank

41951. A "pressure tank" is a tank which maintains working pressure sufficient at all times to prevent hydrocarbon vapor or gas loss to the atmosphere.

(Added by Stats. 1975, Ch. 957.)

H&S 41952 Definition of Vapor Recovery System

41952. A "vapor recovery system" consists of a vapor gathering system capable of collecting the hydrocarbon vapors and gases discharged and a vapor disposal system capable of processing such hydrocarbon vapors and gases so as to prevent their emission into the atmosphere, with all tank gauging and sampling devices gastight except when gauging or sampling is taking place.

(Added by Stats. 1975, Ch. 957.)

H&S 41953 Definition of Floating Roof

41953. A "floating roof" consists of a pontoon-type or double-deck-type roof, resting on the surface of the liquid contents and equipped with a closure seal, or seals, to close the space between the roof edge and tank wall. The control equipment required by this section shall not be used if the gasoline or petroleum distillate has a vapor pressure of 11.0 pounds per square inch absolute or greater under actual storage conditions. All tank gauging and sampling devices shall be gastight except when gauging or sampling is taking place.

(Added by Stats. 1975, Ch. 957.)

H&S 41954 ARB Shall Certify Vapor Recovery Systems

41954. (a) The state board shall 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 that are reasonable and necessary to achieve or maintain any applicable ambient air quality standard.

(b) The state board shall, after a public hearing, adopt additional performance standards that are reasonable and necessary to ensure that systems for the control of gasoline vapors resulting from motor vehicle fueling operations do not cause excessive gasoline liquid spillage and excessive evaporative emissions from liquid retained in the dispensing nozzle or vapor return hose between refueling events, 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) (1) The state board shall certify, in cooperation with the districts, only those gasoline vapor control systems that it determines will meet the following requirements, if properly installed and maintained:

(A) The systems will meet the requirements of subdivision (a).

(B) With respect to any system designed to control gasoline vapors during vehicle refueling, that system, based on an engineering evaluation of that system's component qualities, design, and test performance, can be expected, with a high degree of certainty, to comply with that system's certification conditions over the warranty period specified by the board.

(C) With respect to any system designed to control gasoline vapors during vehicle refueling, that system shall be compatible with vehicles equipped with onboard refueling vapor recovery (ORVR) systems.

(2) The state board shall enumerate the specifications used for issuing the certification. After a system has been certified, if circumstances beyond the control of the state board cause the system to no longer meet the required specifications or standards, the state board shall revoke or modify the certification.

(d) The state board shall test, or contract for testing, gasoline vapor control systems for the purpose of determining whether those systems may be certified.

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

(f) No person shall offer for sale, sell, or install any new or rebuilt gasoline vapor control system, or any component of the system, unless the system or component has been certified by the state board and is clearly identified by a permanent identification of the certified manufacturer or rebuilder.

(g) (1) Except as authorized by other provisions of law and except as provided in this subdivision, no district may adopt, after July 1, 1995, stricter procedures or performance standards than those adopted by the state board pursuant to subdivision (a), and no district may enforce any of those stricter procedures or performance standards.

(2) Any stricter procedures or performance standards shall not require the retrofitting, removal, or replacement of any existing system, which is installed and operating in compliance with applicable requirements, within four years from the effective date of those procedures or performance standards, except that existing requirements for retrofitting, removal, or replacement of nozzles with nozzles containing vapor-check valves may be enforced commencing July 1, 1998.

(3) Any stricter procedures or performance standards shall not be implemented until at least two systems meeting the stricter performance standards have been certified by the state board.

(4) If the certification of a gasoline vapor control system, or a component thereof, is revoked or modified, no district shall require a currently installed system, or component thereof, to be removed for a period of four years from the date of revocation or modification.

(h) No district shall require the use of test procedures for testing the performance of a gasoline vapor control system unless those test procedures have been adopted by the state board or have been determined by the state board to be equivalent to those adopted by the state board, except that test procedures used by a district prior to January 1, 1996, may continue to be used until January 1, 1998, without state board approval.

(i) With respect to those vapor control 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 meets both of the following requirements:

(1) Has been certified by the state board at an efficiency or emission factor required by applicable statutes, rules, or regulations.

(2) Is installed, operated, and maintained in accordance with the requirements set forth in the document certification and the instructions of the equipment manufacturer.

(Amended by Stats. 2000, Ch. 729, Sec. 14.)

References at the time of publication (see page iii):

Regulations:
17, CCR, Sections 94006, 94010, 94011, 94012, 94013, 94014, 94015, 94148, 94149, 94150, 94151, 94152, 94153, 94154, 94155, 94156, 94157, 94158, 94159, 94160, 94163

H&S 41955 Certification Required by Other Agencies

41955. Prior to state board certification of a gasoline vapor control system pursuant to Section 41954, the manufacturer of the system shall submit the system to, or, if appropriate, the components of the system as requested by, the Division of Measurement Standards of the Department of Food and Agriculture and the State Fire Marshal for their certification.

(Added by Stats. 1976, Ch. 1030.)

H&S 41956 Other Agencies to Adopt Rules for Certification

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.

(Amended by Stats. 1981, Ch. 902.)

H&S 41956.1 Revision of Standards for Vapor Recovery Systems

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 or revokes a certification, any systems or any system components certified under procedures in effect prior to the adoption of revised standards or the revocation of the certification and installed prior to the effective date of the revised standards or revocation may continue to be used in gasoline marketing operations for a period of four years after the effective date of the revised standards or the revocation of the certification. However, all necessary repair or replacement parts or components shall be certified.

(b) Notwithstanding subdivision (a), whenever the State Fire Marshal determines that a system or a system component creates a hazard to public health and welfare, the State Fire Marshal 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 any system component 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.

(Amended by Stats. 1996, Ch. 426, Sec. 2.)

References at the time of publication (see page iii):

Regulations: 17, CCR, Section 94011

H&S 41957 Division of Industrial Safety Responsibilities

41957. The Division of Occupational Safety and Health of the Department of Industrial

Relations is the only agency responsible for determining whether any gasoline vapor control system, or component thereof, creates a safety hazard other than a fire hazard.

If the division determines that a system, or component thereof, creates a safety hazard other than a fire hazard, that system or component may not be used until the division has certified that the system or component, as the case may be, does not create that hazard.

The division, in consultation with the state board, shall adopt the necessary rules and regulations for the certification if the certification is required.

(Amended by Stats. 1981, Ch. 714.)

H&S 41958 Rules Shall Allow for Flexibility in Design

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 Occupational Safety and Health, 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.

(Amended by Stats. 1982, Ch. 466, Sec. 72.)

H&S 41959 Certification Testing

41959. Certification testing of gasoline vapor control systems and their components by the state board, the State Fire Marshal, the Division of Measurement Standards, and the Division of Occupational Safety and Health may be conducted simultaneously.

(Amended by Stats. 1981, Ch. 714.)

References at the time of publication (see page iii):

Regulations: 17, CCR, Sections 94010, 94011, 94012, 94013

H&S 41960 Certification by State Agencies Sufficient

41960. (a) Certification of a gasoline vapor recovery system for safety and measurement accuracy by the State Fire Marshal and the Division of Measurement Standards and, if necessary, by the Division of Occupational Safety and Health shall permit its installation wherever required in the state, if the system is also certified by the state board.

(b) Except as otherwise provided in subdivision (g) of Section 41954, no local or regional authority shall prohibit the installation of a certified system without obtaining concurrence from the state agency responsible for the aspects of the system which the local or regional authority disapproves.

(Amended by Stats. 1996, Ch. 426, Sec. 3.)

References at the time of publication (see page iii):

Regulations: 17, CCR, Sections 94011, 94012, 94013

H&S 41960.1 Operation in Accordance with Standards

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.

(Added by Stats. 1981, Ch. 902.)

H&S 41960.2 Maintenance of Installed Systems

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) Whenever a gasoline vapor recovery control system is repaired or rebuilt by someone other than the original manufacturer or its authorized representative, the person shall permanently affix a plate to the vapor recovery control system that identifies the repairer or rebuilder and specifies that only certified equipment was used. In addition, a rebuilder of a vapor control system shall remove any identification of the original manufacturer if the removal does not affect the continued safety or performance of the vapor control system.

(c) (1) The executive officer of the state board shall identify and list equipment defects in systems for the control of gasoline vapors resulting from motor vehicle fueling operations that substantially impair the effectiveness of the systems in reducing air contaminants. The defects shall be identified and listed for each certified system and shall be specified in the applicable certification documents for each system.

(2) On or before January 1, 2001, and at least once every three years thereafter, the list required to be prepared pursuant to paragraph (1) shall be reviewed by the executive officer at a public workshop to determine whether the list requires an update to reflect changes in equipment technology or performance.

(3) Notwithstanding the timeframes for the executive officer's review of the list, as specified in paragraph (2), the executive officer may initiate a public review of the list upon a written request that demonstrates, to the satisfaction of the executive officer, the need for such a review. If the executive officer determines that an update is required, the update shall be completed no later than 12 months after the date of the determination.

(d) When a district determines that a component contains a defect specified pursuant to subdivision (c), 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.

(e) Where a district determines that a component is not in good working order but does not contain a defect specified pursuant to subdivision (c), 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.

(Amended by Stats. 1999, Ch. 501, Sec. 1.)

References at the time of publication (see page iii):

Regulations: 17, CCR, Sections 94006, 94010, 94011

H&S 41960.3 Telephone Number for Reporting Problems

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 in the Department of Food and Agriculture. 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.

(Amended by Stats. 1986, Ch. 194, Sec. 1.)

H&S 41960.4 Operating Instructions

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.

(Added by Stats. 1981, Ch. 902.)

H&S 41960.5 Nozzle Size Requirements

41960.5. (a) No retailer, as defined in Section 20999 of the Business and Professions Code, shall allow the operation of any gasoline pump from which leaded gasoline is dispensed, or which is labeled as providing leaded gasoline, unless the pump is equipped with a nozzle spout meeting the required specifications for leaded gasoline nozzle spouts set forth in Title 40, Code of Federal Regulations, Section 80.22(f)(1).

(b) For the purpose of this section, "leaded gasoline" means gasoline which is produced with the use of any lead additive or which contains more than 0.05 gram of lead per gallon or more than 0.005 gram of phosphorus per gallon.

(Added by Stats. 1987, Ch. 592, Sec. 2.)

H&S 41960.6 Fuel Pump Nozzles

41960.6. (a) No retailer, as defined in subdivision (g) of Section 20999 of the Business and Professions Code, shall, on or after July 1, 1992, allow the operation of a pump, including any pump owned or operated by the state, or any county, city and county, or city, equipped with a nozzle from which gasoline or diesel fuel is dispensed, unless the nozzle is equipped with an operating hold open latch. Any hold open latch determined to be inoperative by the local fire marshal or district official shall be repaired or replaced by the retailer, within 48 hours after notification to the retailer of that determination, to avoid any applicable penalty or fine.

(b) For purposes of this section, a "hold open latch" means any device which is an integral part of the nozzle and is manufactured specifically for the purpose of dispensing fuel without requiring the consumer's physical contact with the nozzle.

(c) Subdivision (a) does not apply to nozzles at facilities which are primarily in operation to refuel marine vessels or aircraft.

(d) Nothing in this section shall affect the current authority of any local fire marshal to establish and maintain fire safety provisions for his or her jurisdiction.

(Added by Stats. 1991, Ch. 468, Sec. 2.)

H&S 41961 Fees for Certification

41961. The State Fire Marshal, the Division of Measurement Standards, and the Division of Occupational Safety and Health may charge a reasonable fee for certification of a gasoline vapor control system or a component thereof, not to exceed their respective estimated costs therefor. Payment of the fee may be made a condition of certification. All money collected by the State Fire Marshal pursuant to this section shall be deposited in the State Fire Marshal Licensing and Certification Fund established pursuant to Section 13137, and shall be available to the State Fire Marshal upon appropriation by the Legislature to carry out the purposes of this article.

(Amended by Stats. 1992, Ch. 306, Sec. 5. Effective January 1, 1993. Operative July 1, 1993, by Sec. 6 of Ch. 306.)

H&S 41962 Vapor Recovery Systems on Cargo Tank Vehicles

41962. (a) Notwithstanding Section 34002 of the Vehicle Code, the state board shall adopt test procedures to determine the compliance of vapor recovery systems of cargo tanks on tank vehicles used to transport gasoline with vapor emission standards which are reasonable and necessary to achieve or maintain any applicable ambient air quality standard. The performance standards and test procedures adopted by the state board shall be consistent with the regulations adopted by the Commissioner of the California Highway Patrol and the State Fire Marshal pursuant to Division 14.7 (commencing with Section 34001) of the Vehicle Code.

(b) The state board may test, or contract for testing, the vapor recovery system of any cargo tank of any tank vehicle used to transport gasoline. The state board shall certify the cargo tank vapor recovery 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 cargo tank vapor recovery 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.

(c) Upon verification of certification pursuant to subdivision (b), which shall be done annually, the state board shall send a verified copy of the certification to the registered owner of the tank vehicle, which copy shall be retained in the tank vehicle as evidence of certification of its vapor recovery system. For each system certified, the state board shall issue a nontransferable and nonremovable decal to be placed on the cargo tank where the decal can be readily seen.

(d) With respect to any tank vehicle operated within a district, the state board, upon request of the district, shall send to the district, free of charge, a certified copy of the certification and test results of any cargo tank vapor recovery system on the tank vehicle.

(e) The state board may contract with the Department of the California Highway Patrol to carry out the responsibilities imposed by subdivisions (b), (c), and (d).

(f) 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. The fees may be collected by the Department of the California Highway Patrol and deposited in the Motor Vehicle Account in the State Transportation Fund. The Department of the California Highway Patrol shall transfer to the Air Pollution Control Fund the amount of those fees necessary to reimburse the state board for the costs of administering the certification program.

(g) No person shall operate, or allow the operation of, a tank vehicle transporting gasoline and required to have a vapor recovery system, unless the system thereon has been certified by the state board and is installed and maintained in compliance with the state board's requirements for certification. Tank vehicles used exclusively to service gasoline storage tanks which are not required to have gasoline vapor controls are exempt from the certification requirement.

(h) Performance standards of any district for cargo tank vapor recovery systems on tank vehicles used to transport gasoline shall be identical with those adopted by the state board therefor and no district shall adopt test procedures for, or require certification of, cargo tank vapor recovery systems. No district may impose any fees on, or require any permit of, tank vehicles with vapor recovery systems. However, nothing in this section shall be construed to prohibit a district from inspecting and testing cargo tank vapor recovery systems on tank vehicles for the purposes of enforcing this section or any rule and regulation adopted thereunder that are applicable to such systems and to the loading and unloading of cargo tanks on tank vehicles.

(i) The Legislature hereby declares that the purposes of this section regarding cargo tank vapor recovery systems on tank vehicles are (1) to remove from the districts the authority to certify, except as specified in subdivision (b), such systems and to charge fees therefor, and (2) to grant such authority to the state board, which shall have the primary responsibility to assure that such systems are operated in compliance with its standards and procedures adopted pursuant to subdivision (a).

(Amended by Stats. 1982, Ch. 1255, Sec. 2. Operative July 1, 1983, or earlier, by Sec. 27.5 of Ch. 1255.)

References at the time of publication (see page iii):

Regulations: 17, CCR, Sections 94014, 94015

APPENDIX C

Gasoline Dispensing Facility (GDF)
Vapor Recovery Hose Population Report

California Environmental Protection Agency

Air Resources Board

Gasoline Dispensing Facility (GDF)
Vapor Recovery Hose Population Report

Prepared By:

Jason McPhee

Evaporative Controls and Certification Branch
Monitoring and Laboratory Division

October 6, 2008

Introduction

In January of 2008, California Air Resources Board (CARB) staff conducted a survey of Air Pollution Control Districts (APCDs) within California to determine the population of vapor recovery hoses at permitted gasoline dispensing facilities (GDFs). In order to get a detailed population estimate, CARB staff requested information on: GDF population, hose population, hose dimensions, and GDF throughput. Twenty-eight of the of the thirty-five California APCDs responded to CARB's survey. From this response, CARB staff estimates that there are approximately 173,257 vapor recovery hoses in use at permitted GDFs in California. The survey further indicates that approximately 85% (146,750) of these hoses are balance style hoses and the remaining 15% (26,507) are vacuum assist style hoses.

Background

It is part of CARB's mission to promote and protect the public health and welfare through the effective and efficient reduction of air pollutants. In carrying out this mission, CARB, in cooperation with local APCDs, has sought to control hydrocarbon emissions at GDFs in California since 1975. Hydrocarbon emissions are reactive organic gases which can react in the atmosphere to form photochemical smog. Recently, CARB staff has identified GDF hoses as a source of uncontrolled reactive organic gas emissions due to gasoline's ability to permeate through common GDF hose materials.

Under the California Health and Safety Code, Section 41954, it is CARB's responsibility to adopt certification procedures for evaporative emissions control systems for use at GDFs. It is the local APCD's responsibility to regulate GDFs and issue them permits to operate. Because the APCDs are responsible for permitting GDFs, staff believes that they are the best source of detailed information available for developing a California GDF hose population.

California GDFs, with few exceptions must use vapor recovery style hoses. A vapor recovery hose is different from a conventional fuel delivery hose in that it has two paths: one for fuel delivery and the other for vapor return. There are two different styles of vapor recovery hose: balance and vacuum assist. For permeation purposes, vacuum assist hoses are similar to standard fuel delivery hoses in that the liquid fuel is carried against the inside of the outer hose wall. Balance hoses are different, carrying vapor against the outer hose wall (Figure 1).

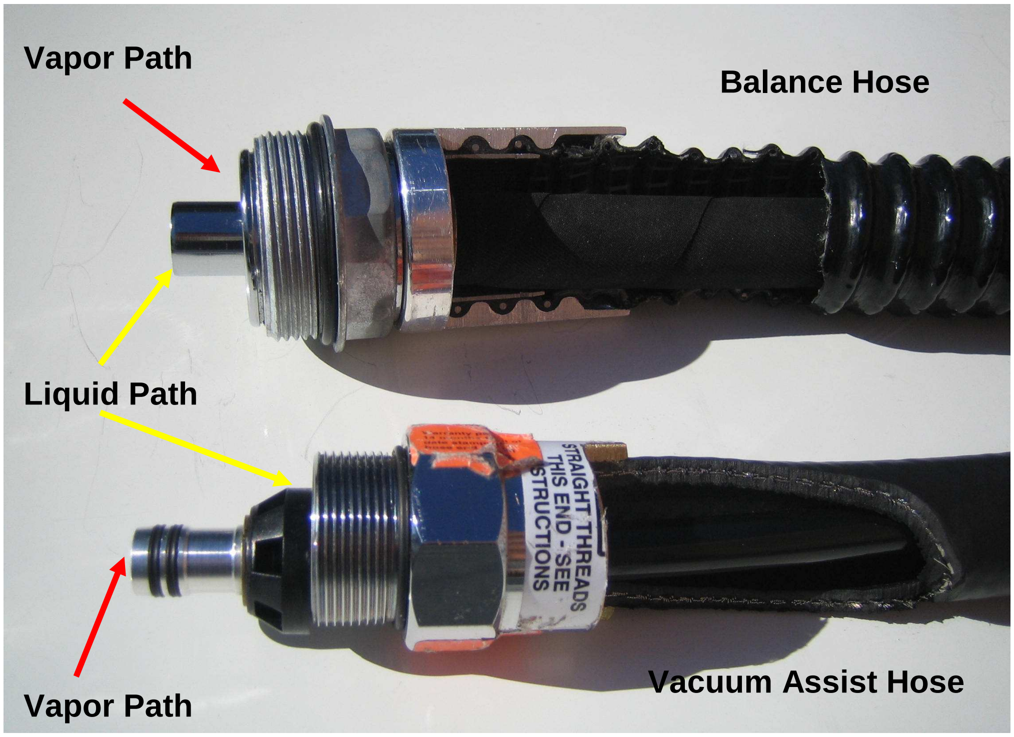

Figure 1. Cutaways of vapor recovery GDF hose showing vapor and liquid paths.

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The Survey

As part of staff's effort to quantify the number of vapor recovery hoses in use within California, staff conducted a GDF hose population survey (Attachment 1). The survey requested population data corresponding to December 31st, 2007. All thirty-five of California's APCD's were sent the survey via mail.

Staff's ultimate objective in conducting this survey was determining the population for vapor recovery hoses in California. This is because only vapor recovery hoses are certified for use on CARB certified vapor recovery systems. Thus, hoses that are in-use at permitted GDFs that are not required to have a CARB certified vapor recovery system fall outside of CARB's current regulatory authority with respect to GDF hoses. From the survey data (Attachments 2 and 3), staff estimates that approximately 2% of the statewide GDF hose population are non-vapor recovery hoses.

The survey requested information on four topics. These included: GDF population, hose population, hose dimensions, and GDF throughput. GDF population numbers were requested to help characterize the number of hoses per GDF. Hose population numbers were requested to determine a precise GDF hose count within California. Hose dimension numbers were requested to help generate average hose characteristics for the purposes of calculating permeation estimates that are based upon material surface area. GDF throughput information was requested to see if there were any correlations that could be drawn between throughput of a GDF and the number of hoses at that GDF.

Survey Response

Of the thirty-five California APCDs, twenty-eight responded to CARB's survey. Of the twenty-eight districts that responded to the survey, only twenty-six responded to the section on hose population. Several follow-up attempts were made by CARB staff via phone and/or email to obtain 100% response for this survey, however these districts remained unresponsive. Results of the survey can be found in Attachments 2 and 3.

From the survey data, staff found the total permitted GDF population employing Phase II vapor recovery to be 14,438 (Attachment 2). The vapor recovery hose population was determined to be 173,257 (Figure 2). The survey further shows that 85% (146,750) of vapor recovery hoses are balance style hoses and the remaining 15% (26,507) are vacuum assist style hoses.

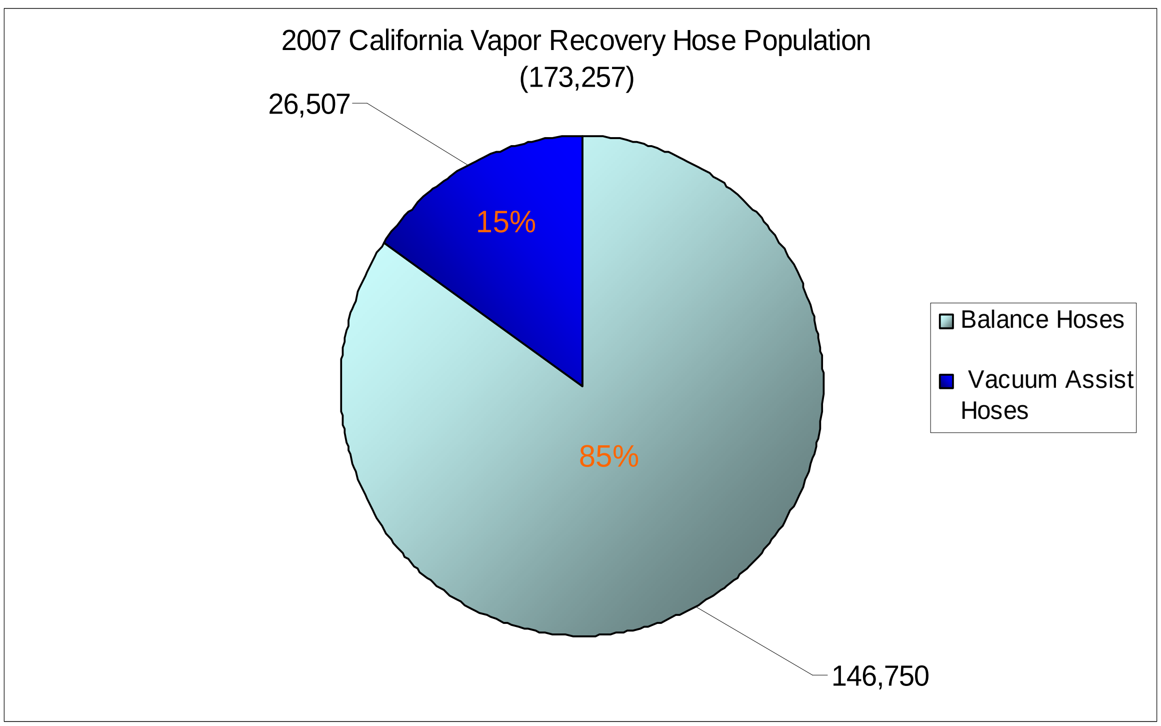

Figure 2. 2007 California Vapor Recovery Hose Population Chart.

Very few districts submitted survey responses for the sections on GDF hose dimensions and GDF throughput. In the case of hose dimensions, staff found that this is not typically data that districts maintain. In the case of throughput, data simply was not submitted by most districts. Therefore, CARB staff did not attempt to make any analysis regarding these hose population characteristics in this report.

Correcting the Survey for Unresponsive Districts

For the districts that failed to respond, GDF populations were derived by determining the average number of GDFs per district based upon district population density (Attachment 4). Population densities were derived from population and land area data from the 2000 U.S. Census.[1] Although it must be noted that the population density data is valid for the year 2000 and this survey has recorded GDF hose population data relevant to 2008, staff believes that the Census data is still useful as a tool to accurately determine GDF population. This is based upon the assumption that although the California population will have increased between 2000 and 2007, the relative population distribution throughout the State will be the very nearly the same. The estimated GDF populations for these districts can be found in Attachment 2. It is staff's estimate that these districts, together, make up approximately 4% of the statewide permitted GDF population and approximately 3% of the statewide vapor recovery hose population.

GDF hose populations were then derived for these districts by calculating the average number of hoses per GDF type from the reporting districts and multiplying these numbers by the estimated station counts that had been determined based upon population density. Staff used representative districts when calculating the number of hoses per GDF to apply to the unresponsive districts. The estimated GDF hose populations for these districts can be found in Attachment 3.

Balance / Vacuum Assist Hose Population Breakdown

This survey demonstrated that, for 2007, balance style hoses make up approximately 85% of the vapor recovery hose population while vacuum assist style hoses make up the other 15% of that population (Figure 2). However, staff is aware that there are large numbers of recent applications at the district level from GDF owners requesting to switch from balance vapor recovery systems to vacuum assist vapor recovery system. This trend has been driven in large part by station owners trying to meet Enhanced Vapor Recovery certification requirement deadlines that occur in April of 2009. Thus, staff assumes that when projecting the GDF hose population out to the year 2014, it is likely that balance and vacuum assist hoses will likely each constitute 50% of the vapor recovery hose population within California. However, other market trends could impact this estimate.

South Coast Hose Population

The South Coast District reported in the survey that their vapor recovery GDF hose population is 100,860. Staff observed that while the South Coast District comprises about 44% of the State's population, it comprises approximately 58% of the vapor recovery hose population. CARB staff asked follow-up questions of South Coast staff regarding this observation. The justification given was that South Coast has a large number of GDFs that employ "six-pack" dispensers. Six-pack dispensers employ 3 hoses for each fueling point, one hose for each octane grade of gasoline: 87, 89, and 91. Most conventional dispensers have ratio of 1 hose per fueling point. Dispensers, whether six-packs or not, generally have 2 fueling points. Therefore, a six-pack dispenser has 6 hoses instead of the conventional 2 hoses, tripling the number of hoses that would normally be employed at a GDF. The average number of vapor recovery hoses per GDF in the South Coast District was calculated by CARB staff to be approximately 20. However, a GDF with a modest 8 fueling points employing six-pack dispensers would have 24 hoses instead of the normal 8 hoses. Therefore, since South Coast staff reports having a large number of GDFs with six-pack dispenser, CARB staff believes that the data submitted is reasonable.

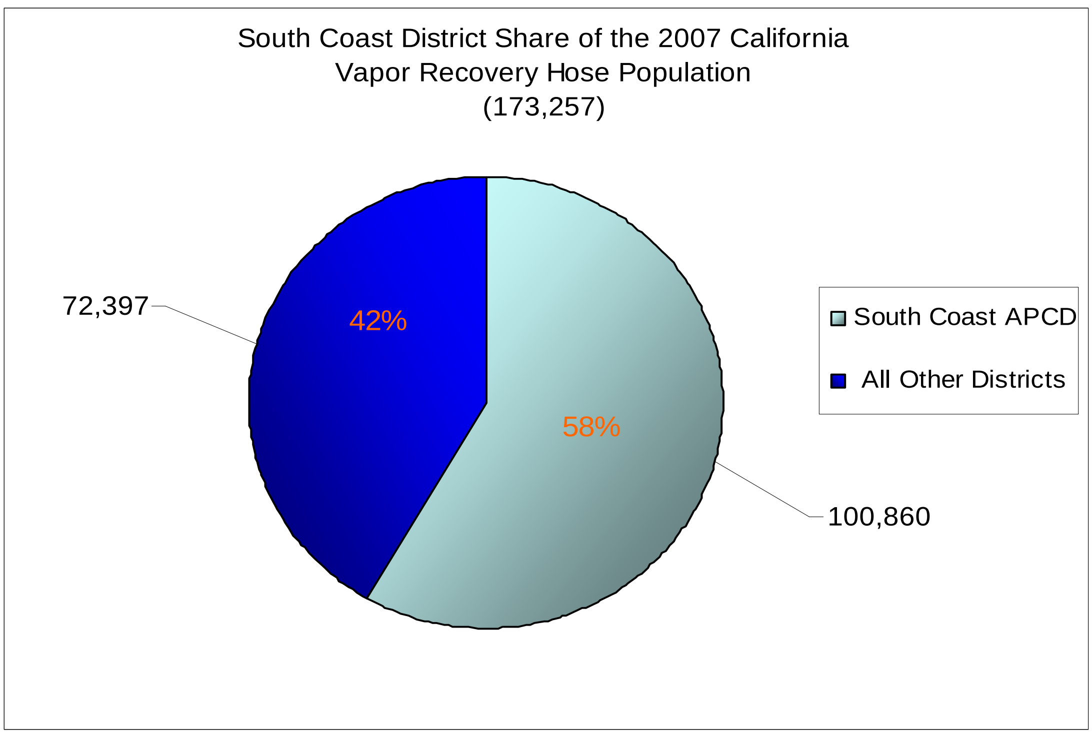

Figure 3. South Coast District's share of the 2007 vapor recovery hose population.

AST / UST Hose Population Breakdown

This survey did not address the population breakdown between permitted GDFs employing underground storage tanks (USTs) and those employing aboveground storage tanks (ASTs). This distinction is significant in that the GDFs employing USTs fall under a different CARB certification procedure than those GDFs employing ASTs, and are thus regulated differently. From an AST population survey of APCDs conducted by CARB staff in 2006, staff determined that there were approximately 2,348 permitted GDFs with Phase II vapor recovery employing ASTs within California.[2] Staff believes that these GDFs would likely employ an average of 2 hoses each. Thus, staff estimates that that vapor recovery hose population employed at GDFs using ASTs is approximately 4,696 (2%),and the vapor recovery hose population employed at GDFs using USTs is approximately 169,247 (98%).

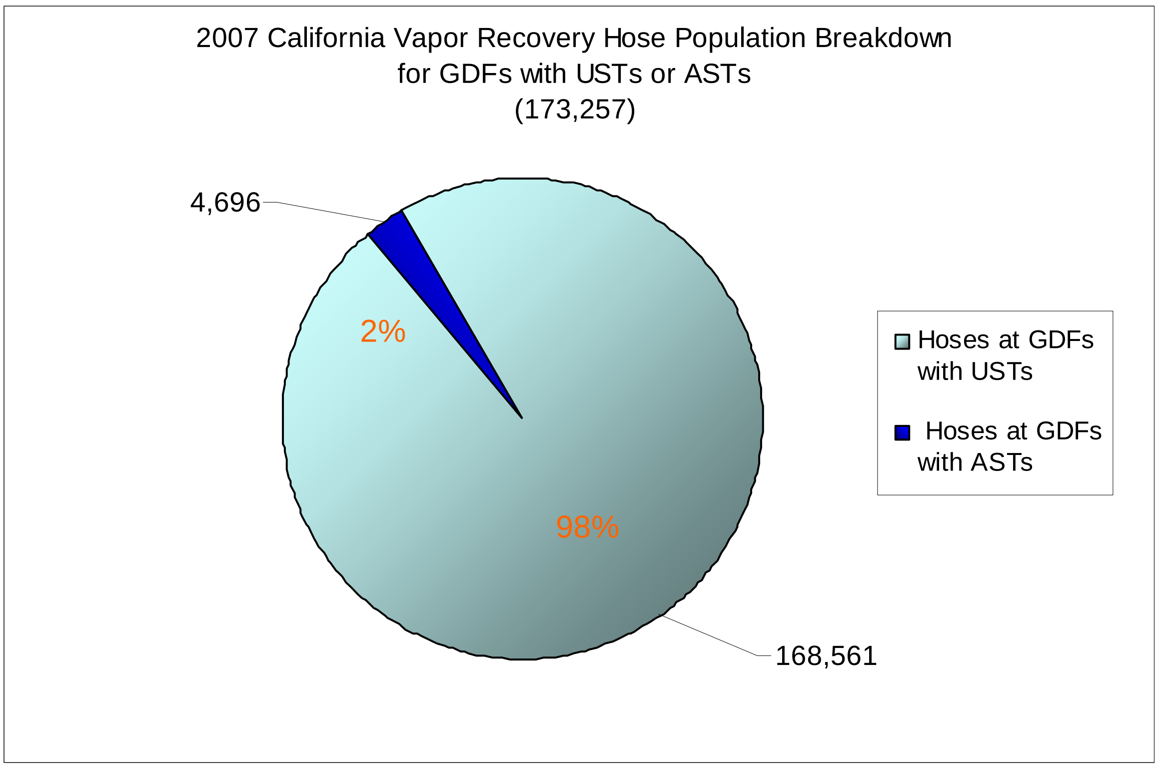

Figure 4. UST / AST 2007 Vapor Recovery Hose Populations.

Retail / Non-Retail GDF Population Breakdown

The Survey did not address the population breakdown between retail and non-retail GDFs. However, the 2006 National Petroleum News Survey of retails GDFs[3] shows that in the first quarter of 2006, California had 9,857 retail GDFs. Because nearly all of these would likely fall under the category of permitted GDFs with phase II vapor recovery, staff estimates that there are approximately 4,600 non-retail permitted GDFs with phase II vapor recovery in California. Staff did not have enough data to determine the numbers of hoses that were used at retail GDFs and non-retail GDFs although staff believes that the number of hoses used at retail GDFs is generally greater than the number of hoses used at non-retail GDFs.

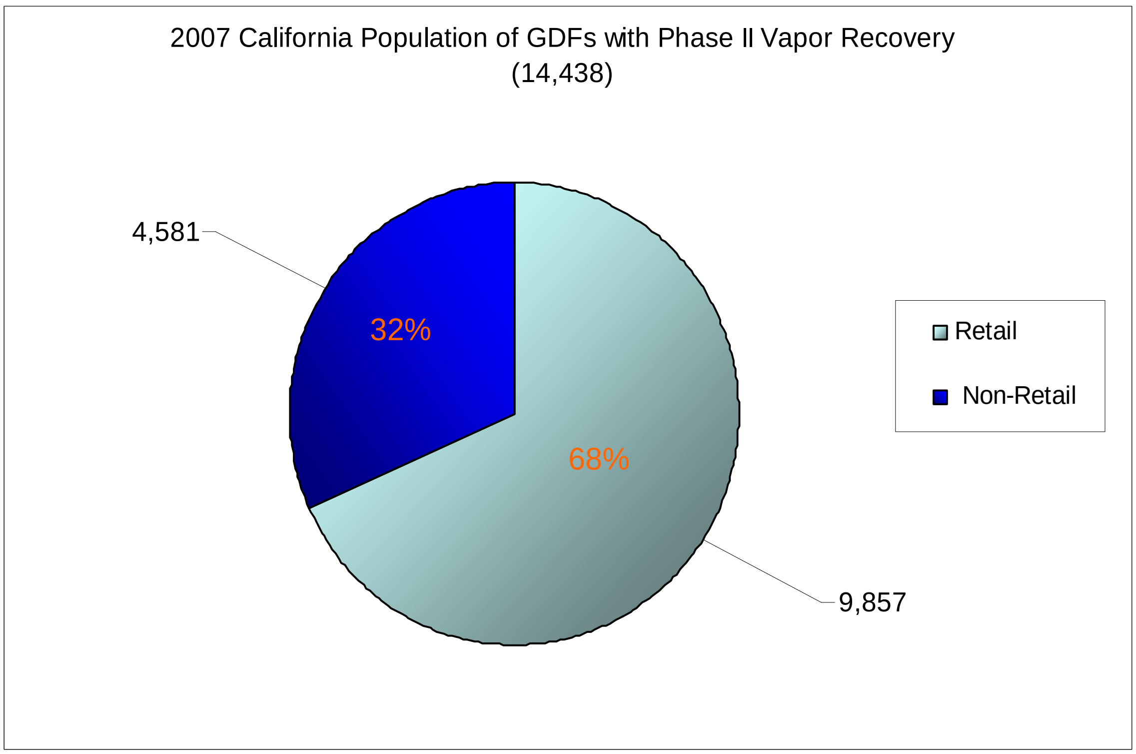

Figure 5. 2007 retail and non-retail population estimate of GDFs with vapor recovery.

Conclusion

Based upon the survey results, CARB staff estimates that there are approximately 173,257 vapor recovery hoses in use at permitted GDFs in California. The survey further indicates that approximately 85% (146,750) of these hoses are balance style hoses and the remaining 15% (26,507) are vacuum assist style hoses.

Works Cited

[1] United States. U.S. Census Bureau. GCT-PH1. Population, Housing Units, Area, and Density: 2000 Data Set: Census 2000 Summary File 1 (SF 1) 100-Percent Data Geographic Area: California – County. U.S. Census Bureau, 2001. <http://factfinder.census.gov/servlet/GCTTable?_bm=y&-ds_name=DEC_2000_SF1_U&-CONTEXT=gct&-mt_name=DEC_2000_SF1_U_GCTPH1_US9&-redoLog=false&-_caller=geoselect&-geo_id=&-format=US-25|US-25S&-_lang=en>

[2] California. California Air Resources Board. STAFF REPORT: INITIAL STATEMENT OF REASONS FOR PROPOSED RULEMAKING PUBLIC HEARING TO CONSIDER ADOPTION OF REGULATIONS FOR THE CERTIFICATION AND TESTING OF GASOLINE VAPOR RECOVERY SYSTEMS USING ABOVEGROUND STORAGE TANKS. Sacramento, California Air Resources Board, 2007. 115. <http://www.arb.ca.gov/regact/2007/ast07/isor.pdf>

[3] National Petroleum News. 2006 NPN Station Count (a), National Petroleum News, 2006. <http://www.npnweb.com/uploads/researchdata/2006/USAnnualStationCount/06-stationcount.pdf>

Attachment 1

Air Resources Board

Linda S. Adams
Secretary for Environmental Protection

Mary D. Nichols, Chairman
1001 I Street • P.O. Box 2815
Sacramento, California 95812 • www.arb.ca.gov

Arnold Schwarzenegger
Governor

January 3, 2008

Dear Air Pollution Control Officer:

The purpose of this letter is to request your district's participation in a survey to collect data for the development of an emissions inventory of in-use Gasoline Dispensing Facility (GDF) hoses. The inventory will support a staff proposal to control emissions permeation from GDF hoses. Your help in this endeavor is greatly appreciated.

The enclosed survey form requests data to quantify the types and characteristics of permitted in-use GDF hoses in your district. If there are any portions of this survey that cannot be completed, please provide feedback explaining why. We are requesting that the completed questionnaire be returned by February 4, 2008 to Jason McPhee at P.O. Box 2815, Sacramento, California 95812. Also, it would be helpful if you can provide a staff contact for any future inquiries on this matter.

If you have questions or need further assistance please contact Jason McPhee at (916) 322-8116 or via email at jmcphee@arb.ca.gov, or me at (916) 322-2886 or via email at dgoodeno@arb.ca.gov.

Sincerely,

Dennis Goodenow, Manager
Regulatory Development Section
Monitoring and Laboratory Division

Enclosure

Attachment 1

Gasoline Dispensing Facility (GDF) Hose Survey Form

(District Level)

ARB staff is requesting data on in-use gasoline dispensing hoses at permitted Gasoline Dispensing Facilities (GDFs) in each district. For the following questions, please give data that corresponds to 12/31/2007. If the data set was not collected in the 2007 calendar year, please note this. Any reference to Phase II systems includes both Phase II vapor recovery and enhanced vapor recovery (EVR) systems.

Please list the district that you are providing data for. ______________________

GDF Population

1. Total number of existing permitted GDFs. ____________
2. Total number of existing GDFs with Phase II systems. ____________
3. Total number of existing GDFs with balance type Phase II systems. ____________
4. Please indicate below, how the data was collected (i.e.. Permits to operate, construct, etc.).

Hose Population

5. Total numbers of GDF hoses in-use at permitted GDFs. ____________
6. Total numbers of GDF hoses in-use at GDFs with Phase II systems. ____________
7. Total numbers of GDF hoses in-use at GDFs with balance type Phase II systems. ____________
8. Please indicate below, how the data was collected (i.e.. Permits to operate, construct, etc.). ____________

Hose Dimensions (Use best judgement on aquiring this data.)

9. Average length of in-use balance type GDF hose (feet) (includes hose, whip, and fittings). ____________
10. Average length of in-use vacuum assist type GDF hose (feet) (includes hose, whip, and fittings). ____________
11. Average inner diameter of the outer hose wall of in-use balance type hose (inches). ____________
12. Average inner diameter of the outer hose wall of in-use vacuum assist type hose (inches). ____________
13. Please indicate below, how the data was collected (i.e.. Permits to operate, construct, etc.).

Number of Permitted GDFs in the Following Throughput Categories (gal/yr):

14. Up to 300,000. ____________
15. 300,000 to 600,000. ____________
16. 600,000 to 1.2 million. ____________
17. 1.2 million to 2.4 million. ____________
18. 2.4 million and up. ____________
19. Please indicate below, how the data was collected (i.e.. Permits to operate, construct, etc.).

Attachment 2

Survey Results: GDF Population

Air Pollution Control District	Number of Permitted GDFs	Number of GDFs with Phase II	Number of Balance GDFs	Number of Vacuum Assist GDFs**
Amador County	43	41	34	7
Antelope Valley	138	135	111	24
Bay Area	2581	2458	2146	312
Butte County	137	103	83	20
Calaveras County	45	41	38	3
Colusa County	22	19	15	4
El Dorado County	118	78	45	33
Feather River	76	71	62	9
Glenn County	24	21	16	5
Great Basin Unified	89	55	45	10
Imperial County	143	118	70	48
Kern County	156	150	62	88
Lake County	42	31	20	11
Lassen County	18	10	8	2
Mariposa County*	52	41	34	7
Mendocino County*	108	86	70	16
Modoc County*	10	8	7	2
Mojave Desert	344	333	260	73
Monterey Bay Unified	459	426	371	55
North Coast Unified	106	89	26	63
Northern Sierra	64	64	46	18
Northern Sonoma County*	263	209	171	38
Placer County	197	180	150	30
Sacramento Metro	514	494	429	65
San Diego County	1080	892	773	119
San Joaquin Valley Unified	2720	2193	1771	422
San Luis Obispo County*	327	260	213	47
Santa Barbara County	188	188	146	42
Shasta County*	189	150	123	27
Siskiyou County*	31	25	20	4
South Coast	5298	4960	4070	890
Tehama County	36	35	27	8
Tuolumne County	35	32	28	4
Ventura County	297	272	195	77
Yolo-Solano	222	170	136	34
Totals	16172	14438	11821	2617

* Numbers were estimated by staff for this district.

** Vacuum Assist numbers were obtained by subtracting Balance numbers from Phase II numbers.

Attachment 3

Survey Results: Hose Population

Air Pollution Control District	Number of hoses at Permitted GDFs	Number of Vapor Recovery Hoses	Number of Balance Hoses	Number of Vacuum Assist Hoses**
Amador County	158	154	120	34
Antelope Valley	1115	1112	825	287
Bay Area	20865	20595	17405	3190
Butte County	1000	853	680	173
Calaveras County	185	173	164	9
Colusa County	314	294	236	58
El Dorado County	660	450	242	208
Feather River	608	603	522	81
Glenn County	181	174	137	37
Great Basin Unified	358	318	253	65
Imperial County	1030	996	513	483
Kern County*	1050	1027	889	138
Lake County	267	225	163	62
Lassen County	244	164	60	104
Mariposa County*	348	340	295	46
Mendocino County*	725	709	614	95
Modoc County*	71	69	60	9
Mojave Desert	2248	2229	1669	560
Monterey Bay Unified	2630	2597	2148	449
North Coast Unified	628	423	188	235
Northern Sierra*	431	421	365	57
Northern Sonoma County*	1770	1730	1498	232
Placer County	1440	1421	152	1269
Sacramento Metro	3690	3600	3000	600
San Diego County	8695	8495	7316	1179
San Joaquin Valley Unified	14365	13838	10593	3245
San Luis Obispo County*	2202	2152	1863	289
Santa Barbara County	1362	1362	1041	321
Shasta County*	1272	1243	1077	167
Siskiyou County*	208	203	176	27
South Coast	102595	100860	89254	11606
Tehama County	359	357	259	98
Tuolumne County	244	232	210	22
Ventura County	2482	2452	1685	767
Yolo-Solano	1494	1386	1080	306
Totals	177295	173257	146750	26507
* Numbers were estimated by staff for this district.				
** Vacuum Assist numbers were obtained by subtracting Balance numbers from Phase II numbers.				

Attachment 4

Survey Results: GDF Population by Population Density*

Air Pollution Control District	Population (People)	Land Area ($mile^2$)	Population Density (People / $mile^2$)	Permitted GDFs / People / $mile^2$	Phase II GDFs / People / $mile^2$
Amador County	35100	593	59	0.7	0.7
Antelope Valley**	298908	1421	210	0.7	0.6
Bay Area**	6605945	5521	1197	2.2	2.1
Butte County	203171	1639	124	1.1	0.8
Calaveras County	40554	1020	40	1.1	1.0
Colusa County	18804	1151	16	1.3	1.2
El Dorado County	156299	1711	91	1.3	0.9
Feather River	139149	1233	113	0.7	0.6
Glenn County	26453	1315	20	1.2	1.0
Great Basin Unified	32006	13986	2	38.9	24.0
Imperial County	142361	4175	34	4.2	3.5
Kern County**	112148	3419	33	4.8	4.6
Lake County	58309	1258	46	0.9	0.7
Lassen County	33828	4557	7	2.4	1.3
Mariposa County	17130	1451	12	*4.4*	*3.5*
Mendocino County	86265	3509	25	*4.4*	*3.5*
Modoc County	9449	3944	2	*4.4*	*3.5*
Mojave Desert**	400725	19200	21	16.5	16.0
Monterey Bay Unified	710598	5156	138	3.3	3.1
North Coast Unified	167047	7759	22	4.9	4.1
Northern Sierra	116412	4465	26	2.5	2.5
Northern Sonoma County	56731	946	60	*4.4*	*3.5*
Placer County	248399	1404	177	1.1	1.0
Sacramento Metro	1223499	966	1267	0.4	0.4
San Diego County	2813833	4200	670	1.6	1.3
San Joaquin Valley Unified**	3190644	23857	134	20.3	16.4
San Luis Obispo County	246681	3304	75	*4.4*	*3.5*
Santa Barbara County	399347	2737	146	1.3	1.3
Shasta County	163256	3785	43	*4.4*	*3.5*
Siskiyou County	44301	6287	7	*4.4*	*3.5*
South Coast**	14920816	11488	1299	4.1	3.8
Tehama County	56039	2951	19	1.9	1.8
Tuolumne County	54501	2235	24	1.4	1.3
Ventura County	753197	1845	408	0.7	0.7
Yolo-Solano**	289744	1469	197	1.1	0.9
Totals and Statewide Averages	33871648	155959	217	4.4	3.5

* Note that this survey uses GDF numbers taken from this 2008 survey while the population and land information are taken from the 2000 Census.

** Because these districts comprise multiple counties and fractions of counties, populations and land areas are estimated for these districts from the 2000 Census.

Italicized entries indicate unresponsive districts which have been assigned the Statewide Average.

APPENDIX D

Proposed Amendment to CP-201: Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities

[Note: The text is shown in ~~strikeout~~ to indicate that it is proposed for deletion and underline to indicate that it is proposed for addition.]

California Environmental Protection Agency

Air Resources Board

Vapor Recovery Certification Procedure

CP - 201

Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities

Adopted: December 9, 1975
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Amended: July 1, 2003
Amended: October 8, 2003
Amended: August 6, 2004
Amended: February 9, 2005
Amended: May 25, 2006
Amended: <u>(Date of amendment to be inserted)</u>

CP-201
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California Environmental Protection Agency
Air Resources Board

Vapor Recovery Certification Procedure

CP-201

Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities

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

D-200 Definitions for Vapor Recovery Procedures

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

1. GENERAL INFORMATION AND APPLICABILITY

This document describes the procedure for evaluating and certifying Phase I and Phase II vapor recovery systems, and components, used at Gasoline Dispensing Facilities (GDF) with underground storage tanks. An ARB Executive Order certifying the system shall be issued only after all of the applicable certification requirements have been successfully completed.

This Certification Procedure, CP-201, is adopted pursuant to Section 41954 of the California Health and Safety Code (CH&SC) and is applicable to vapor recovery systems installed at gasoline dispensing facilities for controlling gasoline vapors emitted during the fueling of storage tanks (Phase I) and the refueling of vehicle fuel tanks (Phase II). Vapor recovery systems are complete systems and shall include all associated dispensers, piping, nozzles, couplers, processing units, underground tanks and any other equipment or components necessary for the control of gasoline vapors during Phase I or Phase II refueling operations at GDF.

1.1 Legislative and Regulatory Requirements of Other State Agencies

As required pursuant to Sections 25290.1.2, 41955 and 41957 of the CH&SC, the Executive Officer shall coordinate this certification procedure with:

1.1.1 Department of Food and Agriculture,
Division of Measurement Standards (DMS)

1.1.2 Department of Forestry and Fire Protection,
Office of the State Fire Marshall (SFM)

1.1.3 Department of Industrial Relations, Division of Occupational Safety and Health (DOSH)

1.1.4 State Water Resources Control Board (SWRCB)
Division of Water Quality

Prior to certification of the vapor recovery system by the Executive Officer, the applicant shall submit plans and specifications for the system to each of these agencies. Certification testing by these agencies may be conducted concurrently with ARB certification testing; however, the approval of the SFM, DMS, DOSH, and a determination by the SWRCB shall be a precondition to certification by ARB. The applicant is responsible for providing documentation of these approvals and determinations to ARB.

1.2 Requirement to Comply with All Other Applicable Codes and Regulations

Certification of a system by the Executive Officer does not exempt the system from compliance with other applicable codes and regulations such as state fire codes, weights and measures regulations, and safety codes and regulations.

2. PERFORMANCE STANDARDS AND SPECIFICATIONS

2.1 Performance Standards

A performance standard defines the minimum performance requirements for certification of any system, including associated components. An applicant may request certification to a performance standard that is more stringent than the minimum performance standard specified in CP-201. Ongoing compliance with all applicable performance standards, including any more stringent standards requested by the applicant, shall be demonstrated throughout certification testing.

2.2 Performance Specifications

A performance specification is an engineering requirement that relates to the proper operation of a specific system or component thereof. In addition to the performance specifications mandated in CP-201, an applicant may specify additional performance specifications for a system or component. An applicant may request certification to a performance specification that is more stringent than the minimum performance specification in CP-201. Ongoing compliance with all applicable performance specifications, including any more stringent specifications requested by the applicant, shall be demonstrated throughout certification testing.

2.3 Innovative System

The innovative system concept provides flexibility in the design of vapor recovery systems. A vapor recovery system that fails to comply with an identified performance standard or specification may qualify for consideration as an innovative system, provided that the system meets the primary emission factor/efficiency, complies with all other applicable requirements of certification, and the Executive Officer determines that the emission benefits of the innovation are greater than the consequences of failing to meet the identified standard or specification.

2.4 Additional or Amended Performance Standards or Performance Specifications

Whenever these Certification Procedures are amended to include additional or amended performance standards, any system that is certified as of the effective date of additional or amended standards shall remain certified until the operative date. Systems installed before the operative date of additional or amended standards may remain in use for the remainder of their useful life or for up to four years after the effective date of the new standard, whichever is shorter, provided the requirements of section 19 are met.

Whenever these Certification Procedures are amended to include additional or amended performance specifications, a system shall remain certified until the Executive Order expiration date. A system that was installed before the operative date of additional or amended performance specifications may remain in use subject to the requirements of section 17.

2.4.1 The effective and operative dates of adoption for all performance standards and specifications contained herein are specified in Table 2-1.

2.4.2 The operative dates of performance standards shall be the effective date of adoption of amended or additional performance standards, except as otherwise specified in Table 2-1. Certifications shall terminate on the operative date of amended or additional performance standards unless the Executive Officer determines that the system meets the amended or additional performance standards. Upon the operative date of amended or additional performance standards, only systems complying with the amended or additional performance standards may be installed.

2.4.3 The operative dates of performance specifications are listed in Table 2-1. As of the operative date of amended or additional performance specifications, only systems complying with the amended or additional performance specifications may be installed.

2.4.4 When the Executive Officer determines that no Phase I or Phase II system has been certified or will not be commercially available by the operative dates specified in Table 2-1 of CP-201, the Executive Officer shall extend the operative date and may extend the effective date of amended or additional performance standards or specifications. If there is only one certified system to meet amended or additional standards, that system is considered to be commercially available if that system can be shipped within eight weeks of the receipt of an order by the equipment manufacturer.

2.4.5 The Executive Officer may determine that a system certified prior to the operative date meets the amended or additional performance standards or specifications. In determining whether a previously certified system conforms with any additional or amended performance standards, specifications or other requirements adopted subsequent to certification of the system, the Executive Officer may consider any appropriate information, including data obtained in the previous certification testing of the system in lieu of new testing.

2.4.6 Gasoline Dispensing Facilities in districts that ARB determines are in attainment with the state standard for Ozone are exempted from the Enhanced Vapor Recovery performance standards and specifications set forth in sections 3 through 9, inclusive, with the exception of the requirement for compatibility with vehicles that are equipped with Onboard Refueling Vapor Recovery (ORVR) systems as specified in subsection 4.4. New GDFs, and those undergoing major modifications, are not exempt. If exempt facilities become subject to additional standards due to a subsequent reclassification of their district from attainment to non-attainment, the facilities will have four years to comply.

2.4.7 The gasoline dispensing facility's gasoline throughput for calendar year 2003 shall be used for determining compliance with the Onboard Refueling Vapor Recovery (ORVR) requirements in Table 2-1.

Table 2-1
Effective and Operative Dates for Phase I and Phase II Vapor Recovery Performance Standards and Specifications

Performance Type	Requirement	Sec.	Effective Date	Operative Date
P/V Vent Valve	As specified in Table 3-1	3.5	Not applicable	July 1, 2007
All other Phase I Standards and Specifications	As specified in Table 3-1	3	April 1, 2001	July 1, 2001
ORVR Compatibility for GDF > 2.0 million gal/yr throughput[1]	As specified in section 2.4.7 and section 4.4	4.4	September 1, 2001	April 1, 2003
ORVR Compatibility for GDF ≥ 1.0 million gal/yr throughput[1]	As specified in section 2.4.7 and section 4.4	4.4	January 1, 2002	April 1, 2003
ORVR Compatibility for GDF < 1.0 million gal/yr throughput[1]	As specified in section 2.4.7 and section 4.4	4.4	March 1, 2002	April 1, 2003
Nozzle Criteria	Post-Refueling Drips ≤ 3 drop/refueling	4.7	April 1, 2005	April 1, 2005
Liquid Retention	≤ 350 ml/1,000 gals.	4.8	April 1, 2001	July 1, 2001
Liquid Retention Nozzle Spitting	≤ 100 ml/1,000 gals. ≤ 1.0 ml /nozzle/fueling	4.8	April 1, 2005	April 1, 2005
Spillage (including drips from spout)	≤ 0.24 pounds/1,000 gallons	4.3	April 1, 2005	April 1, 2005
For GDF > 1.8 mil. gal/yr.	ISD Requirements	9	September 1, 2005	September 1, 2005
For GDF > 600,000 gal/yr.[2]	ISD Requirements	9.1	September 1, 2006	September 1, 2006
Unihose	One Hose/Nozzle per Dispenser Side	4.10	Not applicable	April 1, 2003
Low Permeation Hoses	Permeation rate ≤ 10.0 g/m^2/day as measured in TP 201.8 or UL Subject 330A	4.14	January 1, 2010	January 1, 2011
All other Phase II Standards and Specifications	As specified in Tables 4-1 through 8-2.	4,5, 6,7,8	April 1, 2005	April 1, 2005

[1] Effective January 1, 2001, state law requires the certification of only those systems that are ORVR compatible (Health and Safety Code section 41954, as amended by Chapter 729, Statutes of 2000; Senate Bill 1300).
[2] GDF ≤ 600,000 gal/yr are exempted from ISD requirements.

3. PHASE I PERFORMANCE STANDARDS AND SPECIFICATIONS

Table 3-1 summarizes the Phase I Performance Standards and Specifications applicable to all Phase I vapor recovery systems.

Table 3-1
Phase I Performance Standards and Specifications
APPLICABLE TO ALL PHASE I VAPOR RECOVERY SYSTEMS

Performance Type	Requirement	Sec.	Std. Spec.	Test Procedure
Phase I Efficiency	≥ 98.0%	3.1	Std.	TP-201.1 TP-201.1A
Phase I Emission Factor	HC ≤ 0.15 pounds/1,000 gallons	3.1	Std.	TP-201.1A
Static Pressure Performance	In accordance with section 3.2	3.2	Std.	TP-201.3
Pressure Integrity of Drop-Tube with Overfill Prevention	≤ 0.17 CFH at 2.0 inches H_2O	3.3	Spec.	TP-201.1D
Phase I Product and Vapor Adaptor/Delivery Elbow Connections	Rotatable 360^o, or equivalent	3.4	Spec.	TP-201.1B and Eng. Eval.
Phase I Product Adaptor Cam and Groove	As shown in Figure 3A	3.4	Spec.	Micrometer
Phase I Vapor Recovery Adaptor Cam and Groove	CID A-A-59326 (As shown in Figure 3B)	3.4	Spec.	Micrometer
Phase I Vapor Adaptor	Poppetted	3.4	Spec.	Testing and Eng. Eval.
Phase I Vapor Adaptor	No Indication of Leaks Using Liquid Leak Detection Solution (LDS) or Bagging	3.4	Spec.	LDS or Bagging
Phase I Product and Vapor Adaptors	≤ 108 pound-inch (9 pound-foot) Static Torque	3.4	Spec.	TP-201.1B

Table 3-1 (continued)
Phase I Performance Standards and Specifications
APPLICABLE TO ALL PHASE I VAPOR RECOVERY SYSTEMS

Performance Type	Requirement	Sec.	Std. Spec.	Test Procedure
UST Vent Pipe Pressure/Vacuum Valves	Pressure Settings 2.5 to 6.0 inches H_2O Positive Pressure 6.0 to 10.0 inches H_2O Negative Pressure Leakrate at +2.0 inches $H_2O \leq 0.17$ CFH Leakrate at -4.0 inches $H_2O \leq 0.63$ CFH	3.5	Spec.	TP-201.1E CERT
Spill Container Drain Valves	Leakrate ≤ 0.17 CFH at +2.0 inches H_2O	3.6	Spec.	TP-201.2B TP-201.1C TP-201.1D
Vapor Connectors and Fittings	No Indication of Leaks Using Liquid Leak Detection Solution (LDS) or Bagging	3.7	Spec.	LDS or Bagging
Compatibility with Fuel Blends	Materials shall be compatible with approved fuel blends	3.8	Spec.	Testing and Eng. Eval.

3.1 Phase I Efficiency/Emission Factor

3.1.1 The minimum volumetric efficiency of Phase I systems shall be 98.0%. This shall be determined in accordance with TP-201.1 (Volumetric Efficiency of Phase I Systems at Dispensing Facilities).

3.1.2 The hydrocarbon emission factor for systems with processors shall not exceed 0.15 pounds per 1,000 gallons dispensed. This shall be determined in accordance with TP-201.1A (Emission Factor for Phase I Systems at Dispensing Facilities).

3.2 Static Pressure Performance

The static pressure performance of Phase I vapor recovery systems not associated with Phase II systems shall be determined in accordance with TP-201.3 (Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities).

3.2.1 All Phase I systems shall be capable of meeting the performance standard in accordance with Equation 3-1.

3.2.2 The minimum allowable five-minute final pressure, with an initial pressure of two (2.00) inches H_2O, shall be calculated as follows:

[Equation 3-1]

$$P_f = 2e^{\frac{-500.887}{V}}$$

Where:

P_f = The minimum allowable five-minute final pressure, inches H_2O
V = The total ullage affected by the test, gallons
e = A dimensionless constant approximately equal to 2.718
2 = The initial starting pressure, inches H_2O

3.3 Phase I Drop-Tubes with Over-Fill Prevention Devices

Phase I drop-tube over-fill prevention devices shall have a leak rate not to exceed 0.17 cubic feet per hour (0.17 CFH) at a pressure of two inches water column (2.0" H_2O). The leak rate shall be determined in accordance with TP-201.1D (Leak Rate of Drop Tube Overfill Prevention Devices and Spill Container Drain Valves). Drop-tubes that do not have an over-fill prevention device shall not leak.

3.4 Phase I Vapor Recovery and Product Adaptors

3.4.1 The vapor recovery and product adaptors shall not leak. The vapor recovery and product adaptors, and the method of connection with the delivery elbow, shall be designed so as to prevent the over-tightening or loosening of fittings during normal delivery operations. This may be accomplished by installing a swivel connection on either the storage tank (rotatable adaptor) or delivery elbow side of the equipment, or by anchoring the product and vapor adaptors in such a way that they are not rotated during deliveries, provided the anchoring mechanism does not contribute undue stress to other tank connections. If a delivery elbow with a swivel connection is the preferred method, only cargo tank trucks with those elbows shall deliver to the facility. The adaptors at such a facility shall be incompatible with a delivery elbow that does not have a swivel.

3.4.2 Phase I product adaptors shall be manufactured in accordance with the cam and groove specification as shown in Figure 3A. Phase I vapor recovery adaptors shall be manufactured in accordance with the cam and groove specification as specified in the Commercial Item Description CID A-A-59326 (shown in Figure 3B). These specifications shall be applicable only to new adaptors and shall not be applied to in-use adaptors.

3.4.3 Phase I vapor recovery adaptors shall have a poppet. The poppet shall not leak when closed. The absence of vapor leaks may be verified by the use of commercial liquid leak detection solution, or by bagging, when the vapor containment space of the underground storage tank is subjected to a non-zero gauge pressure. (Note: leak detection solution will detect leaks only when positive gauge pressure exists.)

3.4.4 The static torque of product and vapor recovery adaptors shall not exceed 108 pound-inch (9 pound-foot) when measured in accordance with TP-201.1B.

3.5 Pressure/Vacuum Vent Valves

The Executive Officer shall certify only those vapor recovery systems equipped with a pressure/vacuum (P/V) valve(s) on the underground storage tank vent pipe(s). Verification of the P/V valve requirements set forth below shall be determined by TP-201.1E CERT, (Leak Rate and Cracking Pressure of Pressure/Vacuum Vent Valves).

3.5.1 The pressure specifications for P/V valves shall be:

Positive pressure setting of 2.5 to 6.0 inches H_2O.
Negative pressure setting of 6.0 to 10.0 inches H_2O.

3.5.2 The total leak rates for P/V valves, shall be less than or equal to:

0.17 CFH at +2.0 inches H_2O.
0.63 CFH at -4.0 inches H_2O.

3.5.3 The total leakrate of all P/V valves certified for use with any vapor recovery system shall not exceed 0.17 CFH at 2.0 inches H_2O or 0.63 CFH at -4.0 inches H_2O. Applicants may request to certify a system for use with multiple P/V valves by choosing P/V valves certified to more restrictive leak rate performance specifications. The applicant shall state in the certification application the leak rates to which P/V valves are to be certified. All individual valves shall be tested and certified to those stated leak rate specifications.

3.5.4 Phase I Certification test sites shall be configured with a minimum of three P/V valves (i.e., for representativeness), each P/V valve to be configured with an associated ball valve.

3.6 Spill Containers

3.6.1 Phase I spill container drain valves shall not exceed a leak rate of 0.17 CFH at 2.0 inches H_2O. Spill containers with cover-actuated drain valves shall be tested both with the lid installed and with the lid removed. The leak rate shall be determined in accordance with TP-201.2B (Pressure Integrity of Vapor Recovery Equipment). Phase I configurations installed so that liquid drained through the drain valve drains directly into the drop tube rather than the UST ullage shall be tested in accordance with TP-201.1C (Leak Rate of Drop Tube/Drain Valve Assembly) or TP-201.1D (Leak Rate of Drop Tube Overfill Prevention Device and Spill Container Drain Valves), whichever is applicable.

3.6.2 Drain valves shall not be allowed in spill containers used exclusively for

Phase I vapor connections unless required by other applicable regulations.

3.6.3 Spill Containers shall be maintained in accordance with all applicable requirements.

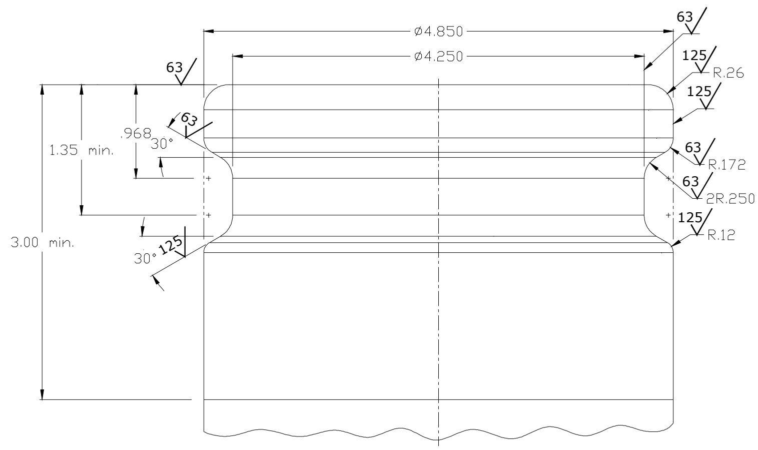
3.7 Vapor Connections and Fittings

All vapor connections and fittings not specifically certified with an allowable leakrate shall not leak. The absence of vapor leaks may be verified by the use of commercial liquid leak detection solution, or by bagging individual components, when the vapor containment space of the underground storage tank is subjected to a non-zero gauge pressure. (Note: leak detection solution will detect leaks only when positive gauge pressure exists.) The absence of liquid leaks may be verified by visual inspection for seepage or drips.

3.8 Materials Compatibility with Fuel Blends

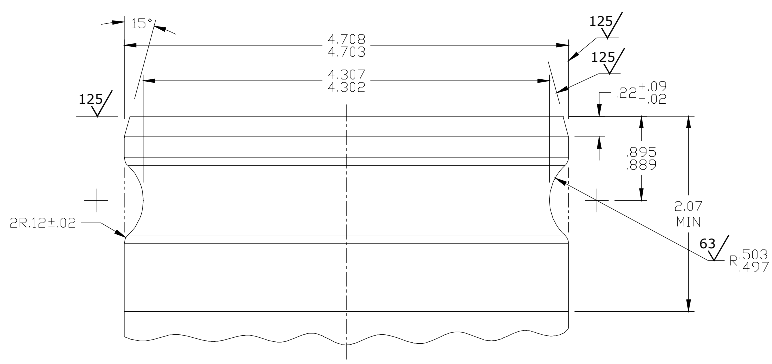
Vapor recovery systems and components shall be compatible with any and all fuel blends in common use in California, including seasonal changes, and approved for use as specified in title 13, CCR, section 2260 et seq. Applicants for certification may request limited certification for use with only specified fuel blends. Such fuel-specific certifications shall clearly specify the limits and restrictions of the certification.

Figure 3A
Phase I Product Adaptor Cam and Groove Specification



UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS
.XXX ± .005
.XX ± .01
ANGLES ± 0.5°

Figure 3B
Phase I Vapor Recovery Adaptor Cam and Groove Specification



UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON DECIMALS
.XXX ± .005
.XX ± .02
ANGLES ± 0.5°

BASED ON
COMMERCIAL ITEM DESCRIPTION
CID A-A-59326
COUPLING HALF, MALE

4. PHASE II PERFORMANCE STANDARDS AND SPECIFICATIONS APPLICABLE TO ALL PHASE II VAPOR RECOVERY SYSTEMS

Table 4-1 summarizes the Phase II Performance Standards and Specifications applicable to all Phase II vapor recovery systems. Phase II vapor recovery systems shall be certified only in facilities equipped with a certified Phase I system.

Table 4-1
Phase II Performance Standards and Specifications
APPLICABLE TO ALL PHASE II VAPOR RECOVERY SYSTEMS

Performance Type	Requirement	Sec.	Std Spec.	Test Procedure
Phase II Emission Factor Includes: Refueling and Vent Emissions Pressure-Related Fugitives	Summer Fuel: 95% Efficiency and HC ≤ 0.38 pounds/1,000 gallons Winter Fuel: 95% Efficiency or HC ≤ 0.38 pounds/1,000 gallons	4.1	Std.	TP-201.2 TP-201.2A TP-201.2F
Static Pressure Performance	In accordance with Section 4.2	4.2	Std.	TP-201.3
Spillage Including Drips from Spout	≤ 0.24 pounds/1,000 gallons	4.3	Std.	TP-201.2C
ORVR Compatibility	Interaction when Refueling ORVR Vehicles Shall Meet the applicable Efficiency or Emission Standard, Including ORVR Penetrations to 80%	4.1 4.4	Std.	Approved Procedure Developed by Mfg.
Liquid Retention Nozzle “Spitting”	≤ 100 ml/1,000 gallons ≤ 1.0 ml per nozzle per test	4.8	Std.	TP-201.2E
ISD	See Section 9	9	Std.	TP-201.2I
Low Permeation Hoses	Permeation rate ≤ 10.0 $g/m^2/day$	4.14	Std.	TP 201.8 or UL Subject 330A
Phase II Compatibility with Phase I Systems	See Section 4.5	4.5	Spec.	Testing and Eng. Eval.

Table 4-1 (continued)
Phase II Performance Standards and Specifications
APPLICABLE TO ALL PHASE II VAPOR RECOVERY SYSTEMS

Performance Type	Requirement	Sec.	Std Spec.	Test Procedure
UST Pressure Criteria (30 day rolling average)	Daily Average Pressure ≤ +0.25 in. H_2O Daily High Pressure ≤ +1.50 in. H_2O	4.6	Spec.	TP-201.7
Nozzle Criteria Each Phase II Nozzle Shall:	Post-Refueling Drips ≤ 3 Drops/Refueling Have an OD ≤ 0.840 inches for 2.5 inches Be capable of fueling any vehicle that can be fueled with a conventional nozzle	4.7	Spec.	TP-201.2D Engineering Evaluation
Nozzle/Dispenser Compatibility	Vapor Check Valve Closed When Hung Hold-open Latch Disengaged When Hung	4.9	Spec.	Testing and Eng. Eval.
Unihose MPD Configuration	One Hose/Nozzle per Dispenser Side	4.10	Spec.	Testing and Eng. Eval.
Phase II Vapor Riser	Minimum 1" Nominal ID	4.11	Spec.	Testing and Eng. Eval.
Vapor Return Piping	No liquid or fixed blockage Minimum 3" Nominal ID after first manifold Recommended slope 1/4" per foot Minimum slope 1/8" per foot	4.11	Spec.	Testing and Eng. Eval.
Vapor Return Piping Rigidity	Rigid piping, or equivalent Bend radius exceeds 6 feet	4.11	Spec.	TP-201.2G
Vapor Return Pipe Runs	The Maximum Allowable Lengths of Pipe Runs Shall Be Established During the Certification Process	4.11	Spec.	Testing and Eng. Eval.
Liquid Condensate Traps	Shall have Automatic Evacuation System	4.12	Spec.	Testing and Eng. Eval.
Connectors and Fittings	No Indication of Vapor Leaks With Liquid Leak Detection Solution (LDS) or Bagging	4.13	Spec.	LDS or Bagging

4.1 Phase II Emission Factor/Efficiency

4.1.1 The Hydrocarbon emission factor and/or efficiency for Phase II vapor recovery systems shall be determined as follows:

When testing conducted with gasoline meeting the requirements for summer fuel:
95% Efficiency and
Hydrocarbon emission factor not to exceed 0.38 pounds/1,000 gallons.

When testing conducted with gasoline meeting the requirements for winter fuel:
95% Efficiency or
Hydrocarbon emission factor not to exceed 0.38 pounds/1,000 gallons.

The emission factor shall demonstrate compliance with the standard when calculated for each of these test populations:
The entire population of 200 vehicles as defined in TP-201.2A
The vehicles defined as "ORVR vehicles" and
The vehicles defined as "non-ORVR vehicles."

The efficiency shall demonstrate compliance with the standard when calculated for the vehicles identified as "non-ORVR."

4.1.2 The emission factor and/or efficiency shall be determined in accordance with TP-201.2 (Efficiency and Emission Factor for Phase II Systems) and shall include all refueling emissions, underground storage tank vent emissions and pressure-related fugitive emissions. Pressure-related fugitive emissions shall be determined in accordance with TP-201.2F (Pressure-Related Fugitive Emissions). Phase II systems that have underground storage tank (UST) pressures sufficient to cause potential fugitive emissions that exceed fifty percent (50%) of the maximum allowable emission factor shall not be certified.

4.2 Static Pressure Performance

The static pressure performance of Phase II systems, including the associated Phase I system, shall be determined in accordance with TP-201.3 (Determination of 2 Inch WC Static Pressure Performance of Vapor Recovery Systems of Dispensing Facilities).

4.2.1 All Phase II vapor recovery systems shall be capable of meeting the performance standard in accordance with Equation 4-1 or 4-2.

4.2.2 For Phase II Balance Systems, the minimum allowable five-minute final pressure, with an initial pressure of two (2.0) inches H_2O, shall be calculated as follows:

[Equation 4-1]

$$P_f = 2e^{\frac{-760.490}{V}}$$ if N = 1-6

$$P_f = 2e^{\frac{-792.196}{V}}$$ if N = 7-12

$$P_f = 2e^{\frac{-824.023}{V}}$$ if N = 13-18

$$P_f = 2e^{\frac{-855.974}{V}}$$ if N = 19-24

$$P_f = 2e^{\frac{-888.047}{V}}$$ if N > 24

Where:

N = The number of affected nozzles. For manifolded systems, N equals the total number of nozzles. For dedicated plumbing configurations, N equals the number of nozzles serviced by the tank being tested.
P_f = The minimum allowable five-minute final pressure, inches H_2O
V = The total ullage affected by the test, gallons
e = A dimensionless constant approximately equal to 2.718
2 = The initial starting pressure, inches H_2O

4.2.3 For Phase II Vacuum Assist Systems, the minimum allowable five-minute final pressure, with an initial pressure of two (2.0) inches H_2O, shall be calculated as follows:

[Equation 4-2]

$$P_f = 2e^{\frac{-500.887}{V}}$$ if N = 1-6

$$P_f = 2e^{\frac{-531.614}{V}}$$ if N = 7-12

$$P_f = 2e^{\frac{-562.455}{V}}$$ if N = 13-18

$$P_f = 2e^{\frac{-593.412}{V}}$$ if N = 19-24

$$P_f = 2e^{\frac{-624.483}{V}}$$ if N > 24

Where:

N = The number of affected nozzles. For manifolded systems, N equals the total number of nozzles. For dedicated plumbing configurations, N equals the number of nozzles serviced by the tank being tested.
P_f = The minimum allowable five-minute final pressure, inches H_2O
V = The total ullage affected by the test, gallons
e = A dimensionless constant approximately equal to 2.718
2 = The initial starting pressure, inches H_2O

4.2.4 Under no circumstances shall Phase II components be partially or completely immersed in water to check for pressure integrity.

4.3 Spillage

The Executive Officer shall not certify vapor recovery systems that cause excessive spillage.

4.3.1 Spillage shall be determined in accordance with TP-201.2C (Spillage from Phase II Systems). The emission factor for spillage shall not exceed 0.24 pounds/1000 gallons dispensed, for each of the following three categories:

All refueling events;
Refueling operations terminated before activation of the primary shutoff; and
Refueling events terminated by activation of the primary shutoff.

4.3.2 The number of self-service refueling operations observed during certification testing of any system for spillage shall be not less than:

1,000 refueling operations [not including topoffs]; and
400 fill-ups [terminated by full tank shut-off, not including topoffs].

4.3.3 Increased spillage resulting from one top-off following the first activation of the automatic (primary) shutoff mechanism shall be subjected to challenge mode testing. Nozzles that result in excessive spillage following one top off shall not be certified.

4.4 Compatibility of Phase II Systems with Vehicles Equipped with ORVR Systems

4.4.1 When refueling vehicles equipped with onboard refueling vapor recovery (ORVR), the Phase II system shall meet the criteria as specified in section 4.1.

4.4.2 Compatibility shall be demonstrated for typical and worst case situations and vehicle populations, up to and including 80% ORVR-equipped vehicles. Actual vehicles shall be used whenever feasible. Simulations may be proposed for specific demonstrations. Any ORVR simulation protocols shall be approved by the Executive Officer prior to conducting the test.

4.4.3 The system manufacturer shall be responsible for developing a procedure by which compatibility can be demonstrated. This procedure is subject to engineering evaluation by the Executive Officer; if it is deemed inadequate and/or unusable, the certification application shall be deemed unacceptable.

4.5 Compatibility of Phase II Systems with Phase I Systems

4.5.1 Phase II vapor recovery systems shall be certified only in facilities equipped with a certified Phase I system. During a Phase II system certification, the associated Phase I system shall be subject to all of the standards and specifications in Section 3, and tested pursuant to Section 13.

Compatibility of the proposed Phase II system with the certified Phase I system installed at the certification test site shall be determined by use of all data collected as part of the monitoring described in Section 13 as well as an evaluation of the UST pressure profiles generated during the certification tests. Failure of any Phase I system tests conducted during the Phase II system certification shall require an explanation from the applicant and a determination by ARB in regard to the possible cause of the failure. Phase I system test failures shall not trigger termination of the Phase II system certification unless sufficient information demonstrates that the Phase II system caused the failure(s).

Repeated component test failures may lead to a determination of incompatibility during the 180-day operational test.

After successfully completing the certification, the Phase II system shall be evaluated based on engineering evaluation of pressure profiles to determine compatibility with other certified Phase I systems. Unless otherwise specified by the applicant, compatibility with all other certified Phase I systems shall be evaluated by ARB**.**

4.5.2 Applicants for certification may, as a performance specification, limit the type of equipment with which their system is compatible. Any such specification shall become a condition of certification.

4.6 Underground Storage Tank Pressure Criteria

Phase II systems that have underground storage tank (UST) pressures sufficient to cause potential fugitive emissions that exceed fifty percent (50%) of the maximum allowable emission factor shall not be certified. In addition, the following criteria shall apply to all Phase II systems.

4.6.1 The vapor recovery system pressure data shall be evaluated so that periods during which system pressure changes directly attributable to Phase I equipment or operations that do not comply with Sections 4.1.2 and/or 4.1.3 of CP-204 are not used to determine failure of the Phase II system to meet the system pressure criteria.

4.6.2 If the vapor recovery system pressure does not deviate from atmospheric pressure except for those excursions attributable to Phase I operations, the integrity of the vapor recovery system shall be presumed to be inadequate.

4.6.3 The daily average pressure shall be computed as follows:

Zero and negative pressure shall be computed as zero pressure; and
Time at positive and zero pressures shall be included in the calculation.
(Example: 6 hours at +1.0 inches H_2O and 18 hours at -1.0inches

H_2O yields an average daily pressure of 0.25 inches H_2O.)

4.6.4 The daily high pressure shall be computed as follows:

Zero and negative pressure shall be computed as zero pressure;
Time at positive and zero pressures shall be included in the calculation;
The average positive pressure for each hour shall be calculated; and
The highest hour is the daily high pressure for the day.

4.6.5 A rolling 30 day average of the daily average pressures and the daily high pressures for each day shall be calculated by averaging the most current daily value with the appropriate values for the previous 29 days. These 30-day rolling averages shall meet the following criteria:

The daily average pressure shall not exceed +0.25 inches H_2O.
The daily high pressure shall not exceed +1.5 inches H_2O.

4.6.6 Pressure readings shall be taken in accordance with TP-201.7 (Continuous Pressure Monitoring). Other methods of data collection and analysis may be used with prior approval of the Executive Officer.

4.7 Nozzle Criteria

4.7.1 Each vapor recovery nozzle shall be capable of refueling any vehicle that complies with the fillpipe specifications and can be fueled by a conventional nozzle.

4.7.2 Each vapor recovery nozzle shall be “dripless,” meaning that no more than three drops shall occur following each refueling operation. This shall be determined in accordance with TP-201.2D (Post-Fueling Drips from Nozzles).

4.7.3 Each vapor recovery nozzle shall comply with the following:
(a) The terminal end shall have a straight section of at least 2.5 inches (6.34 centimeters) in length;
(b) The outside diameter of the terminal end shall not exceed 0.840 inch (2.134 centimeters) for the length of the straight section; and
(c) The retaining spring or collar shall terminate at least 3.0 inches (7.6 centimeters) from the terminal end.

4.7.4 Additional nozzle criteria are contained in Sections 5 and 6.

4.7.5 A minimum of 10 nozzles must be tested for determination of post fueling drips.

4.8 Liquid Retention

4.8.1 Liquid retention in the nozzle and vapor path on the atmospheric side of the vapor check valve shall not exceed 100 ml per 1,000 gallons. This shall be determined in accordance with TP-201.2E (Gasoline Liquid Retention in

Nozzles and Hoses).

4.8.2 Nozzle “spitting” shall not exceed 1.0 ml per nozzle per test and shall be determined in accordance with TP-201.2E (Gasoline Liquid Retention in Nozzles and Hoses).

4.8.3 The number of self-service refueling operations observed during certification testing of any system for liquid retention shall be not less than:

10 refueling operations per nozzle (not including topoffs); and
4 fill-ups (terminated by automatic shut-off, not including topoffs).

4.8.4 A minimum of 10 nozzles must be tested for determination of liquid retention.

4.9 Nozzle/Dispenser Compatibility

The nozzle and dispenser shall be compatible as follows:

4.9.1 The nozzle and dispenser shall be designed such that the vapor check valve is in the closed position when the nozzle is properly hung on the dispenser.

4.9.2 The nozzle and dispenser shall be designed such that the nozzle cannot be hung on the dispenser with the nozzle valves in the open position.

4.10 Unihose MPD Configuration

There shall be only one hose and nozzle for dispensing gasoline on each side of a multi-product dispenser (MPD). This shall not apply to facilities installed prior to April 1, 2003 unless the facility replaces more than 50 percent of the dispensers. Facility modifications that meet the definition of “major modification” for a Phase II system in D-200 trigger the unihose requirement as the facility is considered a “new installation”. Exception: dispensers which must be replaced due to damage resulting from an accident or vandalism may be replaced with the previously installed type of dispenser.

4.11 Vapor Return Piping

The requirements of Sections 4.11.1 through 4.12.2 for the vapor return piping and, if applicable, condensate traps, from the dispenser riser to the underground storage tank, shall apply to any facility installed after April 1, 2003.

4.11.1 The vapor return piping from any fueling point to the underground storage tank shall be free of liquid or fixed blockage.

4.11.2 The Phase II riser shall have a minimum nominal internal diameter of one inch (1” ID). The connection between the Phase II riser and the dispenser shall be made with materials listed for use with gasoline, and shall have a minimum nominal 1” ID.

4.11.3 All new vapor return piping shall have a minimum nominal internal diameter of three inches (3” ID) from the point of the first manifold to the storage tank, including the float vent valve, if applicable. Facilities permitted by a local district prior to the adoption date of this procedure shall be required to meet the minimum three inch diameter standard only upon facility modifications requiring exposing at least 50 percent of the underground vapor return piping.

4.11.4 Wherever feasible, the recommended minimum slope of the vapor return piping, from the dispensers to the tank, shall be at least one-fourth (1/4) inch per foot of run. The minimum slope, in all cases, shall be at least one-eighth (1/8) inch per foot of run.

4.11.5 vapor return piping shall be constructed of rigid piping (any piping material with a bend radius that exceeds six feet; the maximum allowable deflection distance is 9 5/8 inches, as determined by TP-201.2G), or shall be contained within rigid piping, or shall have an equivalent method, approved by the Executive Officer, to ensure that proper slope is achieved and maintained. (Note: this does not apply to flexible connectors at potential stress points, such as storage tanks, dispensers, and tank vents.) Rigidity shall be determined in accordance with TP-201.2G (Bend Radius Determination for Underground Storage Tank Vapor Return Piping).

4.11.6 The Executive Officer shall determine, by testing and/or engineering evaluation, the maximum allowable length of vapor return piping for the system.

4.12 Liquid Condensate Traps

Liquid condensate traps (also known as knockout pots and thief ports) are used to keep the vapor return piping clear of liquid when it is not possible to achieve the necessary slope from the dispenser to the underground storage tank.

4.12.1 Liquid condensate traps shall be used only when the minimum slope requirements of 1/8” per foot of run cannot be met due to the topography.

4.12.2 When condensate traps are installed, they shall be:

(a) certified by ARB;
(b) maintained vapor tight;
(c) accessible for inspection upon request;
(d) capable of automatic evacuation of liquid; and
(e) equipped with an alarm system in case of failure of the evacuation system.

4.13 Connections and Fittings

All connections, fittings, or components not specifically certified with an allowable leakrate shall not leak. Vapor leaks may be determined by the use of commercial leak detection solution, or by bagging individual components, when the vapor containment space of the underground storage tank is subjected to a non-zero gauge pressure. (Note: leak detection solution will detect vapor leaks only when a positive gauge pressure exists). The absence of liquid leaks may be verified by visual inspection for seepage or drips.

4.14 Low Permeation Hoses

The permeation rate for GDF hoses shall be measured in accordance with TP 201.8 or UL Subject 330A, Outline for Investigation for Permeation of Hose Assemblies for Dispensing Flammable Liquids (September 30, 2008), and reported in grams per square meter per day ($g/m^2/day$). If the UL method is chosen and the testing is not conducted by ARB staff, then ARB must be made a beneficiary of the data within the contract of the applicant and the testing facility. All data relevant to measuring the permeation rate of the hose that is collected by the testing facility shall be transmitted to ARB concurrently when it is transmitted to the applicant. The permeation rate shall be less than, or equal to, the following:

Hose: 10.0 $g/m^2/day$
Whip Hose: 10.0 $g/m^2/day$

5. PHASE II PERFORMANCE STANDARDS AND SPECIFICATIONS

APPLICABLE TO BALANCE VAPOR RECOVERY SYSTEMS

Table 5-1 summarizes the performance standards and specifications specifically applicable to Phase II Balance vapor recovery systems. These systems are also subject to all of the standards and specifications in Sections 3 and 4, and the applicable requirements in Sections 7 and 8.

Table 5-1
Phase II Performance Standards and Specifications
APPLICABLE TO PHASE II BALANCE VAPOR RECOVERY SYSTEMS

Performance Type	Requirement	Sec.	Std Spec.	Test Procedure
Nozzle Criteria Each Balance Nozzle Shall:	Have an Insertion Interlock Be Equipped with a Vapor Valve	5.1	Spec.	Testing and Eng. Eval.
Insertion Interlock	Verification of No Liquid Flow Prior to Bellows Compression	5.1	Spec.	Testing and Eng. Eval.
Vapor Check Valve Leakrate	$\leq$ 0.07 CFH at 2.0 inches H_2O	5.1	Spec.	TP-201.2B
Bellows Insertion Force	Pounds (force) to Retaining Device Specified by Applicant and Verified During Certification Testing	5.1	Spec.	Testing and Eng. Eval.
Nozzle Pressure Drop	ΔP at 60 CFH of $N_2 \leq$ 0.08 inches H_2O	5.2	Std.	TP-201.2J
Hose Pressure Drop [Including Whip Hose]	ΔP at 60 CFH of $N_2 \leq$ 0.09 inches H_2O	5.2	Std.	TP-201.2J
Breakaway Pressure Drop	ΔP at 60 CFH of $N_2 \leq$ 0.04 inches H_2O	5.2	Std.	TP-201.2J
Dispenser Pressure Drop	ΔP at 60 CFH of $N_2 \leq$ 0.08 inches H_2O	5.2	Std.	TP-201.2J
Swivel Pressure Drop	ΔP at 60 CFH of $N_2 \leq$ 0.01 inches H_2O	5.2	Std.	TP-201.2J
Pressure Drop Phase II Riser to Tank [Including Vapor Return Line Impact Valve)	ΔP at 60 CFH of $N_2 \leq$ 0.05 inches H_2O	5.2	Std.	TP-201.4
Pressure Drop from Nozzle to UST	ΔP at 60 CFH of $N_2 \leq$ 0.35 inches H_2O ΔP at 80 CFH of $N_2 \leq$ 0.62 inches H_2O	5.2	Std.	TP-201.4
Liquid Removal Systems	Capable of Removing 5 ml/ gal. (average)	5.3	Std.	TP-201.6

5.1 Balance Nozzle Criteria

Nozzles for use with balance systems shall comply with all of the criteria in Section 4.7, as well as all the criteria below.

5.1.1 Each balance nozzle shall have an insertion interlock designed to prevent the dispensing of fuel unless there is an indication that the nozzle is engaged in the fillpipe (i.e., the nozzle bellows is compressed). The performance specifications for the insertion interlock mechanism shall be established during the certification process.

5.1.2 Each balance nozzle shall be equipped with a vapor valve. The leakrate for the vapor valve shall not exceed 0.07 CFH at a pressure of 2.0 inches H_2O.

5.1.3 The force necessary to compress the nozzle bellows to the retaining device, or a specified distance, shall be specified by the applicant for certification and verified during certification testing. The applicant shall include a protocol to test the nozzle bellows compression force in the certification application. This procedure is subject to engineering evaluation and approval by the Executive Officer.

5.2 Dynamic Pressure Drop Criteria for Balance Systems

5.2.1 The dynamic pressure drop for balance systems shall be established in accordance with TP-201.4 (Dynamic Back Pressure). The dynamic pressure drop standards from the tip of the nozzle spout to the underground storage tank, with the Phase I vapor poppet open, shall not exceed the following:

0.35 inches H_2O at a flowrate of 60 CFH of Nitrogen; and
0.62 inches H_2O at a flowrate of 80 CFH of Nitrogen.

5.2.2 The dynamic pressure drop for balance system components, measured in accordance with TP-201.2J (Pressure Drop Bench Testing of Vapor Recovery Components), shall not exceed the following:

Nozzle:	0.08 inches H_2O
Hose (Including Whip Hose):	0.09 inches H_2O
Breakaway:	0.04 inches H_2O
Dispenser:	0.08 inches H_2O
Swivel:	0.01 inches H_2O

The dynamic pressure drop for the balance system vapor return line, including the impact valve, shall not exceed the following:

Phase II Riser to UST:	0.05 inches H_2O

The applicant may request to be certified to a dynamic pressure lower than those specified above. This shall be specified in the application and verified during certification testing.

5.3 Liquid Removal Systems

Liquid removal systems shall be required in configurations that would otherwise be subject to liquid blockage.

The liquid removal rate shall be determined in accordance with TP-201.6 (Determination of Liquid Removal of Phase II Vapor Recovery Systems of Dispensing Facilities). The minimum removal rate, averaged over a minimum of 4 gallons, shall equal or exceed 5 ml per gallon. The minimum dispensing rate for this requirement shall be specified during the certification process.

6.0 PHASE II PERFORMANCE STANDARDS AND SPECIFICATIONS APPLICABLE TO ALL ASSIST VAPOR RECOVERY SYSTEMS

Table 6-1 summarizes the performance standards and specifications specifically applicable to Phase II Assist vapor recovery systems. These systems are also subject to all of the standards and specifications in Sections 3, 4 and the applicable requirements in Sections 7 and 8.

Table 6-1
Phase II Performance Standards and Specifications
APPLICABLE TO ALL PHASE II VACUUM ASSIST SYSTEMS

Performance Type	Requirement	Sec.	Std. Spec.	Test Procedure
Nozzle Criteria Each Assist Nozzle Shall:	Possess a Mini-Boot Have an Integral Vapor Valve	6.1	Spec.	Testing and Eng. Eval.
Nozzle Vapor Valve Leakrate	≤ 0.038 CFH at +2.0 inches H_2O ≤ 0.10 CFH at –100 inches H_2O	6.1	Spec.	TP-201.2B
Nozzle Pressure Drop Specifications ΔP at Specified Vacuum Level	Specified by Applicant and Verified During the Certification Process	6.1	Spec.	TP-201.2J
Maximum Air to Liquid Ratio	1.00 (without processor) 1.30 (with processor)	6.2	Std.	TP-201.5
Air to Liquid Ratio Range	Specified by Applicant and Verified During the Certification Process	6.2	Spec.	TP-201.5

6.1 Nozzle Criteria

6.1.1 Nozzles for use with assist systems shall comply with all of the criteria in Section 4.7, as well as all the criteria below.

6.1.2 Each assist nozzle shall be equipped with a mini-boot that both allows for a lower A/L ratio and minimizes the quantity of liquid gasoline exiting the fillpipe during a spitback event.

6.1.3 Each assist nozzle shall be equipped with a vapor valve. The leakrate for the vapor valve shall not exceed the following:

0.038 CFH at a pressure of +2.0 inches H_2O; and
0.10 CFH at a vacuum of –100 inches H_2O.

6.1.4 The nozzle pressure drop shall be specified by the applicant and verified during the certification process.

6.2 Air to Liquid Ratio

The air to liquid (A/L) ratio shall be specified by the applicant and verified during the certification process in accordance with TP-201.5 (Air to Liquid Volume Ratio). The maximum A/L shall not exceed the following:

1.00 (without processor); and
1.30 (with processor).

7. PHASE II PERFORMANCE STANDARDS AND SPECIFICATIONS APPLICABLE TO ASSIST SYSTEMS UTILIZING A CENTRAL VACUUM UNIT

Table 7-1 summarizes the performance standards and specifications specifically applicable to Phase II Assist vapor recovery systems utilizing a Central Vacuum Unit. These systems are also subject to all of the standards and specifications in Sections 3, 4, 6 and, if applicable, Section 8.

Table 7-1
Phase II Performance Standards and Specifications
APPLICABLE TO ALL PHASE II ASSIST SYSTEMS UTILIZING A CENTRAL VACUUM UNIT

Performance Type	Requirement	Sec.	Std. Spec.	Test Procedure
Specification of Minimum and Maximum Vacuum Levels	Specified by Applicant and Verified During the Certification Process	7.1	Spec.	Testing and Eng. Eval.
Number of Refueling Points Per Vacuum Device	Specified by Applicant and Verified During the Certification Process; and Challenge Mode Testing	7.2	Spec.	TP-201.5

7.1 Vacuum Levels Generated by the Collection Device

The normal operating range of the system shall be specified by the applicant and verified during the certification process, and the maximum and minimum vacuum levels shall be specified in the certification Executive Order. The applicant may propose challenge mode testing to extend the limits of the operating range.

7.2 Maximum Number of Refueling Points per Vacuum Device

The maximum number of refueling points that can be adequately associated with the vacuum device, including meeting the A/L limits, shall be specified by the applicant and verified during certification testing. The test shall be conducted with all of the refueling points except one using the same fuel grade, and the refueling point on which the effectiveness is being tested using a different fuel grade. An engineering evaluation followed by certification testing shall demonstrate the system's ability to meet the required A/L ratio and/or emission factor with a self-adjusting submersible turbine pump (STP).

8. PHASE II PERFORMANCE STANDARDS AND SPECIFICATIONS APPLICABLE TO SYSTEMS UTILIZING A DESTRUCTIVE OR NON-DESTRUCTIVE PROCESSOR

Tables 8-1 and 8-2 summarize the performance standards and specifications specifically applicable to Phase II vapor recovery systems utilizing a processor. These systems are also subject to all of the standards and specifications in Sections 3 and 4 and, the applicable provisions of Sections 5, 6, and 7.

Table 8-1
Phase II Performance Standards and Specifications
APPLICABLE TO ALL PHASE II SYSTEMS
UTILIZING A DESTRUCTIVE PROCESSOR

Performance Type	Requirement	Sec.	Std. Spec.	Test Procedure
Hazardous Air Pollutants (HAPS) from the processor	HAPS from the Processor Shall Not Exceed these Limits: 1,3-Butadiene: 1.2 lbs/year Formaldehyde: 36 lbs/year Acetaldehyde: 84 lbs/year	8.1, 8.2	Std.	TP-201.2H
Maximum HC Rate from Processor	≤ 5.7 lb/1,000 gallons (in breakdown mode)	8.3	Spec.	Testing and Eng. Eval.
Typical Load on Processor	Specified by Applicant and Verified during the Certification Process	8.4	Spec.	Testing and Eng. Eval.
Processor Operation Time	Specified by Applicant and Verified during the Certification Process	8.5	Spec.	Testing and Eng. Eval.

Table 8-2
Phase II Performance Standards and Specifications
APPLICABLE TO ALL PHASE II SYSTEMS
UTILIZING A NON-DESTRUCTIVE PROCESSOR

Performance Type	Requirement	Sec.	Std. Spec.	Test Procedure
Maximum HC Rate from Processor	≤ 5.7 lb/1,000 gallons (in breakdown mode)	8.3	Spec.	Testing and Eng. Eval.
Typical Load on Processor	Specified by Applicant and Verified during the Certification Process	8.4	Spec.	Testing and Eng. Eval.
Processor Operation Time	Specified by Applicant and Verified during the Certification Process	8.5	Spec.	Testing and Eng. Eval.

8.1 Processor Emission Factors

The emission factors shall be established in accordance with TP-201.2 (Efficiency and Emission Factor for Phase II Systems).

8.2 Hazardous Air Pollutants from Destructive Processors

Hazardous Air Pollutants (HAPS) from facilities using processors shall not exceed the following limits:

1,3-Butadiene: 1.2 pounds per year
Formaldehyde: 36 pounds per year
Acetaldehyde: 84 pounds per year

The emission factor shall be established in accordance with TP-201.2H (Determination of Hazardous Air Pollutants from Vapor Recovery Processors).

8.3 Maximum Hydrocarbon Feedrate from the Processor

The maximum Hydrocarbon feedrate from the processor, in breakdown mode, shall not exceed 5.7 pounds per 1,000 gallons.

8.4 Typical Load on the Processor

The typical load on the processor shall be identified by the applicant and verified during the certification process, and shall be included in the specifications in the certification Executive Order.

8.5 Processor Operation Time

The typical processor operation time shall be identified by the applicant and verified during the certification process, and shall be included in the specifications in the certification Executive Orders.

9. IN-STATION DIAGNOSTIC SYSTEMS

9.1 General Requirements

9.1.1 All GDF vapor recovery systems, unless specifically exempted, shall be equipped with an In-Station Diagnostic (ISD) system. Gasoline dispensing facilities that dispense less than or equal to 600,000 gallons per year are exempted from ISD requirements.

9.1.2 All GDF vapor recovery systems shall be equipped with an ISD system or device that has the capability to automatically prohibit the dispensing of fuel and has the capability to automatically inform the station operator in the event of either a malfunction, failure, or degradation of the system as defined below in Section 9.2.

9.1.3 All ISD systems shall be equipped with an RS232 port to remotely access ISD status information using standardized software.

9.1.4 The ISD manufacturer shall provide a means of testing and calibrating the sensors or devices installed on the GDF vapor recovery ISD system, including procedures for verifying that the ISD system operates properly. The means of testing and calibration shall be verified and subjected to challenge mode testing during the certification process.

9.1.5 Personnel trained and certified by the Executive Order certification holder, ISD manufacturers, or California Contractors State License Board shall test and calibrate the installed vapor recovery ISD system sensors or devices annually, at a minimum, with test equipment calibrated to National Institute of Standards and Technology-traceable standards. The minimum annual calibration frequency requirement may be waived and replaced with a frequency to be determined during certification testing if the ISD system manufacturer demonstrates equivalent self testing and automatic calibration features. All vapor recovery ISD system sensors or devices not performing in conformance with the manufacturer's specifications shall be promptly repaired or replaced.

9.1.6 Subject to the Executive Officer approval, other monitoring strategies may be used provided the manufacturer provides a description of the strategy and supporting data showing such strategy is equivalent to these requirements. Information such as monitoring, reliability, and timeliness shall be included.

9.1.7 The vapor recovery ISD system shall include self-testing including the ISD system and sensors that will be verified during the certification process.

9.1.8 The ISD system shall maintain an electronic archive of monthly reports for a period of 12 months and an archive of daily reports for the last rolling 365 days.

9.1.9 The vapor recovery ISD system shall be operational a minimum of ninety five percent (95%) of the time, based on an annual basis or prorated thereof, and shall record the percentage of ISD up-time on a daily basis.

9.1.10 The Executive Officer shall, during certification testing, verify that the system is capable of detecting failures (of a size defined in each subsection, below) with at least a 95% probability while operating at no more than a 1% probability of false alarms. A false alarm occurs when the ISD system issues an alarm, but the vapor recovery system is functioning normally; i.e., the vapor recovery system is operating within the parameter limits required by CP-201 and specified in its Executive Orders.

9.1.11 Certification testing shall be performed in accordance with TP-201.2I (Test Procedure for In-Station Diagnostic Systems).

9.2 Monitoring Requirements

9.2.1 Air/Liquid (A/L) Ratio Vapor Collection Monitoring

(a) Requirement

The GDF vapor recovery ISD system shall monitor the Air to Liquid (A/L) ratio for vapor recovery systems which have A/L limits required by Section 6 and specified in their Executive Orders.

(b) Malfunction Criteria – Gross Failure

The GDF vapor recovery ISD system shall assess, on a daily basis, based on a minimum of 15 non-ORVR dispensing events, when the A/L ratio is at least 75% below the lower certified A/L ratio or at least 75% above the upper certified A/L ratio, shall activate a warning alarm, and shall record the event. This condition must be detected with a probability of 95%. If fewer than 15 non-ORVR dispensing events occur in a day, the ISD system may accumulate events over an additional day or days until a minimum of 15 non-ORVR events is reached. When two such consecutive failed assessments occur, the ISD system shall activate a failure alarm, record that event, and prohibit fuel dispensing from the affected fueling point(s). The ISD system shall have the capability of re-enabling dispensing, and shall record that event.

For example, for a vapor recovery system that is certified to operate with an A/L ratio between 0.9 and 1.0, a failed assessment shall occur if the daily A/L ratio is less than or equal to .22 (25% of .9) or if the daily ratio is greater than or equal to 1.75 (75% more than 1.0). When the ISD system assesses two consecutive failures, the ISD system shall activate an alarm.

(c) Malfunction Criteria - Degradation

The GDF vapor recovery ISD system shall assess, on a weekly basis, based on a minimum of 30 non-ORVR dispensing events, when the A/L ratio is at least 25% below the lower certified A/L ratio or at least 25% above the upper certified A/L ratio, shall activate a warning alarm, and shall record the event. This condition must be detected with a probability of 95%. If fewer than 30 non-ORVR dispensing events occur in a week, the ISD system may accumulate events over an additional day or days until a minimum of 30 non-ORVR events is reached. When two such consecutive failed assessments occur, the ISD system shall activate a failure alarm, record that event, and prohibit fuel dispensing from the affected fueling point(s). The ISD system shall have the capability of re-enabling dispensing, and shall record that event.

For example, for a vapor recovery system that is certified to operate with an A/L ratio between 0.9 and 1.0, a failed assessment shall occur if the weekly A/L ratio is less than or equal to .68 (75% of .9) or if the weekly ratio is greater than or equal to 1.25 (25% more than 1.0). When the ISD system assesses two consecutive failures, the ISD system shall activate an alarm.

9.2.2 Balance Performance Vapor Collection Monitoring

(a) Requirement

The GDF vapor recovery ISD system shall monitor vapor collection performance for balance vapor recovery systems. Vapor collection performance is defined as the amount of vapor collected relative to fuel dispensed to a non-ORVR vehicle. The baseline vapor collection performance is established during certification as described in TP-201.2I.

(b) Malfunction Criteria

The GDF vapor recovery ISD system shall assess, on a daily basis, based on a minimum of 15 non-ORVR dispensing events, when the vapor collection performance is less than 50%, shall activate a warning alarm, and shall record the event. The vapor collection performance can be monitored using flowmeters, pressure transducers, liquid sensors or any other means that indicates a 50% vapor collection decrease from the baseline. This condition must be detected with a probability of 95%. If fewer than 15 non-ORVR dispensing events occur in a day, the ISD system may accumulate events over an additional day or days until a minimum of 15 non-ORVR events is reached. When two such consecutive failed assessments occur, the ISD system shall activate a failure alarm, record that event, and prohibit fuel dispensing from the affected fueling point(s). The ISD system shall have the capability of re-enabling dispensing, and shall record that event.

9.2.3 Central Vacuum Unit Monitoring

(a) Requirement

The GDF vapor recovery ISD system shall verify that the central vacuum unit is operating within the specified range by measuring and recording the vacuum at a minimum of one reading every minute.

(b) Malfunction Criteria

The GDF vapor recovery ISD system shall assess, on a continuous rolling 20 minute basis, when a vacuum failure occurs as determined by the Executive Officer for each Phase II system, shall activate a failure alarm, record the event, and prohibit fuel dispensing from the affected fueling point(s). This condition must be detected with a probability of 95%. The ISD system shall have the capability of re-enabling dispensing and will disable the central vacuum unit monitoring for 24 hours, and shall record that event.

9.2.4 Ullage Pressure Vapor Containment Monitoring

(a) Requirement

The GDF vapor recovery ISD system shall measure and record the pressure of each UST ullage at a minimum of one reading every minute. One pressure monitoring device may be used for multiple USTs that have common vapor recovery piping.

(b) Malfunction Criteria – Gross Failure

The GDF vapor recovery ISD system shall assess, on a weekly basis, when the UST ullage pressure exceeds 1.5” wcg for at least 5% of the time, shall activate a warning alarm, and shall record the event. This condition must be detected with a probability of 95%. When two such consecutive failed assessments occur, the ISD system shall activate a failure alarm, record that event, and prohibit fuel dispensing from the affected fueling point(s). The ISD system shall have the capability of re-enabling dispensing, and shall record that event.

(c) Malfunction Criteria – Degradation

The GDF vapor recovery ISD system shall assess, on a monthly basis, when the UST ullage pressure exceeds 0.50" wcg for at least 25% of the time, shall activate a warning alarm, and shall record the event. This condition must be detected with a probability of 95%. When two such consecutive failed assessments occur, the ISD system shall activate a failure alarm, record that event, and prohibit fuel dispensing from the affected fueling point(s). The ISD system shall have the capability of re-enabling dispensing, and shall record that event.

(d) Malfunction Criteria – Pressure Integrity

The ISD system shall detect the potential for excessive rates of vapor leakage from the UST system. The ISD system shall assess, on a weekly basis, when the vapor recovery system leaks at a rate which is at least 2 times the rate allowed in section 4.2, shall activate a warning alarm, and shall record the event. This condition must be detected with a probability of 95%. When two such consecutive failed assessments occur, the ISD system shall activate a failure alarm, record that event, and prohibit fuel dispensing from the affected fueling point(s). The ISD system shall have the capability of re-enabling dispensing, and shall record that event.

9.2.5 Vapor Processing Monitoring

(a) Requirement

The GDF vapor recovery ISD system shall verify that the processor is functioning properly as specified in Section 8 and the Executive Order.

(b) Malfunction Criteria

The GDF vapor recovery ISD system shall assess, on a daily basis, when the vapor processor is malfunctioning as defined in the Executive Order, shall activate a warning alarm, and shall record the event. When two such consecutive failed assessments occur, the ISD system shall activate a failure alarm, record that event, and prohibit fuel dispensing from the affected fueling point(s). The ISD system shall have the capability of re-enabling dispensing, and shall record that event.

9.3 Records

9.3.1 The GDF vapor recovery ISD system shall generate a monthly report which includes the following:

(a) ISD operational time (as a percentage);
(b) Vapor Recovery system's operating requirements;
(c) Vapor recovery system pass time (as a percentage);

(d) ISD monitoring requirements;
(e) Warnings - this shall include the time and date;
(f) Failures - this shall include the time and;
(g) Event log describing re-enabling action taken - this shall include the time and date; and the time and date the ISD system clock was adjusted.

9.3.2 The GDF vapor recovery ISD system shall generate a monthly printout version on demand which includes the following:

(a) ISD operational time (as a percentage);
(b) Vapor recovery system pass time (as a percentage);
(c) Warnings - this shall include the time and date of the last ten warnings in the selected month;
(d) Failures - this shall include the time and date of the last ten failures in the selected month;
(e) Event Log - this shall include the time and date of the last ten logged exception events in the selected month including re-enabling actions taken and any ISD system clock adjustments.

9.3.3 The GDF vapor recovery ISD system shall generate a daily report which includes the following:

(a) Record of the percentage of ISD up-time on a daily basis;
(b) Highest ullage pressure;
(c) Lowest ullage pressure;
(d) 75th percentile ullage pressure;
(e) 95th percentile ullage pressure;
(f) Daily measured values of each fueling point; and
(g) Daily pass or fail assessment for each fueling point, and
(h) Processor Assessment.

9.3.4 Daily reports (as outlined in Section 9~~10~~.3.3) and monthly printout versions (as outlined in Section 9~~10~~.3.2) shall be available for printing, on demand, at the GDF site from the integral ISD printer. Daily reports shall be available for printing for the previous 30 days. Monthly printout versions shall be available for printing for the previous 12 months.

9.3.5 The ISD system shall store the electronic records of the monthly reports, monthly printout versions, and daily reports, such that the records are maintained despite loss of power to the ISD system.

9.4 Tampering Protection

The GDF vapor recovery ISD system sensors or devices shall be designed and installed in a manner designed to resist unauthorized tampering and to clearly show by visual inspection if tampering has occurred. The ISD system shall be designed and installed so that the station can not dispense fuel unless the ISD system is operating. The manufacturer shall include measures to prevent tampering of the

GDF vapor recovery ISD system in the application. All tampering features are subject to Executive Officer approval.

9.5 Readiness/Function Code

The GDF vapor recovery ISD system shall store a code upon first completing a full diagnostic check of all monitored components and systems. This is applicable when the GDF vapor recovery ISD system is initially installed or when power is restored.

9.6 Stored Vapor Recovery System Conditions

Upon detection of a vapor recovery component or system failure the GDF vapor recovery system conditions shall be stored in computer memory. Subject to Executive Officer approval, stored GDF vapor recovery system conditions shall include, but are not limited to, the time, date, which fueling point was shut down (if applicable), and the fault code.

9.7 Challenge Mode Testing

The Executive Officer shall conduct, or shall contract for and observe, challenge mode testing using test procedures to verify that the ISD system can detect various types of failures, record the incidence of such failures, and respond accordingly with alarms and/or by prohibiting fuel dispensing, as applicable. The ISD system shall have the capability of re-enabling dispensing, and shall record that event. Challenge mode testing shall include verification that interaction with ORVR-equipped vehicles will not cause the ISD to inappropriately identify a failure condition. ISD systems with false positive determinations in excess of one percent (1%) shall not be certified.

9.8 Electronic Access

The monthly and daily reports shall be made available on demand through an RS 232 serial port on a standardized data link connector. All ISD reports shall be electronically accessible with standardized software.

10. CERTIFICATION OF VAPOR RECOVERY SYSTEMS

The Executive Officer shall certify only those vapor recovery systems that, based on testing and engineering evaluation of that system's design, component qualities, and performance, are demonstrated to meet all applicable requirements of this certification procedure. Except as provided in Sections 18 and 19, this certification procedure should not be used to certify individual system components. Steps and conditions of the certification process, along with the Sections of this document that describe them, are outlined below.

(a)	Application Process	Section 11
(b)	Evaluation of the Application	Section 12
(c)	Vapor Recovery System Certification Testing	Section 13
(d)	Alternate Test and Inspection Procedures	Section 14
(e)	Documentation of Certification	Section 15

(f)	Duration and Conditions of Certification	Section 16
(g)	Certification Renewal	Section 17
(h)	Amendments to Executive Orders	Section 18

10.1 Each applicant submitting a system and/or component for certification shall be charged fees not to exceed the actual cost of evaluating and testing the system to determine whether it qualifies for certification. The applicant is required to demonstrate ability to pay the cost of testing prior to certification and performance testing. Applicants may request a payment plan for testing and certification costs. Requests for a payment plan should be submitted in writing to the Executive Officer and should include the payment frequency (monthly, quarterly, etc.) and amount of each payment to meet the obligation. Failure to fulfill the conditions of payment may result in revocation of the Executive Order.

11. APPLICATION PROCESS

All of the information specified in the following subsections shall be submitted to the Executive Officer for an application to be evaluated. An application for certification of a Phase I or Phase II vapor recovery system may be made to the Executive Officer by any applicant.

The applicant for certification shall identify, in the preliminary application, the standard(s) or specification(s) with which the system complies, and demonstrate that the proposed system meets the primary performance standard(s) or specification(s) required by sections 3 through 9 of this Procedure. For the preliminary application, the applicant shall have performed tests for all applicable performance specifications and standards. Engineering reports of successful test results for all these tests must be included in the preliminary application. In order to expedite the application process, the Executive Officer may determine that the application is acceptable based on the results of abbreviated operational and/or efficiency/emission factor testing and spillage. Test results shall be submitted for an operational test of at least 30 days, for a test of at least 50 vehicles demonstrating adequate collection, and for at least 200 observations of spillage (including at least 40 percent fills-ups), or equivalent verification that the system is capable of meeting the performance standards and specifications.

The system, as characterized by these reports, shall be subjected to an engineering evaluation. If the preliminary application is deemed acceptable, the applicant shall be notified and shall expeditiously install the system for certification testing. If the preliminary application is deemed unacceptable, applicants will be notified of any deficiencies within 60 days. The final application shall not be deemed complete until it contains the results of all necessary testing, the approvals of other agencies, the finalized operating and maintenance manuals, and all other requirements of certification.

The manufacturer shall demonstrate, to the satisfaction of the Executive Officer, that the GDF vapor recovery ISD system complies with the performance standards under actual field conditions and simulated failures. Such demonstrations shall include the submission of test results with the certification application.

Estimated timelines for evaluation of certification applications are provided below.

Table 11-1
Estimated Timeline for the Certification Application Process

Action	Time	Determination	ARB Response
Preliminary Application Filed	60 days	Acceptable	Preliminary Application Accepted Test Site Approval Granted
Preliminary Application Filed	60 days	Unacceptable	Notification of Deficiencies
Application Resubmitted	30 days	Acceptable	Preliminary Re-Application Accepted Test site Approval Granted
Application Resubmitted	30 days	Unacceptable	Initial Re-Application Returned with Notation of Deficiencies
Final Application Complete	120 days	Acceptable	Executive Officer Issues Certification Executive Order
Final Application Complete	120 days	Unacceptable	Executive Officer Denies Certification

The application shall be written and signed by an authorized representative of the applicant, and shall include all of the items listed below.

(a) Description of Vapor Recovery System (§11.1)
(b) Description of In-Station Diagnostics System (§11.2)
(c) Materials Compatibility with Fuels (§11.3)
(d) Evidence of Compatibility of the System (§11.3)
(e) Evidence of Reliability of the System (§11.4)
(f) Installation and Maintenance Requirements of the System (§11.5)
(g) Evidence of Financial Responsibility of the Applicant (§11.6)
(h) A copy of the warranty (§11.7)
(i) Request for and information about proposed test station (§11.8)
(j) Notification of System Certification Holder, if applicable (§11.9)
(k) Equipment Defect Identification and Test Protocols (§11.10)
(l) Challenge Modes and Test Protocols (§11.11)
(m) Other Information (§11.12)
(n) <u>Low Permeation Hose Testing Results (§11.13)</u>

11.1 Description of Vapor Recovery System

The application shall include a complete description of the system concept, design and operation, including, but not limited to, the following items.

11.1.1 Identification of critical system operating parameters. An engineering evaluation of the system will be performed by ARB to evaluate any proposed specifications and to establish additional performance specifications if required.

11.1.2 Engineering drawings of system, components, and underground piping and tank configurations for which certification is requested.

11.1.3 Engineering parameters for dispenser vapor system control boards and/or all vapor piping, pumps, nozzles, hanging hardware, vapor processor, etc.

11.1.4 Listing of components and evidence that the manufacturers of any components intended for use with the system and not manufactured by the applicant have been notified of the applicant's intent to obtain certification.

11.1.5 Applicable performance standards and specifications of components, specifically identifying those which exceed the minimum acceptable specifications and for which certification of superior performance is requested, and test results demonstrating compliance with these specifications.

11.1.6 Results of tests demonstrating that the system and components meet all the applicable performance standards. These tests shall be conducted by, or at the expense of, the applicant.

11.1.7 If the application is for an innovative system, the applicant shall identify the performance standard(s) or specification(s) with which the system does not comply. The applicant shall supply any necessary alternative test procedures, and the results of tests demonstrating that the system complies with the emission factor/efficiency. The applicant shall also supply test results demonstrating that the emission benefits of the innovation are greater than the consequences of failing to meet the identified performance standard or specification.

11.1.8 Any additional specifications of the system including, but not limited to, underground pipe sizes, lengths, fittings, volumes, material(s), etc.

11.1.9 Estimated retail price of the system.

11.1.10 For previously tested systems, identification of any and all new components and physical and operational characteristics, together with new test results obtained by the applicant.

11.2 Description of In-Station Diagnostics (ISD)

The applicant shall include the following documentation with the certification application.

11.2.1 A written description of the functional operation of the GDF vapor recovery ISD system.

11.2.2 A table providing the following information shall be included for each monitored component or system, as applicable:

- (a) Corresponding fault code;
- (b) Monitoring method or procedure for malfunction detection;
- (c) Primary malfunction detection parameter and its type of output signal;
- (d) Fault criteria limits used to evaluate output signal of primary parameter;
- (e) Other monitored secondary parameters and conditions (in engineering units) necessary for malfunction detection;
- (f) Monitoring time length and frequency of checks;
- (g) Criteria for storing fault code;
- (h) Criteria for notifying station operator; and
- (i) Criteria used for determining out of range values and input component rationality checks.

11.2.3 A logic flowchart describing the general method of detecting malfunctions for each monitored emission-related component or system.

11.2.4 A written detailed description of the recommended inspection and Maintenance procedures, including inspection intervals that will be provided to the gasoline dispensing facility operator.

11.2.5 A written detailed description of the training plan to train and certify system testers, repairers, installers, and rebuilders.

11.2.6 A written description of the manufacturer's recommended quality control checks.

11.2.7 A written description of calibration and diagnostic checks.

11.2.8 A list of system components that are monitored by the ISD system and test procedures for challenge mode testing. The Executive Officer may modify the list or test procedures based on an engineering evaluation. Additional procedures may be developed as necessary to verify that the system's self-check and self-test features perform accurately.

11.3 Compatibility

11.3.1 The applicant shall submit evidence of system compatibility, including the following:

11.3.2 A procedure developed by the applicant for demonstrating compatibility between the Phase II vapor recovery system and ORVR-equipped vehicles shall be submitted, along with the test results demonstrating compatibility. The procedure shall comply with the provisions in Section 4.4.

11.3.3 Evidence demonstrating the compatibility of the Phase II system with any type of Phase I system with which the applicant wishes the Phase II system to be certified, as specified in Section 4.5. Continuous recordings of pressure readings in the underground storage tank, as well as challenge mode tests, may be used for this demonstration.

11.3.4 Evidence that the system can fuel any vehicle meeting state and federal fillpipe specifications and capable of being fueled by a non-vapor-recovery nozzle.

11.3.5 The applicant shall provide information regarding the materials specifications of all components, including evidence of compatibility with all fuels in common use in California and approved as specified in Section 3.8. If the applicant is requesting a certification for use only with specified fuel formulations, the applicant shall clearly identify, in the application, the included and excluded fuel formulations for which certification is requested.

11.4 Reliability of the System

In order to ensure ongoing compliance, adequately protect public health, and protect the end-user, the reliability of the system shall be addressed in the application, including the following:

11.4.1 The expected life of system and components.

11.4.2 Description of tests conducted to ascertain compliance with performance standards and specifications for the expected life of the system or component, any procedures or mechanisms designed to correct problems, and test results.

11.4.3 Identification of and emission impact of possible failures of system, including component failures

11.4.4 Procedure and criteria for factory testing (integrity, pressure drop, etc.)

11.5 Installation, Operation, and Maintenance of the System

The installation, operation, and maintenance plan shall be submitted, and shall include at least the following items:

11.5.1 Installation, operation, and maintenance manuals of the system, including the ISD.

11.5.2 A plan for training installers in the proper installation of the system.

11.5.3 A replacement parts program.

11.5.4 The estimated installation costs and yearly maintenance costs.

11.6 Evidence of Financial Responsibility

The applicant shall submit evidence of financial responsibility to ensure adequate protection to the end-user of the product as specified in Section 16 and to demonstrate the ability to pay for certification tests.

11.7 Warranty

The applicant shall submit a copy of the warranty for the system, warranties for each component, and samples of component tags or equivalent method of meeting warranty requirements as specified in Section 16.

11.8 Test Station

11.8.1 The vapor recovery system shall be installed and tested in an operating gasoline dispensing facility for the purpose of certification testing.

11.8.2 The applicant shall make arrangements for the vapor recovery system to be installed in an operating gasoline dispensing facility meeting the requirements of Section 13.1.

11.8.3 The request for designation as a test site shall include the following information:

(a) Location of the facility;
(b) Verification of throughput for at least six months; and
(c) Hours of operation.

11.8.4 The applicant shall submit final construction diagrams of the proposed test station. These drawings shall clearly identify the type of vapor recovery piping and connections, pipe slope, and type of storage tanks (i.e., single or double wall, steel, fiberglass, etc.). The Executive Officer may require Professional Engineer or Architect Approved As-Built drawings of the test site. If such drawings are not obtainable, the applicant may request the Executive Officer to accept alternatives sources of this information, such as detailed schematics of the vapor piping configuration and/or photographs clearly identifying underground components.

11.9 Notification of System Certification Holder

If the applicant is not the manufacturer of all system components, the applicant shall include evidence that the applicant has notified the component manufacturer(s) of the applicant’s intended use of the component manufacturers’ equipment in the vapor recovery system for which the application is being made.

11.9.1 When the applicant is requesting inclusion of one or more components on a certified system, the applicant shall notify the manufacturer, if any, named as the applicant or holder of the executive order for the certified system.

11.9.2 When the applicant is requesting certification of one or more components as part of a new system, the applicant shall notify all manufacturers.

11.10 Equipment Defect Identification and Test Protocols

The application shall identify where failure of system components may result in an equipment defect as defined by section 94006, Title 17, CCR (Vapor recovery equipment defect, VRED). Test protocols shall be developed by the applicant, and submitted with the certification application, along with test results, observations, or other analyses conducted by the applicant, to determine if the component or system failure meets the criteria of a VRED. These protocols are subject to engineering evaluation and approval by the Executive Officer.

11.11 Challenge Modes and Test Protocols

The application shall identify potential challenge modes, as described in Section 13.4. Test protocols shall be developed and submitted by the applicant, and submitted with the certification application, along with test results, observations, or other analyses conducted by the applicant, to determine if the system meets the applicable standards and specifications when tested in challenge mode. These protocols are subject to engineering evaluation and approval by the Executive Officer.

11.12 Other Information

11.12.1 The applicant shall provide any other information that the Executive Officer reasonably deems necessary.

11.12.2 For a balance type system, the applicant shall provide a specification for the bellows insertion force as specified in Section 5.1. The applicant will include a protocol to test the nozzle bellows compression force in the certification application. This procedure is subject to engineering evaluation and approval by the Executive Officer.

11.12.3 For an assist system, the applicant shall provide specifications for the nozzle pressure drop as specified in Section 6.1 and for the air to liquid ratio as specified in Section 6.2.

11.12.4 For a central vacuum assist system, the applicant shall provide specifications for the minimum and maximum vacuum levels and for the number of refueling points per vacuum device as specified in Sections 7.1 and 7.2, respectively.

11.12.5 For a system with a processor, the applicant shall provide the typical load on the processor and the processor operation time as specified in Sections 8.4 and 8.5 respectively.

11.13 Low Permeation Hose Testing Results

If the UL Subject 330A, Outline for Investigation for Permeation of Hose Assemblies for Dispensing Flammable Liquids (September 30, 2008), is used to determine the permeation rate and the testing is not conducted by ARB staff, then ARB must be made a beneficiary of the data within the contract of the applicant and the testing facility. All data relevant to measuring the permeation rate of the hose that is collected by the testing facility shall be transmitted to ARB concurrently when it is transmitted to the applicant.

12. EVALUATION OF THE APPLICATION

The application for certification of all systems and components shall be subjected to an evaluation by the Executive Officer

The evaluation of the application shall include, but is not limited to, subsections 12.1 through 12.7.

12.1 Performance Standards and Specifications

The system and component performance standards and specifications identified by the applicant shall be reviewed to ensure that they include and conform to the applicable standards and specifications in Sections 3 through 9 of this Procedure.

12.2 Bench and Operational Testing Results

The procedures for, and results of, bench testing and operational testing contained in the application shall be reviewed. The review shall determine if the procedures adhere to required methodology and ensure that the results meet or exceed the standards and specifications in Sections 3 through 9 of this Procedure. The evaluation shall include a determination of necessary verification testing.

12.3 Evaluation of System Concept

The system concept shall be evaluated to ensure that it is consistent with the generally accepted principles of physics, chemistry, and engineering.

12.4 Materials Specifications and Compatibility with Fuel Formulations

The component materials specifications shall be reviewed to ensure chemical compatibility with gasoline and/or any oxygenates that may be present in gasoline on an ongoing or on a seasonal basis, as specified in Section 3.8. This review shall include consideration of the variations in gasoline formulations for octane differences and summer fuel and winter fuel.

12.5 Installation, Operation and Maintenance Manuals

The installation, operation and maintenance manuals for the system and components shall be reviewed for completeness (see Section 16.6). Routine maintenance procedures shall be reviewed to ensure adequacy and determine that the procedures are not unreasonable (see Section 16.6).

12.6 Equipment Defect Identification

The engineering evaluation shall identify where failure of system components may result in a vapor recovery equipment defect (VRED) as defined by section 94006, title 17, CCR. Test protocols may be developed by the applicant to determine if the component or system failure meets the criteria of a VRED. These test protocols, upon approval of the Executive Officer, are applied during certification testing as provided in section 13.4.1. The ARB Executive Officer may, for good cause, require modification of, and/or testing in addition to, VRED testing proposed by the applicant.

All VRED mode test procedures, and the results of tests conducted by the applicant, shall be reviewed. Additionally, all VRED mode testing conducted during the certification process to verify the test results or further evaluate the systems shall be similarly reviewed.

12.7 Challenge Mode Determination

The applicant may propose, and the Executive Officer shall determine, whether additional testing is needed to ensure the system will meet the applicable standards and specifications under various typical operating parameters. Proposed test protocols may be developed by the applicant to determine if the component or system meets the applicable standards and specifications under such conditions. These test protocols, after engineering evaluation and upon approval of the Executive Officer, are applied during certification testing as provided in section 13.4.2. The ARB Executive Officer may, for good cause, require modification of, and/or testing in addition to, challenge mode testing proposed by the applicant.

13. VAPOR RECOVERY SYSTEM CERTIFICATION TESTING

The Executive Officer shall conduct, or shall contract for and observe, testing of vapor recovery systems conducted for the purpose of certification. Except as otherwise specified in Section 14 of this procedure, vapor recovery systems shall be subjected to evaluation and testing pursuant to the applicable performance standards, performance specifications, and test procedures specified in Sections 3 through 9 of this procedure.

Certification testing of vapor recovery systems shall be conducted only after the preliminary application for certification has been found to be acceptable. Some tests may be conducted more than once to characterize the performance of systems and/or system components over time. Except as otherwise provided in Sections 18 and 19 of this procedure, only complete systems shall be certified.

Failure of any component during testing of a Phase I or Phase II system shall be cause for termination of the certification test, except as noted below. Any Phase I or Phase II system and/or component test failures must be investigated by the applicant and an explanation provided to the Executive Officer within one week of the test failure discovery. The Executive Officer may extend this one week time period for good cause. The Executive Officer may consider information and circumstances presented by the applicant, including previous certification testing, to demonstrate that the failure was attributable to something other than the design of the component and/or system, and may allow further testing without modification.

As specified in Section 4, Phase II vapor recovery systems shall be certified only in facilities equipped with a certified Phase I system. During Phase II system certifications, the associated Phase I system shall be subject to all of the standards and specifications in Section 3. Monitoring of Phase I system performance shall be conducted for the purpose of demonstrating compatibility, as required by Section 4.5, as well as to insure that the Phase I system is functioning properly during the Phase II certification test. Any Phase I components identified as not performing correctly shall be replaced and the Phase II system certification continued. However, Phase II system test data collected during any period associated with a Phase I system test failure shall be evaluated for validity.

During Phase II system certifications, failures of any Phase I components that are determined to be unrelated to the performance of the Phase II system shall not be cause for termination of the Phase II system certification. During Phase II certification tests, if any Phase I component is identified as having performance deficiencies, then a more thorough investigation of the Phase I component/system performance will be initiated by the Executive Officer.

During Phase II system certifications, any Phase I system and/or component performance deficiencies that are determined to be related to the performance of the Phase II system shall be cause for termination of the Phase II system certification, as provided by Section 4.5.

Any applicant or representative of an applicant found to have performed unauthorized maintenance, or to have attempted to conceal or falsify information, including test results and/or equipment failures, may be subject to civil and criminal penalties and testing of the system or component shall be terminated.

13.1 Test Site for Field Testing of Vapor Recovery Systems

The applicant shall make arrangements for the vapor recovery system to be installed in one or more operating GDFs for certification testing, and the applicant shall request, in writing, approval of the GDF as a test site from the Executive Officer. Upon determining that the GDF meets all of the following criteria, the Executive Officer shall, in writing, designate the selected location as a test site, and exempt it from any state or local district prohibition against the installation of uncertified equipment. This shall not exempt it from the prohibition against the offer for sale, or sale, of uncertified equipment. The vapor recovery system shall be installed throughout the entire facility (note this requirement applies to the primary certification test site). The Executive Officer may require that the system be installed in more than one facility for the purpose of testing.

13.1.1 The test station shall have a minimum gasoline throughput of 150,000 gallons/month, as demonstrated over a consecutive six-month period. The minimum allowable monthly throughput for each of the six months is 150,000 gallons/month. The throughput data submitted in the certification application, as specified in Section 11, shall be the most current data available. The test site throughput shall also be shown to comply with this criteria for the six months prior to the start of operational tests.

If the facility is equipped with one hose and nozzle for each gasoline grade, rather than a uni-hose configuration, the minimum throughput requirement shall apply to the gasoline grade with the highest throughput.

13.1.2 The station shall be located within 100 miles of the ARB Sacramento offices. When a suitable location for testing cannot be located within 100 miles of the ARB offices, the Executive Officer may, for good cause, grant approval of a test station elsewhere, provided that all the necessary testing can be conducted at that location. The applicant shall be responsible for any additional costs, such as travel, associated with that location.

13.1.3 Continuous access to the test site by ARB staff, without prior notification, shall be provided. Every effort will be made to minimize inconvenience to the owner/operator of the facility. If testing deemed necessary cannot reasonably be conducted, the facility shall be deemed unacceptable and the test shall be terminated.

13.1.4 If test status is terminated for any reason, uncertified equipment shall be removed within sixty (60) days, unless the Executive Officer extends the time in writing. The local district with jurisdiction over the facility may impose a shorter time.

13.1.5 All test data collected by the applicant at the test site shall be made available to the Executive Officer within fifteen (15) working days. Continuous data, such as pressure monitoring data, shall be submitted in bimonthly increments within 15 days of the last day of the increment. Failure to provide this information may result in extension or termination of the test. The Executive Officer may specify the format in which the data is to be submitted.

13.1.6 Test site designation may be requested by the applicant, or by another person, for facilities other than the certification test site(s), for the purpose of research and development, or independent evaluation of a system prior to its certification. Approval of such a test site shall be at the discretion of the Executive Officer. The research and development test site shall be subject to all of the above conditions with the exception of 13.1.1 and 13.1.2.

13.1.7 For testing conducted pursuant to Section 18, Phase I certification test sites configured with fewer than three P/V valves may be approved by the Executive Officer.

13.1.8 Phase II certification test sites will be configured with one to three P/V vent valves, each with an associated ball valve.

13.2 Bench Testing of Components

Components identified by the engineering evaluation as requiring bench testing to verify performance standards and specifications shall be submitted to the Executive Officer prior to commencement of operational testing. This testing may be repeated during and/or after the operational testing.

13.3 Operational Test of at Least 180 Days

13.3.1 All vapor recovery systems shall be subjected to an operational test. The duration of the test shall be for a minimum of 180 days, and for a minimum of 900,000 gallons of gasoline throughput, except as otherwise provided in Sections 18 and 19.

13.3.2 No maintenance shall be performed other than that which is specified in the installation, operation and maintenance manual. Such maintenance as is routine and necessary shall be performed only after notification of the Executive Officer. Occurrences beyond the reasonable control of the applicant, such as vandalism or accidental damage by customers (e.g., drive-offs), shall not be considered cause for failure of the systems.

13.3.3 Except where it would cause a safety problem, maintenance shall not be performed until approval by the Executive Officer has been obtained. In those situations that require immediate action to avoid potential safety problems, maintenance may be performed immediately and the Executive Officer notified as soon as practicable.

13.3.4 For the purpose of certification, the pressure in the underground storage tank (UST) shall be monitored and recorded continuously throughout the operational test in accordance with TP-201.7 (Continuous Pressure Monitoring). Testing in accordance with the procedures specified in TP-201.3, to verify the pressure integrity of the test station, shall be conducted throughout the operational test period, at intervals not to exceed thirty days. Only data collected during periods of pressure integrity shall be deemed valid. No less than three thirty-consecutive-day periods of valid UST pressure data shall be used to verify that the system meets the standard, as specified in Section 4. All valid pressure data shall be used to make this determination. If the system fails to meet the standard, the data may be examined, and the Executive Officer may exclude pressure excursions directly attributable to noncompliant cargo tank deliveries.

13.3.5 Tests of the performance of the system and/or components shall be conducted periodically throughout the operational test period. If the results of such tests, when extrapolated through the end of the warranty period, show a change that results in the degradation of a performance standard or specification, the Executive Officer may extend or terminate the operational test.

13.4 Equipment Defect and Challenge Mode Testing

13.4.1 Equipment Defect Testing

Testing to determine vapor recovery equipment defects as defined by section 94006 of title 17, California Code of Regulations, shall be conducted as part of certification testing. Vapor recovery equipment defect testing may be allowed during the operational test only when the Executive Officer has determined that conducting the testing does not affect the normal operation of the system.

13.4.2 Challenge Mode Testing

Testing to verify that the system meets applicable standards under various GDF operating conditions may be conducted as part of certification testing. Challenge mode tests may be allowed during the operational test only when the Executive Officer has determined that conducting the testing does not affect the normal operation of the system.

13.5 Efficiency and/or Emission Factor Test

Testing to determine the efficiency and/or emission factor of the vapor recovery system shall be conducted in accordance with the applicable test procedures specified in Section 3 or Section 4 of this procedure. Additional testing may be required if the Executive Officer deems it necessary. The additional testing may include, but is not limited to the determination of the Reid Vapor Pressure of the fuel, the volume and/or mass in the vapor return path, fuel and/or tank temperature, and the uncontrolled emission factor.

13.5.1 **Phase I Systems**. A test of the static pressure integrity of the Phase I system may be conducted, in accordance with TP-201.3, no less than 24-hours or more than seven days prior to conducting TP-201.1 or TP-201.1A. Testing, in accordance with TP-201.1 and/or TP-201.1A, shall be conducted at delivery rates typical and representative of the facilities for which certification is requested. More than one test may be required to accomplish this determination. Certification may be limited to specified maximum loading rates. The static pressure integrity of the vapor recovery system shall be verified as soon as possible, but not more than 48 hours, after the completion of this test. Failure of the static pressure integrity test shall invalidate the TP-201.1 or TP-201.1A test results unless the Executive Officer determines that the integrity failure did not result in any significant unmeasured emissions.

13.5.2 **Phase II Systems**. A test of the static pressure integrity of the Phase II system shall be conducted, in accordance with TP-201.3, no more than seven days and no less than three days prior to conducting TP-201.2. The static pressure integrity of the vapor recovery system, including all test equipment installed for the purpose of conducting TP-201.2, shall be verified as soon as possible, but not more than 48 hours, after the completion of this test. Failure of the static pressure integrity test shall invalidate the TP-201.2 test unless the Executive Officer determines that the integrity failure did not result in any significant unmeasured emissions.

13.6 Vehicle Matrix

A representative matrix of 200 vehicles shall be used when testing to determine the Phase II efficiency for the performance standard. The composition of the representative vehicle matrix shall be determined for each calendar year by the Executive Officer in accordance with TP-201.2A (Determination of Vehicle Matrix for Phase II Systems).

13.6.1 Vehicles will be tested as they enter the dispensing facility ("first in" basis) until a specific matrix block of the distribution is filled.

13.6.2 The vehicle matrix shall include a population of ORVR-equipped vehicles consistent with the distribution of ORVR-equipped vehicles in the State of California.

13.6.3 The Executive Officer may exclude any vehicle that fails to comply with the vehicle fillpipe specifications (“Specifications for Fill Pipes and Openings of Motor Vehicle Fuel Tanks” incorporated by reference in title 13, CCR, section 2235).

13.6.4 The Executive Officer may exclude a vehicle prior to its dispensing episode only if such exclusion and its reason is documented; e.g. unusual facility conditions beyond the applicant's control or unusual modifications to the vehicle. All data required by the test procedure shall be taken for such vehicles for subsequent review and possible reversal of the exclusion decision made during the test. The only other reasons for excluding a vehicle from the test fleet are incomplete data or the factors in TP-201.2.

13.6.5 Additional vehicles may be chosen for testing at the test site by the Executive Officer. The vehicles shall be chosen, according to the Executive Officer's judgment, so that any of the first 200 vehicles, which may later be found to have invalid data associated with them, shall have replacements from among the additional vehicles on a "first in" basis.

13.6.6 A matrix of fewer than 200 vehicles may be made by deleting up to a maximum of three vehicles by reducing the representation in any cell or combination of cells of the vehicle matrix, subject to the following requirements for each candidate reduced cell.

(a) No cell shall be reduced by more than one vehicle

(b) At least one dispensing episode has already been tested in each cell.

(c) None of the other dispensing episodes in the cell have yielded field data which, in the Executive Officer's judgment, would cause a failure to meet the standards specified in section 4.1.

(d) All tested dispensing episodes in all cells have yielded field data that, in the Executive Officer's judgment, would yield valid test results after subsequent review and evaluation.

14. ALTERNATE TEST PROCEDURES AND INSPECTION PROCEDURES

Test procedures other than those specified in this certification procedure shall be used only if prior written approval is obtained from the Executive Officer. A test procedure is a methodology used to determine, with a high degree of accuracy, precision, and reproducibility, the value of a specified parameter. Once the test procedure is conducted, the results are compared to the applicable performance standard to determine the compliance status of the facility. Test procedures are subject to the provisions of Section 41954(h) of the H&SC.

14.1 Alternate Test Procedures for Certification Testing

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

14.2 Request for Approval of Alternate Test Procedure

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

14.3 Response to Request

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

14.4 Testing of Alternate Test Procedures

All testing to determine the acceptability of the procedure shall be conducted by ARB staff or by a third party responsible to and under the direction of ARB. Testing shall be conducted in accordance with the written procedures and instructions provided. The testing shall, at a minimum, consist of nine sets of data pairs, pursuant to USEPA Reference Method 301, “Field Validation of Pollutant Measurement Methods from Various Waste Media”, 40 CFR Part 63, Appendix A, 57 Federal Register page 61992. Criteria established in USEPA Reference Method 301 shall be used to determine whether equivalency between the two test methods exists. For situations where Method 301 is not directly applicable, the Executive Officer shall establish equivalence based on the concepts of comparison with the established method and statistical analysis of bias and variance. Method Approval of the procedure shall be granted, on a case-by-case basis, only after all necessary testing has been conducted. Because of the evolving nature of technology and procedures for vapor recovery systems, such approval may or may not be granted in subsequent cases without a new request for approval and additional testing to determine equivalency. If, after approval is granted, subsequent information demonstrates that equivalency between the two methods no longer meets the USEPA Method 301 requirements, the Executive Officer shall revoke the alternate status of the procedure.

14.5 Documentation of Alternate Test Procedures

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

14.6 Inspection Procedures

Inspection procedures are methodologies that are developed to determine compliance based on applicable performance standards or specifications. Inspection procedures are typically, but not necessarily, parametric in nature and possess a built-in factor of safety, usually at least twice the applicable standard or specification. Inspection procedures are not subject to Section 41954(h) of the H&SC.

Upon submittal of an inspection procedure to ARB, the Executive Officer shall respond within thirty (30) days, providing the applicant with a determination of the applicability of Section 41960.2(d) or Section 41960.2(e) of the H&SC.

15. DOCUMENTATION OF CERTIFICATION

Documentation of certification shall be in the form of an Executive Order listing the criteria requirements of installation and operation of a certified system.

15.1 Executive Order

The certification Executive Order shall include the following items.

15.1.1 A list of components certified for use with the system.
15.1.2 Applicable Performance Standards, Performance Specifications and Test Procedures.
15.1.3 Applicable Operating Parameters and Limitations.
15.1.4 Warranty period(s).
15.1.5 Factory testing requirements, if applicable.

15.2 Summary of Certification Process

A summary of the certification process for each certified system shall be prepared. It shall contain documentation of the successful completion of all applicable portions of the requirements contained in this Certification Procedure including but not limited to the following: All problems encountered throughout the certification process, any changes made to address the identified problems, the location of the test station(s), the types of testing performed, the frequency and/or duration of any testing or monitoring, as appropriate, and any other pertinent information about the evaluation process shall be contained in this summary.

16. DURATION AND CONDITIONS OF CERTIFICATION

Vapor recovery system certifications shall specify the duration and conditions of certification.

16.1 Duration of System Certification

Vapor recovery systems shall be certified for a period of four years. The certification Executive Order shall specify the date on which the certification shall expire if it is not renewed as specified in Section 17.

16.2 One Vapor Recovery System per UST System

No more than one certified Phase II vapor recovery system may be installed on each underground storage tank (UST) system unless the Phase II systems have been specifically certified to be used in combination. For facilities with dedicated vapor piping, each underground storage tank and associated dispensing points shall be considered a UST system, and different UST systems may have different vapor recovery systems. For facilities with manifolded vapor piping connecting storage tanks, all the manifolded tanks and associated dispensing points are considered one UST system, and only one certified Phase II vapor recovery system may be installed in conjunction with that UST system.

16.3 Certification Not Transferable

Upon successful completion of all the requirements, certification shall be issued to the company or individual requesting certification, as the Executive Officer deems appropriate. If the ownership, control or significant assets of the certification holder are changed as the result of a merger, acquisition or any other type of transfer, the expiration date of the certification shall remain unchanged. However, no person shall offer for sale, sell, or install any system or component covered by the certification unless the system or component is recertified under the new ownership, or, in the case of a component, is otherwise certified. Systems installed prior to the transfer shall be subject to the specifications contained in Section 19 of this procedure.

16.4 Financial Responsibility

The adequacy of the (1) methods of distribution, (2) replacement parts program, (3) financial responsibility of the applicant and/or manufacturer, and (4) other factors affecting the economic interests of the system purchaser shall be evaluated by the Executive Officer and determined 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 manufacturer or applicant.

If no system has yet been certified that meets additional or amended performance standards and specifications, as provided in Section 2.4, the applicant is also requested to provide evidence of the commitment of financial investors for the commercial manufacture of the system, a projected market demand of the system as of the operative date of the standard, a manufacturing plan with scheduled milestones for implementation of the plan, an inventory of equipment ready for shipment and a list of suppliers and subcontractors which are part of the manufacturing plan.

16.5 Warranty

The requirements of this section shall apply with equal stringency both to the original applicant and to re-builders applying for certification. For systems that include components not manufactured by the applicant, the applicant shall provide information that shows that all components meet the following requirements:

16.5.1 The applicant and/or manufacturer of vapor recovery system equipment shall provide a warranty for the vapor recovery system and components, including all hanging hardware, to the initial purchaser and any subsequent purchaser within the warranty period. This warranty shall include the ongoing compliance with all applicable performance standards and specifications. The applicant and/or manufacturer may specify that the warranty is contingent upon the use of trained installers.

16.5.2 The minimum warranty shall be for one year from the date of installation for all systems and components. The applicant may request certification for a warranty period exceeding the minimum one-year requirement.

16.5.3 The manufacturer of any vapor recovery system or component shall include a warranty tag with the certified equipment. The tag shall contain at least the following information:

(a) Notice of warranty period;
(b) Date of manufacture, or where date is located on component;
(c) Shelf life of equipment or sell-by date, if applicable;
(d) A statement that the component was factory tested and met all applicable performance standards and specifications; and
(e) A listing of the performance standards and/or specifications to which it was certified.

16.5.4 The Executive Officer shall certify only those systems which, on the basis of an engineering evaluation of such system's component qualities, design, and test performance, can be expected to comply with such system's certification conditions over the one-year warranty period specified above.

16.6 Installation, Operation and Maintenance of the System.

Systems requiring unreasonable maintenance or inspection/maintenance frequencies, as determined by the Executive Officer, shall not be certified. The manufacturer of any vapor recovery system or component shall be responsible for developing manual(s) for all installation, operation and maintenance procedures and shall be submitted with the application as provided by Section 11.5. This manual(s) shall be reviewed during the certification process and the certification shall not be issued until the Executive Officer has approved the manual(s).

16.6.1 The manual(s) shall include all requirements for the proper installation of the system and/or component. The manual(s) shall include recommended maintenance and inspection procedures and equipment performance procedures, including simple tests the operator can use to verify that the system or component is operating in compliance with all applicable requirements. The Executive Officer may require the inclusion of additional procedures.

16.6.2 No changes shall be made to ARB Approved Manuals without the Executive Officer's prior written approval.

16.7 Identification of System Components

16.7.1 All components for vapor recovery systems shall be permanently identified with the manufacturer's name, part number, and a unique serial number. This requirement does not apply to replacement subparts of the primary component. Specific components may be exempted from this requirement if the Executive Officer determines, in writing, that this is not feasible or appropriate.

16.7.2 Nozzle serial numbers shall be permanently affixed to, or stamped on, the nozzle body and easily accessible for inspection. The location of the serial number shall be evaluated by the Executive Officer prior to certification.

16.8 Revocation of Certifications

The certification of any system determined not to be achieving the applicable performance standards and specifications listed in CP-201 may be revoked. The Executive Officer may conduct testing for the purpose of investigation of or verification of potential system deficiencies.

Revoked systems may remain in use for the remainder of their useful life or for up to four years after the revocation whichever is shorter, provided they comply with all of the requirements of section 19. Systems with revoked certifications shall not be installed on new installations or major modification of existing installations.

17. CERTIFICATION RENEWAL

At least eighteen months prior to the expiration of the certification period, the applicant may request to renew the certification. System certifications shall be renewed without additional testing if no data demonstrating system deficiencies is found or developed prior to the expiration date. During the four-year certification period, system deficiencies shall be identified through periodic equipment audits, complaint investigations, certification or compliance tests, surveys, or other sources of information. If deficiencies are documented, they shall be resolved to the satisfaction of the ARB Executive Officer or the certification shall expire. The ARB Executive Officer may extend certifications, for up to one year, if resolution of system deficiencies appears likely or if additional time is required to gather and evaluate information.

The renewal process, along with the sections of this document that describe them, are outlined below.

(a) Request for Renewal	Section 17.1
(b) Review of the Request	Section 17.2
(c) Evaluation of System Deficiencies	Section 17.3
(d) Letter of Intent	Section 17.4
(e) Renewal of Executive Order	Section 17.5

If no request for renewal is received by the ARB within eighteen (18) months of the certification expiration date, the Executive Officer shall send a “Notice of Pending Expiration” to the holder of the Executive Order. Table 17-1 provides an estimated timeline for the renewal process. The timeline is intended to serve as a guide to provide approximate target schedules for completion of steps in the renewal process.

Each applicant submitting a certification renewal request shall be charged fees not to exceed the actual cost of evaluating and/or testing the system to determine whether it qualifies for renewal. Refer to Section 10 for more information on Fee Payment.

17.1 Request for Renewal

The request for renewal shall be written and signed by an authorized representative, and shall include the items listed below:

17.1.1 The Executive Order Number to be renewed;

17.1.2 Identification of any system or component deficiencies through warranty claims or other information such as;
- (a) User feedback
- (b) Contractors/Testers
- (c) Distributors

17.1.3 Amendments to the Executive Order such as:
- (a) Warranty information

(b) Installation, Operations, and Maintenance Manual
(c) System or component drawings
(d) Component modifications

17.1.4 Updates to the training program;
17.1.5 Factory Testing Requirements;
17.1.6 Agency approvals or determinations, if any system modifications have been made since the original approval/determinations (to be submitted prior to approval of EO amendment, see Section 1.1), and
17.1.7 Other information such as the Executive Officer may reasonably require.

17.2 Review Request

The Executive Officer shall review the request and determine if any information provided warrants further evaluation/testing or if amendments to the Executive Order are needed. The applicant will be notified within 60 days of the receipt of the request and whether the submission of additional information is required.

17.3 Evaluation of System Deficiencies

In addition to the information provided in Section 17.1, the Executive Officer shall solicit information on system or component deficiencies through equipment audits, complaint investigations, certification or compliance tests, surveys, VRED data (if applicable), any deficiencies identified by District staff, or other sources of information. The Executive Officer may conduct testing to investigate and/or verify system or component deficiencies. Testing to evaluate component modifications, VRED lists (if applicable), to demonstrate compatibility, or for challenge mode determinations, will be subject to the applicable sections of CP-201. If potential deficiencies are noted, an evaluation will be conducted to determine if:

17.3.1 The deficiency has been or is in the process of being resolved;
17.3.2 System/component modification(s) are necessary;
17.3.3 Executive Order modifications are necessary;
17.3.4 Additional testing is required.

17.4 Letter of Intent

After the review has been completed, a letter of intent will be issued to either 1) renew the Executive Order or 2) allow the Executive Order to expire. Conditions for Expired Certifications are discussed in Section 19 of this certification procedure. The letter of intent should be issued prior to the Executive Order expiration date but will not be issued prior to completion of the evaluation process described in Sections 17.1, 17.2 and 17.3. If the evaluation process is not complete and the letter of intent is not issued prior to the expiration date then the Executive Officer may determine that installation of the system at new facilities or major modifications will not be allowed during the extension period.

The Executive Officer may allow up to a 1-year extension if:

17.4.1 resolution is likely but renewal time is insufficient; or

17.4.2 additional time is necessary to gather and evaluate information.

17.5 Renewal of Executive Order

Executive Orders approved for renewal shall be valid for a period of four years.

17.6 Denial of Executive Order Renewal

System certifications shall not be renewed if the Executive Officer determines that the performance standards and/or specifications in the Executive Order and CP-201 fail to be met. Non-renewed systems may remain in use for the remainder of their useful life or for up to four years after the expiration date, whichever is shorter, provided the requirements of Section 19 are met.

Table 17-1
Estimated Timeline for the Renewal Process

Action	By	Time before Expiration
Submittal of renewal request	Applicant	18 months
Notice of pending expiration (if no renewal request received)	ARB	18 months
Solicitation of system information	ARB	18 months (or at time of receipt of request)
Application review and initial response	ARB	
Renewal request documentation completed	ARB/Applicant	15 months
Submittal of system information for other agency approval/determinations	Applicant	12 months
If testing will be required		
Draft Testing protocol and site identification	ARB/Applicant	14 months
Seal site/start test	ARB	12 months
End testing	ARB	11 to 6 months
Administrative		
Letter of Intent and draft Executive Order	ARB	3 months
Final Executive Order	ARB	0 months

18. AMENDMENTS TO EXECUTIVE ORDERS

Amendments to Executive Orders may be requested to add alternate or replacement components to a certified system. Alternate or replacement components may be modifications to originally certified components, components originally certified on another system, or new components.

Sections of this document that describe the process to amend an EO are outlined below.

(a) Request for Amendment	Section 18.1
(b) Review of the Request	Section 18.2
(c) Testing	Section 18.3
(d) Letter of Intent	Section 18.4
(e) Issuance of Executive Order	Section 18.5

18.1 Request for Amendment

The request for amendment shall be written and signed by an authorized representative of the applicant, and shall include the items listed below:

18.1.1 Executive Order to be amended;
18.1.2 Description of change;
18.1.3 Changes to the Executive Order such as:
- (a) System or component drawings
- (b) Installation, Operations, and Maintenance Manual
- (c) Fuel and System Compatibility

18.1.4 Agency approvals or determinations (to be submitted prior to approval of EO amendment, see Section 1.1);
18.1.5 Updates to the training program;
18.1.6 Applicable information specified in Section 11 ; and
18.1.7 Other information such as the Executive Officer may reasonably require.
18.1.8 <u>Low Permeation Hose Testing Results (See 18.2.6).</u>

18.2 Review of the Request

Requests for alternate or replacement components, equipment reconfigurations, or software changes will be subjected to an engineering evaluation to determine the level of testing required. The Executive Officer may require full operational testing of at least 180 days, allow abbreviated and/or limited operational testing, or determine that a component modification does not affect the performance of the vapor recovery system and therefore no testing is required.

General criteria to be considered when determining the level of testing are as follows:

- (a) extent of physical changes to the component;
- (b) extent of material changes to the component;
- (c) changes that may affect the durability of the component;
- (d) whether performance specifications are the same;
- (e) similarity of system designs (i.e. for component transfers); and

(f) information from previous certification testing.

18.2.1 Modified Components

Modified components (i.e., any changes made to vapor recovery components certified as part of a system) may be certified if testing demonstrates that performance standards and specifications will continue to be achieved. The level and duration of operational and/or other testing will be determined by the Executive Officer based on an engineering evaluation.

18.2.2 Transfer of Components from Another Certified System

Components certified with a system may subsequently be considered for use with another certified system of similar design provided that the performance standards and specifications of the components, as specified in the application for the system, are equivalent. Performance standards and specifications, and compatibility, are to be verified by testing and/or engineering evaluation.

Abbreviated/limited operational testing may be considered since the component has previously undergone 180-day/full certification testing as part of another system. Abbreviated tests will only be allowed for components whose performance is not expected to change or degrade over the longer test period.

18.2.3 New Component(s) that have not been Previously Certified on a System.

Components that have not previously been certified with a system, whether for use as an alternate or replacement component, shall be required to undergo operational testing of at least 180 days. Limited operational testing may be considered for such components, if determined to be appropriate by the Executive Officer.

18.2.4 Components that do not affect the performance of the vapor recovery system.

Certification shall not be required for components, either new or modified, determined by the Executive Officer not to affect the performance of the vapor recovery system. The Executive Officer shall notify the applicant in writing of the determination. However, in some cases, such as when a part number changes, an amendment to the Executive Order may be required. An engineering evaluation shall be conducted to document that the change will not affect the performance of the vapor recovery system.

18.2.5 Other Amendments to Executive Orders

(a) System Configurations

Alternative configurations of components of a certified system may be considered for certification based on limited and abbreviated testing. Examples of alternative system configurations include dual fill or remote fill for Phase I and processor placement or vapor piping options for Phase II.

(b) Software Updates

Software revisions of previously certified software components may be considered for certification with limited and/or abbreviated testing. The software change may be approved with no testing if the Executive Officer finds that the software modifications do not affect the vapor recovery system or in-station diagnostic system performance.

18.2.6 Low Permeation Hose Testing Results

If the UL Subject 330A, Outline for Investigation for Permeation of Hose Assemblies for Dispensing Flammable Liquids (September 30, 2008), is used to determine the permeation rate and the testing is not conducted by ARB staff, then ARB must be made a beneficiary of the data within the contract of the applicant and the testing facility. All data relevant to measuring the permeation rate of the hose that is collected by the testing facility shall be transmitted to ARB concurrently when it is transmitted to the applicant.

18.3 Testing

System or component modifications shall be subjected to sufficient operational, challenge mode, and/or VRED testing to verify the performance and durability of the modified system relative to the certified system that was originally tested.

The level of operational testing to be required is determined as outlined in Section 18.2. Normally, full operational testing of at least 180 days is required. Abbreviated and/or limited operational tests may be allowed in some cases , at the discretion of the Executive Officer. If operational tests are abbreviated, the minimum duration (and gasoline throughput requirement) will be specified by the Executive Officer. The test procedure and test frequency requirements for limited operational tests will be specified by the Executive Officer.

If operational testing is required, then the applicant will choose an appropriate test site meeting the requirements of Section 13.1. The applicant shall submit sufficient information to demonstrate that the requirements of Section 11.8 are met.

18.4 Letter of Intent

A letter shall be sent to the applicant stating the Executive Officer's intent to either issue the amended Executive Order or deny the request.

18.5 Issuance of Executive Order

The original expiration date shall be maintained for all Executive Order amendments unless a renewal, as described in Section 17, is specifically requested and approved.

Previous versions of the Executive Order are superseded, as discussed in Section 19.

19. REPLACEMENT OF COMPONENTS OR PARTS OF A SYSTEM WITH A TERMINATED, REVOKED, SUPERSEDED OR EXPIRED CERTIFICATION

This section applies to systems for which the certification was terminated, revoked, superseded, or has expired. Systems that were installed as of the operative date of a new standard, or that are otherwise subject to Health and Safety Code section 41956.1, may remain in use for the remainder of their useful life or for up to four years after the effective date of the new standard or the date of revocation, whichever is shorter, provided they comply with all of the specifications of this section. Installed systems that have superseded or expired Executive Orders, unless renewed in accordance with Section 17, may remain in use for up to four years after the expiration date of the Executive Order, provided they comply with all of the specifications of Section 19.

19.1 Components and replacement parts meeting the currently and prospectively operative performance standards or specifications may be approved for use as a replacement part with the no-longer-certified system for the remainder of the allowable in-use period of the system.

When an approved, compatible component or replacement part that meets the operative standards or specifications is determined to be commercially available, only that component or replacement part shall be installed. Approval shall not require the replacement of already-installed equipment prior to the end of the useful life of that part or component. The approved replacement component shall be considered to be commercially available if that component can be shipped within three weeks of the receipt of an order by the manufacturer of the component.

19.2 A component or replacement part not meeting the currently operative performance standards or specifications, but which was certified for use with the system, shall be used as a replacement only if no compatible component or part that meets the new standards or specifications has been approved as a replacement part.

19.3 A component or part that was not certified for use with the system, and that does not meet all of the currently operative standards or specifications, may be approved as a replacement part or component for use on the system provided that there are no other commercially available certified parts meeting the most current performance standards or specifications.

19.4 Approval of replacement parts shall be requested, evaluated, and granted as follows:

19.4.1 A request shall be submitted to the Executive Officer.

19.4.2 The request shall include the information outlined in Section 18.1 and information demonstrating that the component is compatible with the system.

19.4.3 Requests for replacement parts will be subjected to an engineering evaluation to determine the level of testing required. The Executive Officer may require full operational testing of at least 180 days and other certification tests (e.g., VRED or challenge), allow abbreviated and/or limited operational testing, or determine that additional testing is not necessary.

General criteria to be considered when determining the level of testing are as follows:

(a) similarity of system designs;
(b) information from previous certification testing; and
(c) compatibility of the replacement part.

19.4.4 The Executive Officer shall issue an approval letter to authorize the use of the approved replacement part and to detail any modification(s) to the Executive Order for which the part is approved. Requests not granted shall be documented with a disapproval letter.

APPENDIX E

Proposed Gasoline Dispensing Facility Hose Test Procedure: TP-201.8 Determination of the Permeation Rate from a Gasoline Dispensing Facility Hose

“Note: All text is proposed for adoption as permitted by title 2, California Code of Regulations, section 8. For ease of review, underline to indicate proposed text for adoption has been omitted."

California Environmental Protection Agency

Air Resources Board

Proposed
Vapor Recovery Test Procedure

TP-201.8

DETERMINATION OF THE PERMEATION RATE FROM A GASOLINE DISPENSING FACILITY HOSE

Adopted: (date of adoption to be inserted)

California Environmental Protection Agency
Air Resources Board

Vapor Recovery Test Procedure

TP-201.8

Determination of the Permeation Rate From a Gasoline Dispensing Facility Hose

Definitions common to all certification and test procedures are in:

D-200 Definitions for Vapor Recovery Procedures

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

1. PURPOSE AND APPLICABILITY

The purpose of this procedure is to provide general guidelines and examples of equipment used to determine gasoline permeation rates of gasoline dispensing facility (GDF) hoses. It is applicable for use with those GDF hoses that are part of an ARB certified vapor recovery system that meet the minimum certification requirements as described in Certification Procedure 201 (CP-201). This procedure is used during certification.

2. SUMMARY OF TEST PROCEDURE

This procedure summarizes a method of determining the permeation rate of a GDF hose.

2.1 Preconditioning Procedure. GDF hoses are preconditioned to ensure that materials chosen to reduce permeation in GDF hoses are durable enough to retain their permeation reducing qualities after being exposed to repeated bending representative of normal in use operations. For practicality, only one of the hoses must be subjected to repeated bending during preconditioning. After filling all hoses with test fuel (excluding the blank) and the capping them, a random hose is subjected to five days of repeated bending in a hose bending machine. Once the hose has completed the prescribed number of bending cycles, the preconditioning phase is over.

2.2 Test Procedure. The purpose of the test procedure is to determine permeation rates of filled GDF hoses by observing mass loss over the testing period. Within 72 hours of completing the preconditioning of the hoses, the hoses are to be emptied of there current test fuel, filled with a fresh charge of test fuel, capped, and placed in a temperature control chamber set to a specified temperature. The hoses are weighed over a regular interval with mass loss from each hose being recorded.

Mass loss rates are then calculated and recorded. Testing is continued in this manner until mass loss rates have stabilized such that steady state permeation criteria has been satisfied. The steady state mass loss rates are reported as the steady state permeation rates of the hoses.

3. BIASES AND INTERFERENCES

3.1 Test fuel degradation is the change that can occur in a multi-constituent test fuel over the course of a long test period, as different constituents permeate out of the hose at different rates. Failure to control for test fuel degradation may lead to significant underreporting of hose permeation rates. For this reason, a hose's test fuel mass must be evaluated during each day that hose mass loss is recorded. When it is determined that a hose is close to exceeding a test fuel loss of five percent as determined from hose mass measurements, the hose's test fuel should be refreshed. Fuel refreshing requires the spent test fuel within the sample be dumped and replaced by a fresh charge of test fuel.

3.2 Temperature is a critical factor for when considering permeation rate for a material. If for any day in the test procedure (8) the chamber is outside of the proper operating temperature of 38 ± 1°C (100 ± 2°F) for a total time of more than 60 minutes, data corresponding to this period shall not be used for the purpose of determining a steady state permeation rate. If the temperature disturbance is very significant, engineering judgment should be used to determine how many subsequent data point should be discarded.

3.2 A hose's temperature may not correspond testing chamber temperature if it is removed from the chamber for excessive periods during the testing. For this reason, minimize time for which hoses are removed from the chamber. Hoses should be removed from the chamber no more than 30 minutes on days when the hose is being weighed, and no more than 60 minutes on days when fuel refreshing (3.1) is required.

3.3 Some mass loss may not be due to permeation, but instead attributable to out-gassing of the hose material or humidity changes. For this reason a control hose (blank) must be used to help eliminate mass loss observations that are not due to permeation. The blank will be tested in the same manner as the other test hoses not undergoing the bending test, with the exception that it will not be filled with fuel. The mass change of the blank will be subtracted from the mass changes observed in the other hoses. These corrected mass losses of the test hoses will be the mass losses which from which permeation rates are determined. The blank shall be selected at random from the six test hoses submitted by the certification applicant.

3.4 Excessive surface contact of the hose with foreign objects, or overlapping contact of the sample itself, may interfere with normal permeation pathways within the hose, which could lead to underreporting permeation rates. For this reason, the hose should be positioned within the test chamber such that surface contact with the hose is minimized as much as is practical.

3.5 Hose contact with foreign contaminants may cause changes in mass loss not due to permeation. For this reason, care should be taken when handling the hoses to avoid contact with contaminants. In the event that contamination of a hose occurs, the hose should be immediately wiped clean with a clean towel, and the incident should be noted in the final test report. The testing engineer responsible for the testing will evaluate the severity of the incident and decide what remedy may be taken to correct for any effect this may have on the data.

3.6 Hoses should be examined both visually and by smell during each weighing period for signs of wetness or leakage. If a leak is found, and the leak is determined to be due to an error in capping or sealing of the hose, wipe the leakage from the hose and correct the capping or sealing error. A note of the event should be included in the final test report. The testing engineer responsible for the testing will evaluate the severity of the incident and decide what remedy may be taken to correct for any effect this may have on the data.

3.7 Testing data should be examined regularly for signs that any hose is loosing mass at an exceptionally higher rate than the other hoses. A significantly higher rate of mass loss may indicate leakage. If this is the case, examine the sample for visible leaks (3.6) and re-tighten the hose caps.

4. SENSITIVITY, RANGE, AND PRECISION

4.1 Scale. The scale for determining sample mass must be capable of mass measurements from 2 to 8 kg, and display results to a resolution of 0.01 g.

4.2 Test Chamber Temperature. The testing chamber shall be able to maintain a constant temperature of 38 ± 1°C (100 ± 2°F).

4.3 Torque wrench. The torque wrench shall be capable of producing readable torques from 30 to 100 ± 5 ft lb.

5. EQUIPMENT

5.1 A test chamber capable of maintaining a constant temperature of 38 ± 1°C (100 ± 2°F). The chamber shall be engineered to be intrin sically safe for the purpose of testing with hydrocarbon vapors. The minimum volume of the chamber should be 30 cubic feet and have internal dimensions large enough to minimize hose surface contact. Test chamber temperatures shall be recorded in a data logger, capable of recording a minimum of 2 months worth of temperature data with sampling intervals of 1 minute or less.

5.2 A scale capable of measuring mass measurements from 2 to 8 kg, and display results to a resolution of 0.01 g. The scale should have a weighing pan with a minimum length and width of 8 inches each.

5.3 Six hose samples for testing. One of these hoses will be chosen at random to be the blank (see 3.3). Another shall be chosen at random to be submitted to repeated bending during the preconditioning period. These hoses should all be of the type for which certification is desired. All hoses should be fabricated from the same production run to ensure consistent observed levels of mass loss. This will also ensure that recorded mass loss from the blank is representative of losses to all of the hoses that are not due to permeation. All samples should be 50 ± 6 inches (127 ± 15 centimeters) in length. This length shall be measured from the o-ring seats on the fittings located at each end of the hose while the hose is fully extended.

5.4 GDF hose dimension drawing. A dimension drawing must accompany the hoses submitted for testing. The drawing must clearly indicate;

- The location, material type, and thickness of the low permeation barrier material
- A cross-sectional view of the fitting as it is joined to the hose
- For non-balance type GDF hoses, the outer hose inner diameter
- For balance GDF hoses, maximum and minimum outer hose inner radii (For balance hoses the average diameter will be determined from the average radii)

5.5 A hose bending apparatus should be used to satisfy the preconditioning bending requirement. The bending apparatus will bend the hose over a pulley that is 7 inches in diameter. The hose should remain in constant contact with at least 90 degrees of the pulley surface. The hose should travel a linear distance of no less than 2 feet (61 centimeters).

5.6 CE-10 test fuel. This is a mixture which is 45 percent toluene, 45 percent isooctane, and 10 percent ethanol by volume. This is the test fuel upon which permeation rates will be measured for ARB certification. This fuel should meet all specifications for CE-10 as discussed in Society of Automotive Engineers (SAE) recommended practices SAE J1681 (JAN 2000).

5.7 Carbide scribe. A carbon scribe, or similar etching instrument, shall be used to mark hose fittings or caps with hose sample numbers 1 – 6 for identification purposes.

6. PRE-TEST PROCEDURES

These methods are not inclusive with respect to specifications (e.g., equipment and supplies) and procedures essential to its performance. Persons using these methods should have a thorough knowledge of gasoline, gasoline vapor hoses, and hose permeation test methods. Particular care should be exercised in the area of safety and equipment operation in the presence of gasoline vapor and potentially explosive atmospheres.

6.1 Verify that all equipment is operating within normal manufacturer specified parameters and that all manufacturer specified equipment calibrations are current.

6.2 From the six submitted test hoses, select two hoses at random. With the carbide scribe, label these hoses at their fittings as hoses 5 and 6. Then proceed to label the rest of the hoses as 1 – 4. Hose 6 will be the blank. Hose 5 will be the hose subjected to repeated bending during the preconditioning procedure.

6.3 For vapor recovery hose assemblies, remove the inner hose path. This component is unnecessary for determining permeation rates and could lead to interferences within the test procedure.

6.4 Straighten each hose and measure its length (L) to ± 1.0 cm. Care should be taken not to stretch the hose. L should be measured from:

- O-ring seat at the thread base of both fittings of the hose, for vapor recovery hoses
- Face of the nut at the thread base of both fittings of the hose, for conventional hoses

6.5 Verify all hose dimensions from the dimension drawing (see 5.5) where possible. Incorrect dimension drawings may be grounds for denying certification.

6.6 Cap and weigh all empty hoses and record their masses (m_o) to a hundredth of a gram. Record the time and date.

6.7 Calculate 90 percent of the volume of the hose using the equation in section 10.2. This will be the volume (V) of the initial test fuel charge to be filled into the hoses. Note that 90 percent is only important for consistency between samples and may be altered if necessary based upon engineering judgment.

6.8 Fill hoses 1 – 5 with CE-10 test fuel (see 5.6). The hoses shall be filled to 90 percent volume as calculated in 6.7. Cap both ends and torque to 50 ± 5 foot pounds. Other torque specifications or sealing instructions may be used provided they are reflective of standard installation instructions that would normally be provided with the product when sold. For hoses with NPT style threaded fittings, in addition to the torque requirement specified above, a standard NPT cap and pipe joint sealing compound or tape certified for flammable liquid dispensing applications shall be used. Record the time and date.

7. PRECONDITIONING PROCEDURE

The purpose of the preconditioning procedure is to apply bending stresses to the hose materials that are reflective of normal use and to allow hoses to move closer to steady state permeation rates before beginning the test procedure (8). Material crystallinity and polymer chain stiffness are two material properties that help to reduce or eliminate permeation. These characteristics are not conducive to the normal flexing that a GDF hose experiences on a daily basis which may tend to break down materials with these properties. Applying the repeated bending element of the preconditioning procedure will identify hoses that may appear to meet permeation requirements under static conditions, but do not hold up under real world use. For practicality, only one hose is subjected to repeated bending. This is adequate because the hose is selected at random (6.2) and all hoses must be below the required permeation limits.

Particular care should be exercised in the area of safety and equipment operation in the presence of gasoline vapor and potentially explosive atmospheres.

7.1 Within 7 days of completing the pre-test procedure, attach hose 5 to the bending machine in preparation for repeated bending. All other hoses should be stored nearby so that all hoses are exposed to similar ambient conditions. Record the time and date.

7.2 Begin repeated bending on hose 5. If practical, this should begin on a Monday. The hose should be subjected to 3800 bending cycles per day for a period of five days.

7.3 When repeated bending requirements have been met, remove hose 5 from the bending machine. Record the time and date.

7.4 If not already on, turn the test chamber (5.1) on and set to 38℃ (100℉) in preparation for beginning the test procedure (8). Begin the test procedure within 72 hours of completing the preconditioning procedure.

8. TEST PROCEDURE

These methods are not inclusive with respect to specifications (e.g., equipment and supplies) and procedures essential to its performance. Persons using these methods should have a thorough knowledge of gasoline, gasoline vapor hoses, and hose permeation test methods. Particular care should be exercised in the area of safety and equipment operation in the presence of gasoline vapor and potentially explosive atmospheres.

The test procedure should begin within 72 hours of completing the preconditioning procedure (7) and begin on a Monday, Wednesday, or Friday. Adherence to a regular weighing schedule should be maintained as much as possible. Weighing should be conducted on a Monday, Wednesday, Friday basis for data uniformity. If a different weighing interval is to be used, this should be noted in the final test report. If any regular weighing days are skipped for practical reasons, make a note of this in the final test report.

Steady state permeation shall not be determined until the test procedure has been performed for a period of at least 28 days. It is helpful to enter data as it is recorded into a spread sheet formatted with the calculations given in section 10. This will allow for a quick determination of fuel degradation and steady state permeation rate for each hose.

If at any time during the test procedure (8) the permeation rate for a hose is greater than 15.0 $g/m^2/day$ for at least 3 consecutive data points, and all test parameters are determined to be within specifications, the test procedure shall be terminated and the hose will be denied certification.

8.1 Empty and refill test hoses 1 – 5 with a fresh charge of CE-10 test fuel. The amount of fuel used to refill each hose should be the volume calculated in 6.7. Note that some swelling may have occurred within the hose which may not allow refilling of the amount calculated in 6.7. If this is the case, fill the hose to within one to two inches of the top of the threads before capping and make a note of this in the final test report.

8.2 Weigh hoses and record their initial masses (m_i) to a hundredth of a gram. Record the time and date. This time will be referred to as t_o.

8.3 Immediately following 8.2, place all hoses into the testing chamber. The testing chamber should already be operating at 38°C (100°F) from step 7.4.

8.4 At the next regular weighing interval, and ± 30 minutes of the time recorded in 8.2, remove the hoses from the chamber, weigh them, and record each of their masses (m_n). Record the time and date.

8.5 Immediately following 8.4, place all hoses into the testing chamber.

8.6 If 28 days have not past since beginning the test procedure, skip 8.6. Perform the calculation in section 10.3 to see if steady state permeation has been reached for hoses 1 – 5. If a steady state permeation rate can be determined for a hose, remove that hose from the testing. The steady state permeation rate determined here for that hose is the rate that will be reported for that hose. For all remaining hoses, continue to 8.7.

8.7 Perform the calculation in section 10.4 to determine percent fuel loss for hoses 1 – 5. If it appears that a hose will reach five percent fuel loss (m_{min}) within the next two weighing periods, retrieve that hose from the testing chamber, empty and refill it as described in step 8.1. Proceed to weigh the hose and record the mass of that hose, along with the date and the time. Then place the hose back into the testing chamber.

8.8 Continue with the remaining hoses at step 8.4 until steady state permeation rates have been achieved for hoses 1 – 5.

9. POST-TEST PROCEDURES

Power down all test equipment that is not in use and safely dispose of spent test fuel.

10. CALCULATIONS

The calculations within this section are applied within this procedure for the purpose of determining: hose surface area, test fuel volume, steady state permeation rate for a hose, and percent fuel loss for a hose.

10.1 Permeation surface area of a GDF hose. Permeation surface area shall be determined with the following formula:

$$A = L \cdot D \cdot \pi \qquad (m^2)$$

Where:

A = Permeation surface area reported in square meters (m^2).

L = Length of the hose as measured in 6.4. (Be sure that this number is in meters.)

D = Inner diameter of the outer hose. (Be sure that this number is in meters.)

10.2 Test fuel volume. 90 percent test fuel volume shall be determined from the following formula:

$$V = 0.9 \cdot L \cdot D^2 \cdot \pi/4 \qquad \text{(ml)}$$

Where:

V = 90 percent test fuel volume reported in milliliters (ml).

L = Length of the hose as measured in 6.4. (Be sure that this number is in centimeters.)

D = Inner diameter of the outer hose. (Be sure that this number is in centimeters.)

10.3 Steady state permeation rate. The steady state permeation rate is the steady state mass loss rate as determined with the following steps:

a) Determine the mass loss rate for a hose at a data point as follows:

$$M_n = (m_n - m_{n-1} - (m_{(n),b} - m_{(n-1),b})) / A / d_n \qquad (g/m^2/day)$$

or if following a refilling event

$$M_n = (m_n - m_i - (m_{(n),b} - m_{(n-1),b})) / A / d_n \qquad (g/m^2/day)$$

Where:

M_n = Mass loss rate for a hose at data point n, reported in grams per square meter per day ($g/m^2/day$).

m_n = Mass of a hose (g) at data point n.

m_{n-1} = Mass of a hose (g) at the data point immediately proceeding n.

$m_{(n),b}$ = Mass of the blank (g) at data point n.

$m_{(n-1),b}$ = Mass of the blank (g) at the data point immediately proceeding n.

m_i = Mass of a hose after last being refilled.

A = Permeation surface area from 10.1.

d_n = Number of days since last data point from n.

b) Determine the average mass loss rate for the last seven data points as follows:

$$M_{avg} = \frac{M_n + M_{n-1} + M_{n-2} + M_{n-3} + M_{n-4} + M_{n-5} + M_{n-6}}{7} \qquad (g/m^2/day)$$

Where:

M_{avg} = Average mass loss rate ($g/m^2/day$) at data point n.

M_{n-x} = Mass loss rate ($g/m^2/day$) for a hose at data point n - x.

c) Determine that all seven mass rates calculated in b) that comprise M_{avg} are with 15% of M_{avg} as follows:

$(M_{avg} - 0.15 \cdot M_{avg}) \leq M_n, M_{n-1}, M_{n-2}, M_{n-3}, M_{n-4}, M_{n-5}, M_{n-6} \leq (M_{avg} + 0.15 \cdot M_{avg})$

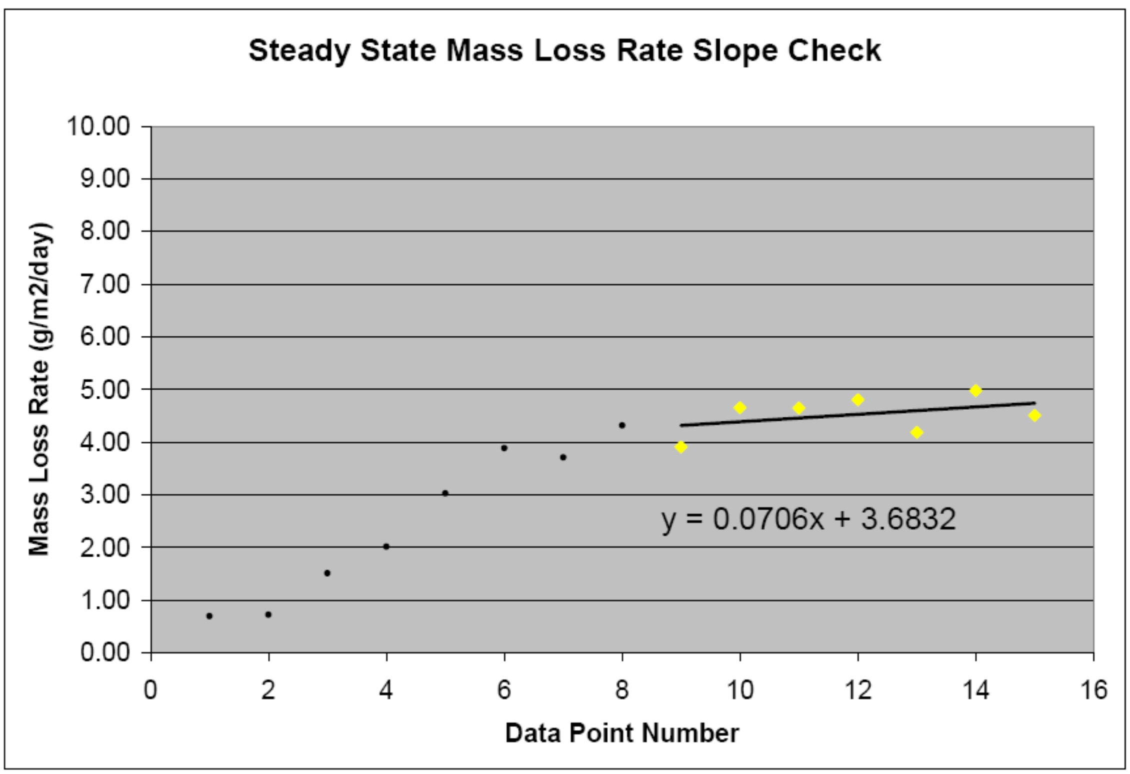
If the above inequality is true, then the 1st criteria for steady state mass loss has been satisfied at point n. Proceed below to step d).

d) If the inequality given in above in step c) is true, then determine the slope of the least square line for the seven mass rates and corresponding data point numbers that comprise M_{avg}. One easy way of determining this slope is with a built spread sheet function. In Excel 2003, the LINEST function is one of many functions that can be used for this calculation, entering mass loss rates for y's and data point numbers for x's. Check the following inequality for the slope of the least squares line:

$$-0.08 \leq \text{slope} \leq 0.08$$

If the inequality conditions for c) and d) are satisfied at data point n, the hose has reached steady state mass loss at data point n which is reported as M_{avg} from step b). This is also the steady state permeation rate for the hose.

e) Steady State Example. Below is a graphical example for a hose which has satisfied steady state criteria described in c) and d) above. The steady state permeation rate which would be reported for this example would be 4.5 g/m^2/day as this is M_{avg} determined at data point 15.



10.4 Maximum allowable fuel loss from a hose. Maximum fuel loss shall be calculated with the following formula:

$$m_k = 0.5 \cdot (m_i - m_o) \qquad \text{(g)}$$

Where:
m_k = Maximum allowable fuel loss reported in grams (g).
m_i = Mass of the hose (g) after last being filled.
m_o = Mass of the empty hose (g) as recorded in 6.6.

Note that for the minimum mass of the hose before emptying and refilling is:

$$m_{min} = m_i - m_k \qquad \text{(g)}$$

11. REPORTING RESULTS

Report the results obtained to the Executive Officer at the conclusion of the test. This should include a steady sate permeation rate for each hose, a completed TP 201.8 data sheet for each hose (see next page), a data logger temperature record for the testing chamber, and any spread sheet calculations used to assist in determining steady state criteria.

Verify that the data format and submittal process are acceptable to the Executive Officer prior to submitting results. Alternate methods of submitting data may be acceptable pending prior Executive Officer approval.

All hoses must have steady state permeation rates, as determined within this procedure, of less than, or equal to, 10.0 $g/m^2/day$ for certification to be granted.

12. ALTERNATE PROCEDURES

This procedure shall be conducted as specified. Modifications to this procedure shall not be used unless prior approval has been obtained from CARB, pursuant to Section 14 of Certification Procedure CP-201.

Precondition/Pretest Data

Test Trial Number	_______	
Hose Number	_______	
Test Temperature	_______	°C
	_______	°F

Hose Description and Dimensions

Hose Brand	_______	
Hose Model Name	_______	
Hose Type	_______	
Hose Length, L	_______	cm
	_______	m
Hose Diameter, D	_______	cm
	_______	m
Hose Permeation Surface Area, A	_______	m^2

Test Fuel

Test Fuel Type	_______	
90% Volume of Test Fuel to Fill Hose, V	_______	m^3

Mass Measurements

Mass of Empty Hose with Caps, m_i	_______	g

Completion of Pretest Procedures

Date	_______	mm/dd/yy
Time	_______	hr, min

Start of Precondition Procedures

Date	_______	mm/dd/yy
Time	_______	hr, min

Completion of Precondition Procedures

Date	_______	mm/dd/yy
Time	_______	hr, min

Pretest notes and comments:

Testing Data

Test Trial Number _______

Hose Number _______

Approximate Time for Weighing, t_o _______ hr, min
(This is the time recorded at step 8.2)

Minimum Mass of Hose Before Fuel Refreshing, m_{min} _______ g

	Measured Values						Calculated Values		
Data Point n	Date mm/dd/yy	Total Days Testing	Weighing Time (hr,min)	Hose Mass m_n (g)	Weighing Time For Refilled Hose (hr,min)	Hose Mass After Refill m_i (g)	Mass Loss Rate, M_n (g/m^2/day)	Average Mass Loss Rate, M_{avg} (g/m^2/day)	Slope of least squares line
0									
1									
2									
3									
4									
5									
6									
7									
8									
9									
10									
11									
12									
13									
14									
15									
16									
17									
18									
19									
20									
21									
22									
23									
24									
25									
26									
27									
28									
29									

Reported Steady State Permeation Rate (g/m^2/day) M_{avg} = _______

Testing notes and comments:

APPENDIX F

GDF Hose Permeation Study Review

California Environmental Protection Agency

Air Resources Board

GDF Hose Permeation Study Review
(October 2007)

Stationary Source Testing Branch
Monitoring and Laboratory Division

October 29, 2007

GDF Hose Permeation Study Review

(October 2007)

Introduction

During September and October of 2004, the California Air Resources Board (CARB) conducted tests to determine the fuel permeation rates of gasoline dispensing facility (GDF) hoses used in California. Staff selected a representative sample of vapor recovery hoses to undergo testing. Hoses were filled with California summer blend commercial pump fuel and exposed to ambient conditions. Hoses were weighed regularly over the course of the testing and permeation results were calculated from the observed losses.

CARB staff first posted permeation results based upon this test data in 2005, in a paper called GDF Curb Pump Hose Emissions Study Results. This paper can be found online at http://www.arb.ca.gov/vapor/gdfhe/gdfhearchive.htm. Staff's initial findings were that the hoses subjected to the conditions of this study permeated at rates of 23.5 g/m^2/day for vacuum assist GDF hoses and 10.9 g/m^2/day for balance GDF hoses.

Since then, CARB staff has re-evaluated the data and found that the previous conclusions drawn by CARB staff about GDF hose permeation rates underestimated actual permeation rates due to misinterpretation of the data. CARB staff currently estimates that the permeation rates from GDF hoses in this study were 52.8 g/m^2/day for vacuum assist style hoses and 22.6 g/m^2/day for balance style hoses.

Note that permeation results are highly dependent upon temperature, permeate type (fuel type) and permeation barrier material (hose material type). Because CARB staff only tested one type of fuel and used an uncontrolled temperature profile, CARB staff realizes that the results from this study only provide the basis for a rough estimate of emissions from this source type. CARB intends to conduct further GDF hose permeation tests in the near future under highly controlled conditions to establish definitive statewide emissions for this source.

Background

It is part of CARB's mission to promote and protect the public health and welfare through the effective and efficient reduction of air pollutants. In carrying out this mission, CARB has sought to control hydrocarbon (HC) emissions at GDFs in California since 1975. HCs are reactive organic gases (ROGs) which can react in the atmosphere to form photochemical smog. Recently, CARB staff has identified GDF hoses as a sources of uncontrolled ROG emissions due to gasoline's ability to permeate through common GDF hose materials. The GDF hose permeation test that CARB conducted in 2004 was an initial attempt to try to estimate the amount of ROGs which were being emitted in California by this source.

California GDFs which are permitted by the local air pollution control districts must use vapor recovery style hose. Vapor recovery hose is different from standard fuel delivery hose in that it has two paths: one for fuel delivery and the other for vapor return. There are two different styles of vapor recovery hose: balance and vacuum assist. For permeation purposes, vacuum assist hoses are similar to standard fuel delivery hose in that the liquid fuel is carried against the inside of the outer hose wall. Balance hoses are the opposite, carrying the vapor against the outer hose wall. Thus special consideration should be taken when designing a permeation test for balance style GDF hose.

Test Protocol

For Approximately 29 days, from September 16th to October 15th of 2004, CARB staff conducted in-house gravimetric testing of 6 new and 12 used vapor recovery GDF hoses under non-controlled ambient conditions. Staff acquired 12 used GDF hoses that had each been in-use for 1 – 3.5 years. The purpose of using hoses that were taken from service, was to assure preconditioning of the test hoses and thereby demonstrate permeation rates that were reflective of actual emissions. All hoses were in serviceable condition.

As the in-use hoses were removed from service, the product hose was immediately refilled with gasoline to a 75 percent fill level. The hose assembly was then capped. The caps separated the liquid path from the vapor path. This entire process occurred within 15 minutes of removal from service. New hoses of each type and manufacturer (6 total) were purchased and used as blanks. The blank (empty) hoses were used to monitor moisture effects on the weight recordings during the test. A complete table detailing all of the hoses used for this test can be found in Attachment 1 at the end of this document.

Immediately before beginning permeation testing, the used hoses were emptied and refueled to 75 percent of capacity with summertime commercial pump fuel. These hoses were refueled within 15 minutes of emptying. Only the liquid fuel paths in the hoses were filled. All hoses (including the blanks) were then leak tested in a warm water bath and hung outside in a configuration similar to their in-service hanging position. Figure 1 shows the test hoses hung outside under an overhang at CARB test facilities in Sacramento CA. The hoses were initially weighed and the data recorded 24 hours after hanging. Hoses were routinely re-weighed and recorded at 24-hour intervals (2 PM local time) when possible from September 17 to October 15. For the times where it was not possible to reweigh on a 24 interval, weighing were taken on the next possible 24 hour interval and the weight loss results were then averaged over the missed 24 hour intervals. Figure 1 shows the weigh stand and scale set-up. Ambient temperature and barometric pressure were recorded continuously by a data logger at 1-minute intervals throughout the test period. A table of the recorded mass loss/gain data can be found in Attachment 2 at the end of this document.

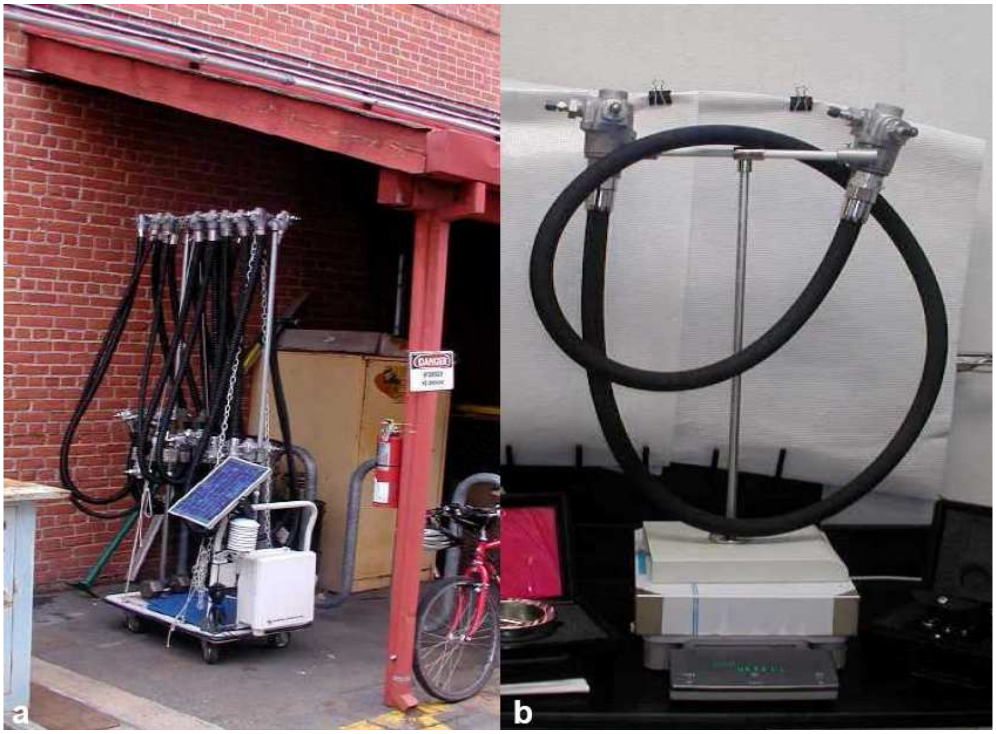


Figure 1 (a) Hose cart and test sensors at CARB testing facility in Sacramento CA. (b) Capped hose, weigh stand and scale.

Initial Analysis of Test Results

Permeation rates for each hose were initially calculated by CARB staff by dividing the daily weight loss over the testing period (minus any gain/loss due to humidity as measured from the blanks) by the hose's external surface area. Average permeation rates were then calculated for both balance and vacuum assist styles of hose. From this, CARB staff determined that an average vacuum assist hose has a permeation rate of 23.5 g/m^2/day, and that average balance hose has a permeation rate of 10.9 g/m^2/day. The average temperature and pressure corresponding to this period were 69.8 °F and 29.9 ″Hg. The results of this are graphically displayed in Figure 2.

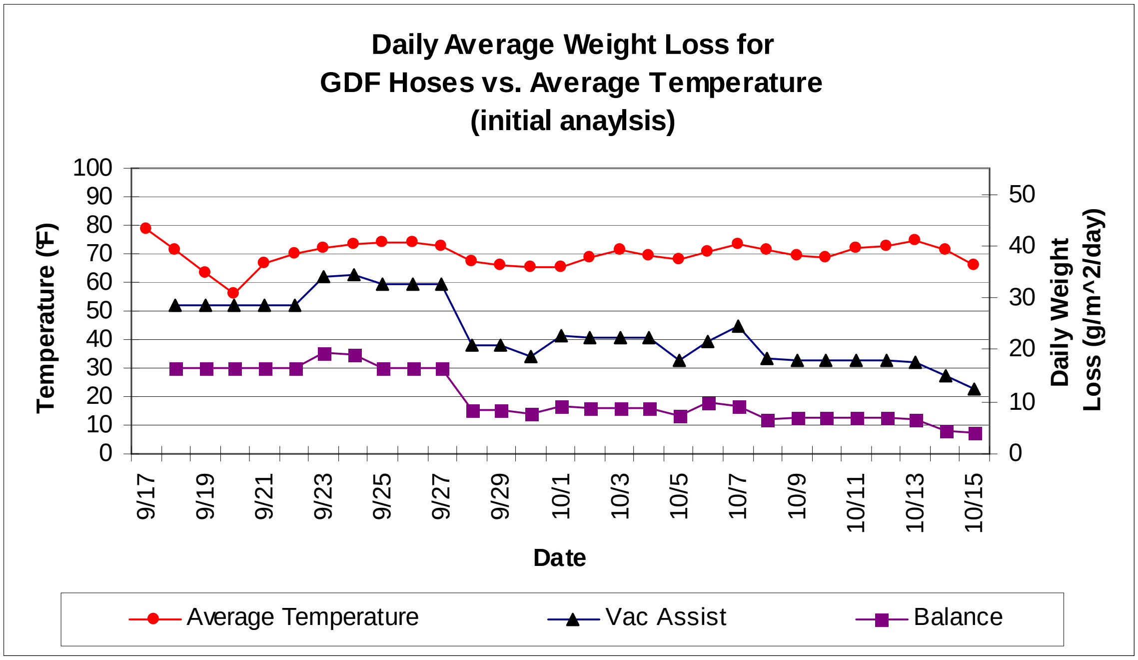


Figure 2 Average hose permeation as initially derived by CARB staff.

Re-evaluation of Test Results

In 2007, after a review of industry permeation standards, CARB staff revised its estimates of permeation rates derived from the testing data.

The first revision that CARB staff made was to calculate permeation rates based upon the inner surface area of the hose. The industry standard employed by the Society of Automotive Engineers (SAE) is to use the inner surface area of the hose wall through which the fuel is permeating. CARB staff had previously used the hose outside surface area from which to derive permeation rates. This revision lead to an increase in the reported average permeation rates of vacuum assist hoses to 35.9 g/m^2/day and balance hoses to 12.9 g/m^2/day. This corresponds to permeation rate increases of 52 and 18 percent respectively. The results can be seen in Figure 3. Although this correction does not change the net reported emissions taken during the test, the reported rate increase is important to note when evaluating how the materials in these hoses perform in comparison with other low permeation materials. With this revision, it becomes comparatively clearer that there are many low permeation materials which may help to reduce emissions from these hoses.

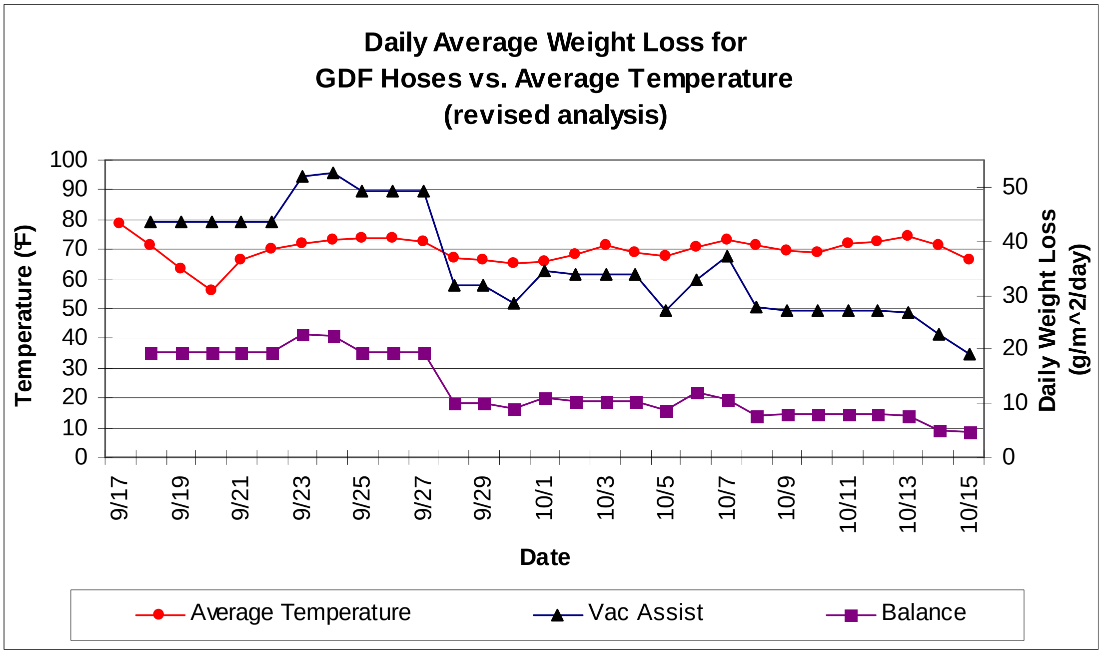


Figure 3 Revised permeation rates that correct for inner surface area in calculations.

The second revision was to account for test fuel degradation. Fuel degradation (or fuel souring) occurs due to different constituents of the fuel permeating out at different rates. This leads to the fuel composition changing gradually throughout the test period. This is important because permeation rates are based upon fuel type, temperature, and the material of the barrier through which the fuel is permeating. If the fuel type is being allowed to change, then no definitive rate can be derived from the data. No steps were taken in ARB's 2004 test to control for fuel degradation.

Controlling for total volume loss of the test fuel is one accepted method of controlling for fuel degradation. If volume losses are low during a test, then it can be assumed that the composition has not changed radically. SAE's fuel hose permeation tests and technical literature call for a maximum fuel volume loss in the testing fuel of between 2 to10 percent before the test must be stopped and the test fuel replaced. Hoses in the ARB test lost an average of 40 percent volume as determined by weight.

SAE Technical Paper 820406 demonstrated the phenomena of fuel degradation with a plug and fill hose permeation test at a constant temperature of 22 ± 2 °C (72 ± 4 °F). In their testing, they used several h ose types and test fuels. In all cases, where there was dramatic fuel volume loss, the percentage of each constituent in the fuel changed dramatically from beginning to the end of the test. For simplicities sake, this paper will only discuss one of the trial results in particular. For the case of using a 30R7 fuel hose with fuel CE-10 (45 percent isooctane, 45 percent toluene, and 10 percent ethanol), the plug and fill test showed that, after the second day of testing, the permeation rate quickly elevated to 132.5 g/m^2/day, then sharply dropped off. A graphical demonstration of this plug and fill test data has been given in Figure 4 demonstrating the sharp drop in permeation rate due to the effects of fuel degradation (note, that the CARB testing data shown in Figure 3 also follows a similar early peak and sharp drop off in permeation rates as seen in the SAE data). When a reservoir was added to the same hose in the SAE test to increase overall fuel volume available to the hose, the permeation rate peaked at 556.8 g/m^2/day, and maintained a high permeation rate throughout the test. Thus, not correcting for fuel degradation with high volume loss decreased the reported emissions by a factor of more than 4 for this particular set of permeation testing parameters.

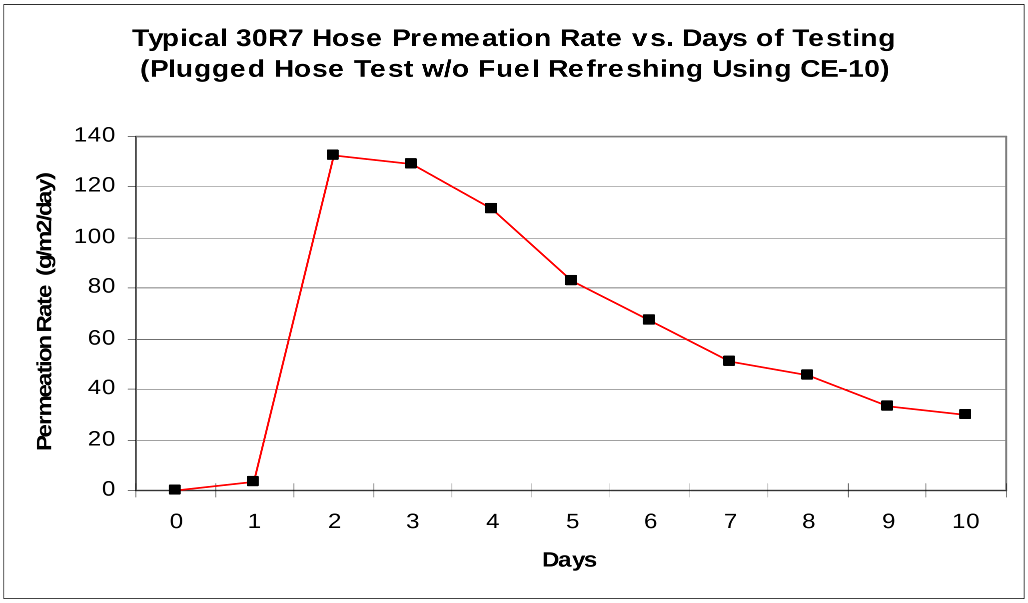


Figure 4 SAE plug-and-fill hose test using 30R7 hose and CE-10 fuel at 22 °C.

In this same SAE test trial, samples were sacrificed throughout the test in order to determine percentages of each fuel constituent remaining in the test hose at several of the data collection points in the test. Figure 5 shows the fuel constituent percentages remaining in the test fuel corresponding to the fuel loss data in Figure 4. Note that in the beginning of the test, ethanol (ETOH) is 9.9 percent of the total composition and after the 10th day of testing, it is 0.4 percent of the total remaining fuel. Similarly, toluene began the test at 49.7 percent and finished at less than 15 percent, while Isooctane began this test at 40.4 percent and finished at more than 85 percent. Thus, it is clear that any permeation rates read near the end of this test are not indicative of permeation rates using fuel CE-10 under the prescribed conditions, as the test fuel is no longer CE-10.

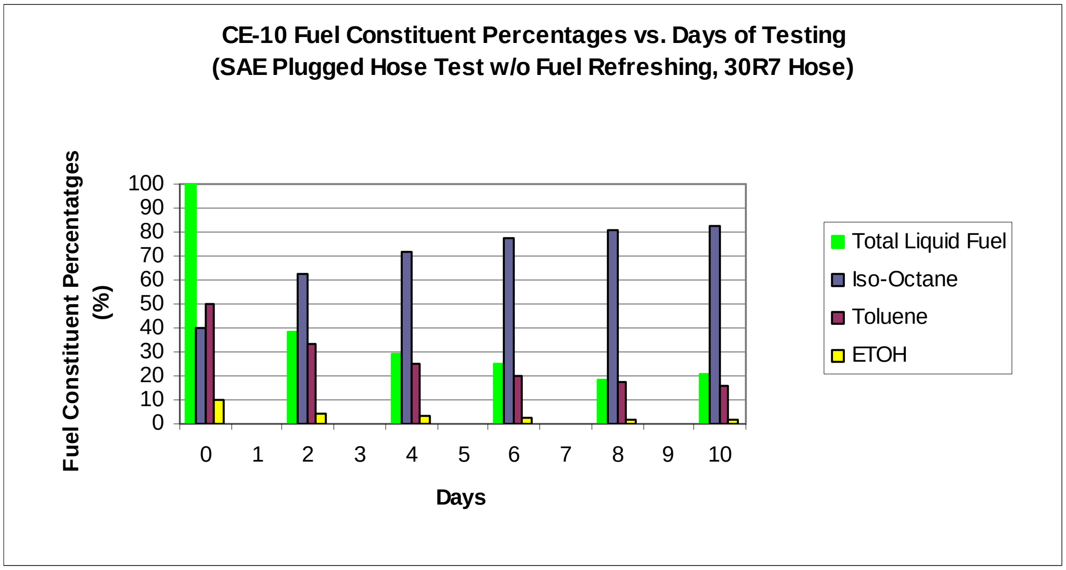


Figure 5 SAE plug-and-fill hose test demonstrating fuel degradation.

To correct for this, CARB staff have identified the maximum permeation rate recorded as indicative of the actual permeation rate instead of using the average permeation rate taken over all of the data as staff had previously done. This lead to an estimated permeation rate of 52.8 g/m^2/day for vacuum assist hose and 22.6 g/m^2/day for balance hose. The average temperature and pressure corresponding to the test period up to the peak permeation point were 68.9 °F and 29.9 ″Hg. Note, that this is only a conservative estimate, as 5 of the 7 data points preceding the peak were averaged, there was slight variance in temperature profiles from day to day, and both the balance and vacuum assist hoses had both exceeded 10 percent volume loss at this point (indicating rates likely would have continued to climb had fuel composition been maintained). Also, note that in the SAE trial mentioned above, that not controlling for fuel degradation underestimated emissions by a factor of more than 4.

One revision that CARB staff would like to address in future GDF hose permeation testing, is to adjust the testing protocol on balance style hoses to more accurately reflect their permeation rates. CARB staff believes that permeation rates indicated in this test were biased to under report emissions on these hoses due to test protocol not factoring in the normal operating conditions of the balance hose vapor path. In a balance style hose, the vapor path is the outer path, and liquid fuel is carried on the inner path. From the design of the test, fuel first had to permeate through the inner hose, form a vapor in the outer hose path, and then permeate through the outer hose wall. No provision was made at the beginning of the test to induce a fresh saturated vapor into the vapor path. Thus, at no time during the testing is it likely that the vapor quality in the outer path would have built up to the quality of a saturated vapor. When a balance hose is under normal in-use operating conditions, a fresh charge of saturated vapor from a vehicle fuel tank is forced in to the hose at intervals of approximately 5 to 15 minutes throughout most of the day. CARB staff consultation with SAE representatives, and many SAE technical papers, suggest that a saturated fuel vapor permeates at the same rate as a liquid of the same fuel under the same testing conditions, whereas, a vapor of lesser quality will permeate less.

Conclusion

Based upon CARB staff's revised analysis of the data gained from CARB's 2004 GDF hose permeation test, staff estimates that the permeation rates for vacuum assist and balance style GDF hoses are 52.8 g/m^2/day and 22.6 g/m^2/day respectively. These rates assume an average temperature and pressure of 68.9 °F and 29.9 ″Hg. Although these estimates offer valuable insight into the understanding of emissions from GDF hoses, CARB staff believes that these numbers are conservative, and that a larger and more rigorously controlled test should be done to better estimate actual statewide emissions from this source.

Attachment 1

Test Hose Detail Table

Hose #	Brand	Style	Liquid Removal	Time In-Use* (months)	Inner Diameter** (in)	Length Collar-to-Collar (in)
1	Dayco	Vac-Assist	N/A	21	0.75	98.5
2	Dayco	Vac-Assist	N/A	21	0.75	98.3
3	Goodyear	Vac-Assist	N/A	19	0.75	92.0
4	Goodyear	Vac-Assist	N/A	19	0.75	91.3
5	Goodyear	Balance	Y	14	1.38	91.4
6	Goodyear	Balance	Y	14	1.38	90.5
7	Dayco	Balance	Y	20	1.38	85.8
8	Dayco	Balance	Y	41	1.38	87.0
9	Goodyear	Balance	N	20	1.38	65.5
10	Goodyear	Balance	N	20	1.38	65.5
11	Dayco	Balance	N	36	1.38	44.4
12	Dayco	Balance	N	36	1.38	44.1
13	Dayco	Vac-Assist	N/A	new	0.75	51.5
14	Goodyear	Vac-Assist	N/A	new	0.75	100.5
15	Goodyear	Balance	Y	new	1.38	90.4
16	Dayco	Balance	Y	new	1.38	97.9
17	Goodyear	Balance	N	new	1.38	66.3
18	Dayco	Balance	N	new	1.38	91.3

* Hoses 11 and 12 had been in service at least 3 yrs, although the exact time is not known.

** In the case of vacuum assist hoses this is the nominal inner diameter of the hose. For balance hoses, due to geometric complexity, this is an average number derived by CARB staff.

Attachment 2

GDF Hose Mass Loss Testing Data

Date	Mass Loss (grams)																		Average Temp (°F)
	Hose # 1	Hose # 2	Hose # 3	Hose # 4	Hose # 5	Hose # 6	Hose # 7	Hose # 8	Hose # 9	Hose # 10	Hose # 11	Hose # 12	Hose # 13**	Hose # 14**	Hose # 15**	Hose # 16**	Hose # 17**	Hose # 18**	
17-Sep*	11.20	10.90	9.70	8.00	7.60	6.50	9.50	14.70	6.70	6.20	3.60	2.80	0.20	0.50	0.70	1.00	0.40	1.20	78.61
18-Sep	6.94	7.04	5.92	5.46	4.32	4.04	4.58	6.36	3.82	3.72	2.54	2.10	0.00	0.06	0.10	-0.04	0.08	0.02	71.50
19-Sep	6.94	7.04	5.92	5.46	4.32	4.04	4.58	6.36	3.82	3.72	2.54	2.10	0.00	0.06	0.10	-0.04	0.08	0.02	63.30
20-Sep	6.94	7.04	5.92	5.46	4.32	4.04	4.58	6.36	3.82	3.72	2.54	2.10	0.00	0.06	0.10	-0.04	0.08	0.02	56.10
21-Sep	6.94	7.04	5.92	5.46	4.32	4.04	4.58	6.36	3.82	3.72	2.54	2.10	0.00	0.06	0.10	-0.04	0.08	0.02	66.60
22-Sep	6.94	7.04	5.92	5.46	4.32	4.04	4.58	6.36	3.82	3.72	2.54	2.10	0.00	0.06	0.10	-0.04	0.08	0.02	70.00
23-Sep	8.20	8.60	7.10	6.40	4.90	5.20	5.40	6.70	4.30	4.20	2.80	2.80	0.00	0.10	0.00	0.00	0.00	0.00	71.80
24-Sep	8.00	8.70	7.20	6.90	5.10	4.70	5.50	6.60	4.10	4.20	3.30	2.70	0.00	0.20	0.00	0.20	-0.10	0.20	73.30
25-Sep	7.80	8.03	6.67	6.33	4.10	3.90	4.53	5.27	3.17	3.70	2.87	2.50	0.03	0.07	0.00	-0.10	0.00	-0.10	73.90
26-Sep	7.80	8.03	6.67	6.33	4.10	3.90	4.53	5.27	3.17	3.70	2.87	2.50	0.03	0.07	0.00	-0.10	0.00	-0.10	73.70
27-Sep	7.80	8.03	6.67	6.33	4.10	3.90	4.53	5.27	3.17	3.70	2.87	2.50	0.03	0.07	0.00	-0.10	0.00	-0.10	72.80
28-Sep	4.85	4.65	4.15	3.95	2.05	2.10	2.20	2.25	1.25	1.45	0.90	0.95	-0.20	-0.10	-0.50	-0.60	-0.40	-0.45	67.30
29-Sep	4.85	4.65	4.15	3.95	2.05	2.10	2.20	2.25	1.25	1.45	0.90	0.95	-0.20	-0.10	-0.50	-0.60	-0.40	-0.45	66.30
30-Sep	4.30	4.60	3.80	3.80	2.00	1.80	2.00	2.00	1.50	1.80	1.40	1.10	0.00	0.00	-0.20	-0.20	0.00	0.00	65.10
1-Oct	5.70	5.40	4.70	4.50	2.50	2.60	3.10	3.10	1.80	1.90	1.50	1.80	0.20	-0.20	0.40	0.20	0.10	-0.10	65.60
2-Oct	5.23	5.43	4.40	4.37	2.17	2.10	2.50	2.63	1.67	2.03	1.57	1.50	-0.07	0.07	-0.03	-0.07	-0.07	0.10	68.40
3-Oct	5.23	5.43	4.40	4.37	2.17	2.10	2.50	2.63	1.67	2.03	1.57	1.50	-0.07	0.07	-0.03	-0.07	-0.07	0.10	71.40
4-Oct	5.23	5.43	4.40	4.37	2.17	2.10	2.50	2.63	1.67	2.03	1.57	1.50	-0.07	0.07	-0.03	-0.07	-0.07	0.10	69.20
5-Oct	4.20	4.40	3.70	3.60	1.90	1.80	2.00	2.30	1.50	1.80	1.30	1.10	0.00	0.10	0.00	0.00	0.20	-0.30	67.80
6-Oct	5.50	5.80	4.70	4.70	2.80	2.90	3.30	3.40	2.40	2.70	2.00	1.80	0.30	0.30	0.30	0.50	0.20	0.70	70.70
7-Oct	5.40	5.50	4.50	4.60	2.10	1.90	2.70	3.00	1.60	1.80	1.40	1.50	-0.30	-0.20	-0.10	-0.20	0.00	-0.30	73.30
8-Oct	4.60	4.40	3.60	3.60	1.80	1.70	2.20	2.20	1.50	1.50	1.30	1.20	0.00	0.00	0.20	0.20	0.20	0.30	71.60
9-Oct	4.45	4.63	3.78	3.95	2.03	2.02	2.50	2.58	1.68	1.88	1.25	1.40	0.15	0.25	0.47	0.47	0.27	0.30	69.60
10-Oct	4.45	4.63	3.78	3.95	2.03	2.02	2.50	2.58	1.68	1.88	1.25	1.40	0.15	0.25	0.47	0.47	0.27	0.30	69.00
11-Oct	4.45	4.63	3.78	3.95	2.03	2.02	2.50	2.58	1.68	1.88	1.25	1.40	0.15	0.25	0.47	0.47	0.27	0.30	71.70
12-Oct	4.45	4.63	3.78	3.95	2.03	2.03	2.50	2.58	1.67	1.88	1.25	1.40	0.15	0.25	0.47	0.47	0.27	0.30	72.70
13-Oct	4.20	4.00	3.50	3.70	1.50	1.50	1.80	1.60	0.90	1.00	0.70	0.70	0.00	-0.10	-0.60	-0.50	-0.30	-0.30	74.60
14-Oct	3.30	2.70	2.90	2.70	0.30	0.50	0.70	0.60	0.50	0.30	0.20	0.10	-0.30	-0.20	-0.80	-0.90	-0.50	-0.90	71.14
15-Oct	2.90	2.90	2.50	2.70	1.50	1.20	1.50	1.70	1.00	1.10	0.70	0.00	0.00	0.00	0.00	0.00	0.00	0.30	66.18

All positive numbers indicate mass loss. Negative numbers indicate mass gain.

* Mass loss for this day was not included in the final results due to unpredictable bias from water bath leak test.

** This hose was used as a blank for controlling effects due to humidity.

_____ Underlined dates indicate dates for which mass loss was averaged over multiple dates.

APPENDIX G

Gasoline Dispensing Facility (GDF) Balance Hose Permeation Study

California Environmental Protection Agency

Air Resources Board

Gasoline Dispensing Facility (GDF)
Balance Hose Permeation Study

Prepared By:

Jason McPhee

Stationary Source Testing Branch
Monitoring and Laboratory Division

June 19,2008

Revised October 6, 2008

Introduction

During April and May of 2008, the California Air Resources Board (CARB) conducted testing to determine saturated vapor permeation rates of gasoline dispensing facility (GDF) balance style hoses used in California. Staff was also interested in characterizing the effects of test fuel degradation on observed permeation rates.

Staff selected three identical samples of balance style vapor recovery hoses to undergo testing. Hoses were filled with California summer blend commercial pump fuel and placed in a testing chamber where temperature was recorded continuously throughout the testing. Hoses were weighed daily over the course of the testing and permeation results were calculated from the observed mass losses.

CARB staff observed that a balance style GDF hose, when subjected to an average temperature of 71.0℉ (21.7℃), and filled in both the vapor and liquid paths with California summer blend commercial pump fuel, permeates at a rate of approximately 104.5 g/m^2/day. By applying the theory that a saturated fuel vapor permeates at approximately the same rate as it would in liquid form under the same conditions[1,2,3,4], CARB staff determined that a balance style GDF hose would permeate at a rate of 104.5 g/m^2/day when exposed to a saturated vapor of California summer blend commercial pump fuel at 71.0℉ (21.7℃). Note that this vapor permeation rate is only valid for a saturated vapor. CARB staff is currently conducting a separate analysis to characterize typical vapor quality within balance style GDF hose.

CARB staff observed that test fuel degradation, beyond a mass loss of 5%, leads to a reduction of permeation rates. If not corrected for during testing, this will lead to an underestimation of actual emissions. It is possible that this effect may be present for test fuel degradations corresponding to fuel mass loss slightly lower than 5%, but temperature fluctuations in this area of the data set made this impossible determine.

Note that permeation results are highly dependent upon temperature, permeate type (fuel type) and permeation barrier material (hose material type). Because CARB staff only tested one type of fuel and used an uncontrolled temperature profile, CARB staff realizes that the results from this study only provide the basis for a rough estimate of emissions from GDF hoses. CARB staff intends to conduct further GDF hose permeation tests in the near future under highly controlled conditions to establish definitive statewide emissions for this source.

Background

It is part of CARB's mission to promote and protect the public health and welfare through the effective and efficient reduction of air pollutants. In carrying out this mission, CARB has sought to control hydrocarbon emissions at GDFs in California since 1975. Hydrocarbon emissions are reactive organic gases which can react in the atmosphere to form photochemical smog. Recently, CARB staff has identified GDF hoses as a sources of uncontrolled reactive organic gas emissions due to gasoline's ability to permeate through common GDF hose materials.

California GDFs, which are permitted by the local air pollution control districts, in most cases must use vapor recovery style hose. Vapor recovery hose is different from conventional fuel delivery hose in that it has two paths: one for fuel delivery and the other for vapor return. There are two different styles of vapor recovery hose: balance and vacuum assist. For permeation purposes, vacuum assist hoses are similar to conventional fuel delivery hoses in that the liquid fuel is carried against the inside of the outer hose wall. Balance hoses are different, carrying vapor against the outer hose wall (Figure 1). Thus special consideration should be taken when designing a permeation test for balance style GDF hoses.

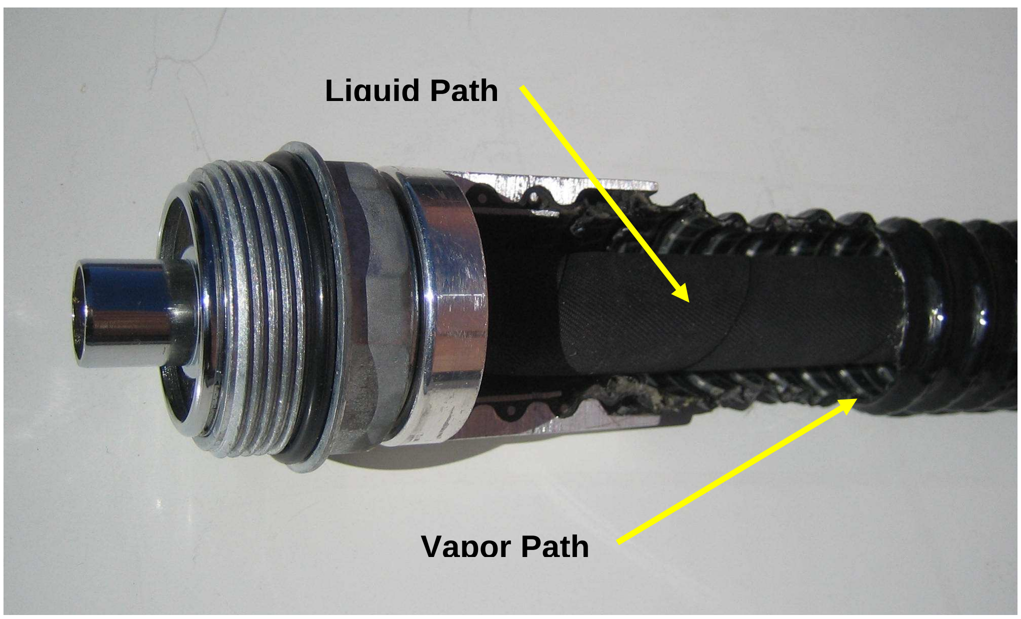


Figure 1 Balance style vapor recovery GDF hose showing vapor and liquid paths.

In 2004, ARB staff conducted a GDF hose permeation test as an initial attempt to try to estimate the amount of reactive organic gasses which were being emitted in California from GDF hoses.[5] However, that testing failed to address test fuel degradation throughout the testing period and it did not characterize vapor concentrations in the balance hose vapor path. The GDF balance hose permeation test discussed in this paper is an attempt to more accurately estimate permeation emissions from balance hoses when exposed to a saturated fuel vapor.

Test Protocol

For Approximately 28 days, from April 11th to May 9th of 2008, CARB staff conducted in-house gravimetric testing of 3 balance style vapor recovery GDF hoses under non-controlled ambient conditions. The hoses were placed on racks within a fuel storage cabinet in a fuel storage room throughout the testing (Figure 2). Hoses were removed from this environment daily only for the purpose of recording weight and refreshing fuel (dumping old test fuel in the hose and replacing with fresh test fuel). Time was recorded for all weighings during the test.

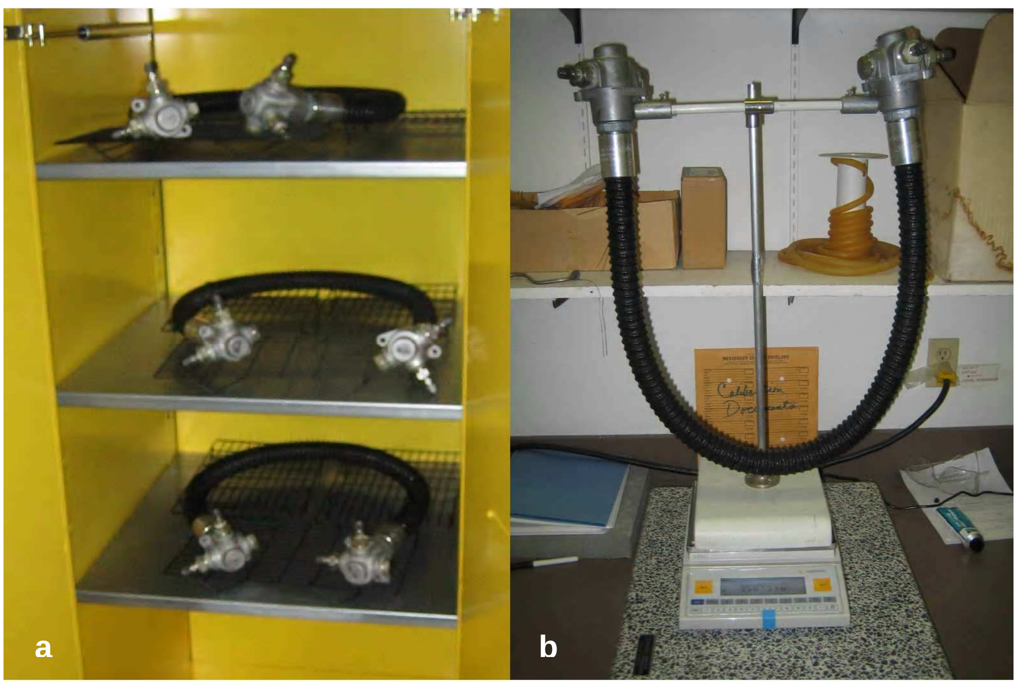


Figure 2 (a) Hoses in testing room. (b) Hose being weighed.

Testing room temperature was continuously recorded a via data logger over the course of the testing. Temperature was only controlled to the extend that building temperature controls limited the temperatures to small diurnal swings of an average of 5.2 °F (2.9°C) at an average temperat ure of 71.0°F (21.7°C) throughout the testing (Attachment 2). Although it would have been preferable to control testing temperature more precisely, staff was able to observe clear trends in the data and draw robust conclusions.

Staff purchased 3 balance hoses from a local distributor. These hoses were each measured to be approximately 48 1/2 inches in length as measure from o-ring flange to o-ring flange. The average internal diameters were measured to be approximately 1 3/8 inches. Because the inner path of the balance hose was not of any importance in this permeation test, the inner hose was removed from all samples. For the purpose of identification, the hoses were labeled B1, B2, and B3. The hoses had been used in a previous test conducted by CARB staff in the summer of 2006 to observe fuel temperature profiles in GDF hoses. The hoses had been filled with summertime pump fuel and hung outdoors in various degrees of shade for approximately 3 months. Staff believes that this exposure was beneficial in that helped to precondition the hoses to behave more closely to hoses taken from service. All hoses were within the normal life expectancy age of approximately 2 years and in serviceable condition. However, during the previous testing hose B1 was kept in full shade throughout that experiment whereas hoses B2 and B3 were exposed to partial and full sun throughout that testing. Staff believes that this difference in UV exposure between the hoses may have played a role in differences in permeation rates measured throughout the testing.

Approximately 7.5 gallons of California summer blend commercial pump fuel was purchased from a local station of a major brand name retailer to use as test fuel on April 11, 2004. The fuel was dispensed into two 5 gallon low permeation CARB certified portable fuel containers. The test fuel was weighed throughout the testing to control for any fuel degradation not related to the hose permeation testing.

On Friday, April 11th, the first day of testing, each of the hoses was weighed empty, then filled with 1.0 liters of test fuel (75% of each hose's capped volume). The hoses were immediately capped after filling, then weighed. The hoses were placed in the testing room and allowed to precondition for approximately 3 days, at which point they were pulled from the testing room and their weights recorded. At this point, the hoses were each emptied and refilled with 1.25 liters of fresh fuel (90% of each hose's capped volume), reweighed, then placed back in the testing room. This process was repeated at approximately 24 hour intervals through the 7th day of testing. From this point, fuel refreshing was discontinued. Daily weighings were continued throughout the testing.

Note, that fuel refreshing for of all three hoses generally took about 1 hour. In order to correct for this time discrepancy, time that elapsed between taking the weight of all of the hoses before fuel refreshing and taking the weight of all of the hoses after fuel refreshing was omitted from the calculations so as not to underestimate emissions. This omitted time is also corrected for in all graphs that have been included in this paper.

Throughout the testing, the hose caps were inspected daily both visually and by smell for fuel leaks. On April 23rd (day 12), a small amount of wetness was detected at the threads for hose sample B1, that is best characterized as dampness consisting of 1 to 2 drops total. The damp area around the threads was wiped clean and the threads further tightened. No further episodes of leakage were detected throughout the testing. The effect of this minor amount of leakage is hardly noticeable in the data, as the permeation rate of hose sample B1 lagged the other samples significantly during this period of the testing. Because the high permeation rates observed greatly eclipsed the minor amount of fuel lost from this one episode of leakage in one sample, CARB staff believes that this minor leakage created no significant problems in the analysis of the overall study.

Test Results

It was staff's intent to determine a balance hose's steady state permeation rate when using California summer blend commercial pump fuel for a given temperature. For the purposes of this paper, steady state permeation is loosely defined as a permeation rate which appears to change very little when testing conditions (temperature and test fuel composition) are held constant. Because temperature was not able to be controlled precisely, staff needed to monitor the data closely to make this determination and only an approximate determination could be made. Technical papers published by the Society of Automotive Engineers (SAE) suggest that a change in temperature of 1℃ typically results in a permeation change of approximately 10%.[6,7] Test fuel composition was controlled early in the procedure by refreshing the fuel within the hoses daily so that test fuel composition would be maintained. From testing days 3 through 7, fuel mass loss did not exceed 1.7% (Figure 3). Note that this amount of fuel loss does not exceed the 2% limit given in SAE's most rigorous test procedure for low permeation fuel hoses, SAE J1737.[8]

CARB staff calculated daily permeation rates for each hose by dividing the daily weight loss by the hose's internal surface area. Staff calculated the internal hose surface areas to be 209.5 in^2 (0.135 m^2). Staff believes that the data demonstrates that steady state permeation was approximately achieved on the 7th day of testing, noting that the average permeation rate of the 3 hoses increased at 0.5% while temperature decreased only 1.1℉ (0.62℃) as fuel degradation was controlled below 2% loss. The average steady state permeation rate of the 3 hose samples was determined to be 104.5 g/m^2/day. Staff believes this number to be slightly conservative, as the slight temperature decrease likely would have had a small lowering effect on the permeation rate.

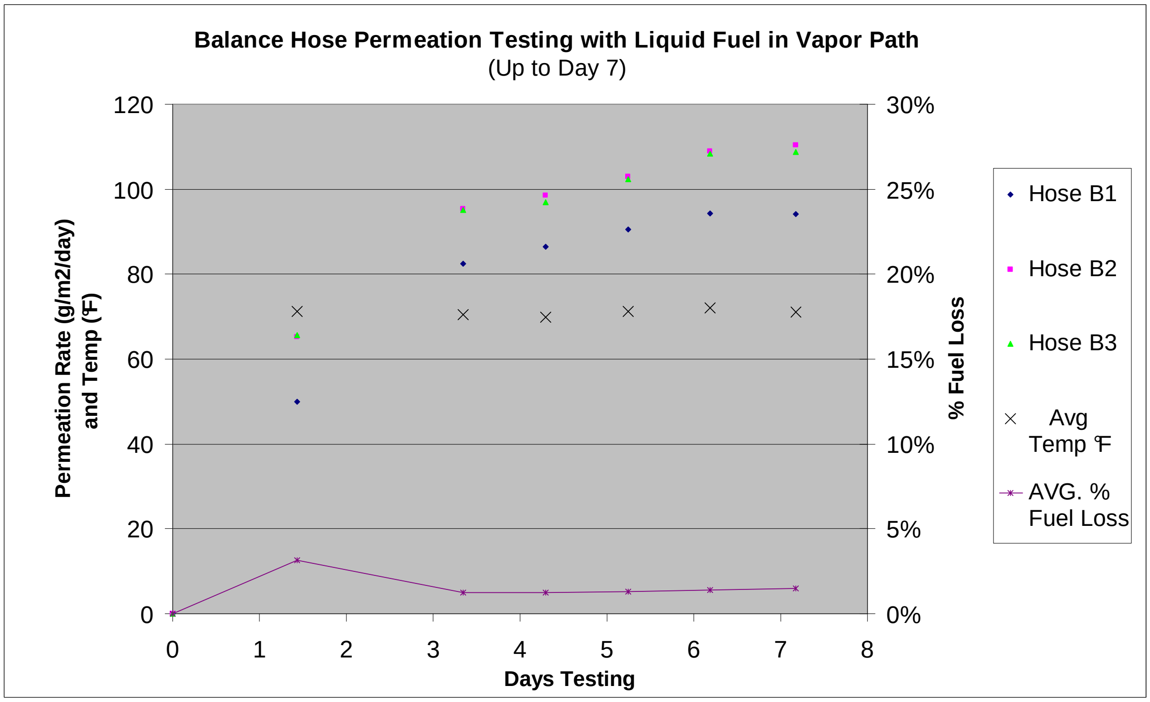


Figure 3 Steady state hose permeation rates achieved in 7 days.

After the 7th day of testing, fuel composition began changing beyond 2% fuel loss as fuel refreshing was not continued after the 7th day of testing due to limited testing resources. Also, the average daily temperature dropped significantly after the 7th day, by 3.4℉ (1.9℃). Because of these factors, permeation rates dropped. Because the permeation rate change through day 9 fell 21.6%, and is roughly within the predictability of a temperature drop of 3.4 ℉ (1.9℃), it is hard to tell if fuel degradation had an effect. However, after the 9th day of testing, it is clear that fuel degradation did have an effect on the permeation rate, as temperature increased while permeation rates decreased. Thus, at approximately 5% fuel loss by weight, fuel degradation of this test fuel has become significant enough to bias permeation rates downward. Therefore, all data taken after day 9 should not be used to determine the steady state permeation rate for California summer blend commercial pump fuel and this type of hose.

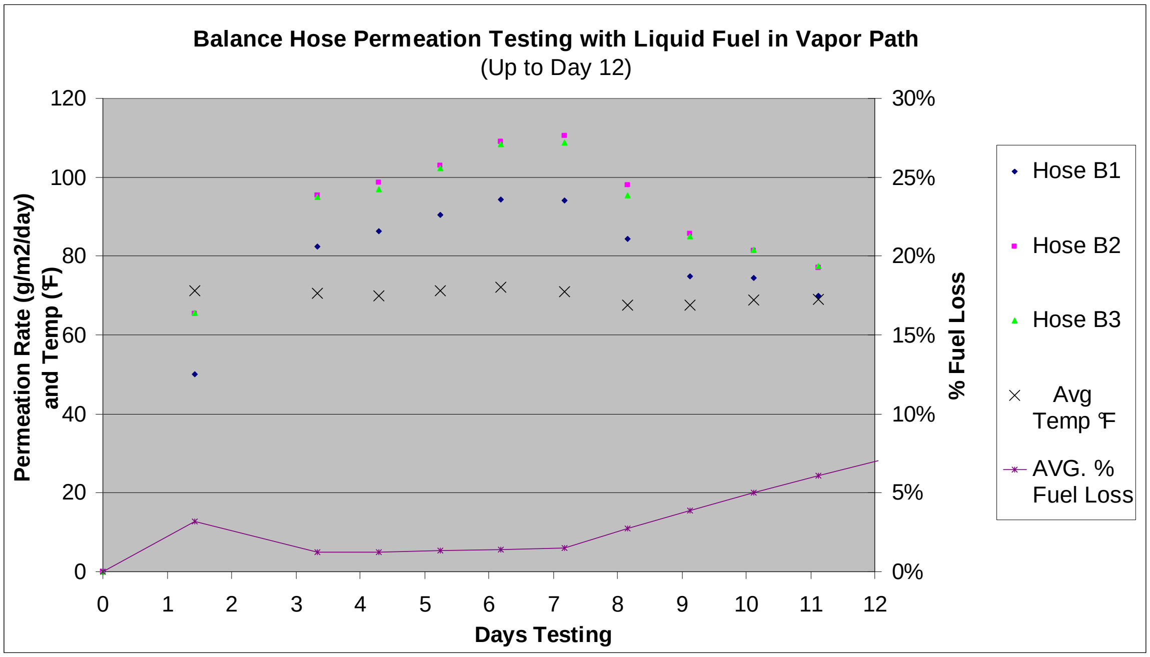


Figure 4 Fuel degradation effects become apparent at day 10 for 5% fuel loss.

Fuel Analysis

Samples of both the original test fuel and spent test fuel (from hose B3) were taken and subjected to laboratory analysis. The purpose of this testing was to observe any constituents that may permeate at higher rates than the average constituent, as this information may prove valuable for future permeation analysis. Due to a lack of testing resources, the fuel was only examined for criteria upon which CARB performs active enforcement. The results of the analysis are given in Table 1.

The most striking observation is that all of the ethanol completely permeated out during the test period while only 14.4% of the overall test fuel was lost through permeation. This observation is consistent with other studies that have shown ethanol tends to permeate at a higher rate than other fuel constituents.[9,10] However, it is noteworthy in this study that ethanol appears to have permeated out at a rate extremely fast relative to the other fuel constituents. It is not known at exactly what point all of the ethanol permeated out as analysis was only performed on the original test fuel and the spent test fuel that was remaining at the end of the test.

Another noteworthy observation was that benzene, as a percent of the total volume of the fuel had decreased by over 36%. Since Benzene is listed by the EPA as a Toxic Air Pollutant, and is a known carcinogen, it is important to note that not only can this substance be emitted into the atmosphere via permeation, but that is appears to permeate at a higher rate than many other fuel constituents.

Table 1: Test Fuel Analysis

Test criteria	Original Test Fuel	Spent Test Fuel	Units	Test Method
Ethanol	6.1	0.0	%V	ASTM D4815-99
Toluene	6.29	4.85	%W	ASTM D5580-00
Benzene	0.55	0.35	%V	ASTM D5580-00
E-Benzene	1.50	1.34	%W	ASTM D5580-00
m,p - Xylene	5.98	5.38	%W	ASTM D5580-00
o - Xylene	2.20	1.99	%W	ASTM D5580-00
Olefins	3.1	2.9	%V	ASTM D6550-00 (modified)
Total Aromatics	23.9	19.4	%V	ASTM D5580-00
C9+ (carbon chains of 9 or greater)	11.5	9.05	%W	ASTM D5580-00
Sulfur	7	7	ppm	ASTM D5453-93
Specific Gravity	0.742	0.737		ASTM D4052-96
RVP (Reid Vapor Pressure)	6.8	5.35	PSI	13 CCR Section 2297
T50 (Temp at which 50% boils off)	211	216	℉	ASTM D 86-99
T90 (Temp at which 90% boils off)	307	313	℉	ASTM D 86-99

Other Observations

Staff believes that the average steady state permeation rate of 104.5 g/m^2/day derived from this study is conservative due to the permeation rate of hose B1 clearly lagging the permeation rates of the other two samples (Attachment 2). As described in the testing protocol section, hose B1 had not had direct sun exposure, whereas the other two hose samples had had significant sun exposure. Staff believes hoses B2's and B3's exposure to UV had led to a degrading, or aging, effect on the hoses which may have caused higher permeation rates more reflective of in-service hoses which are generally exposed to some degree of sunlight throughout the course of a normal day. If the permeation rate of hose B1 is eliminated from the average steady state permeation rate, that permeation rate would rise to 109.6 g/m^2/day, or by approximately 5%. However, due to the limited number of samples involved in this testing, additional testing should be done before drawing conclusions on the effects of UV light exposure and hose permeation.

Another observation that staff drew from this permeation study is the overall importance of controlling for fuel degradation, or test fuel composition. The final mass loss measurement taken for each hose in this study shows an average permeation rate of 16.3 g/m^2/day at 72.5℉ (22.5℃). This average rate also corresponds to a total average fuel loss from the 3 hoses of 14.4% by mass. With a fuel loss of only 14.4%, the permeation rate has fallen from its steady state permeation rate by more than 84% (Attachment 2). Such a large change in permeation rate corresponding to a relatively modest loss in fuel mass greatly highlights the importance of controlling for fuel degradation when reporting steady state permeation rates.

Conclusion

Based upon the testing data discussed in this paper, CARB staff estimates that the liquid, and saturated vapor, steady state permeation rate for balance style GDF hoses is 104.5 $g/m^2/day$ when using California summer blend commercial pump fuel at an average temperature of 71.0℉ (21.7℃). CARB staff also observed that to avoid under reporting of steady state permeation rates during testing, test fuel degradation should be minimized to the greatest extent possible. Staff observed that fuel loss within the sample of over 5% of the total fuel mass led to lower permeation rates due to fuel degradation. CARB staff further observed that ethanol permeates at a much greater rate that many of the other fuel constituents which make up California summer blend commercial pump fuel. This may be an especially important consideration in light of many proposals to increase ethanol content in fuels nationwide. Although these observations offer valuable insight into the understanding of emissions from GDF hoses, CARB staff believes that these numbers are conservative. CARB staff intends to do a larger and more rigorously controlled GDF hose permeation test in the near future to better estimate actual statewide emissions from this source.

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[8] SAE J1737:Test Procedure to Determine the Hydrocarbon Losses from Fuel Tubes, Hoses, Fittings, and Fuel Line Assemblies by Recirculation. Society of Automotive Engineering Surface Vehicle Recommended Practice, REV. NOV 2004, pp. 12.

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Attachment 1

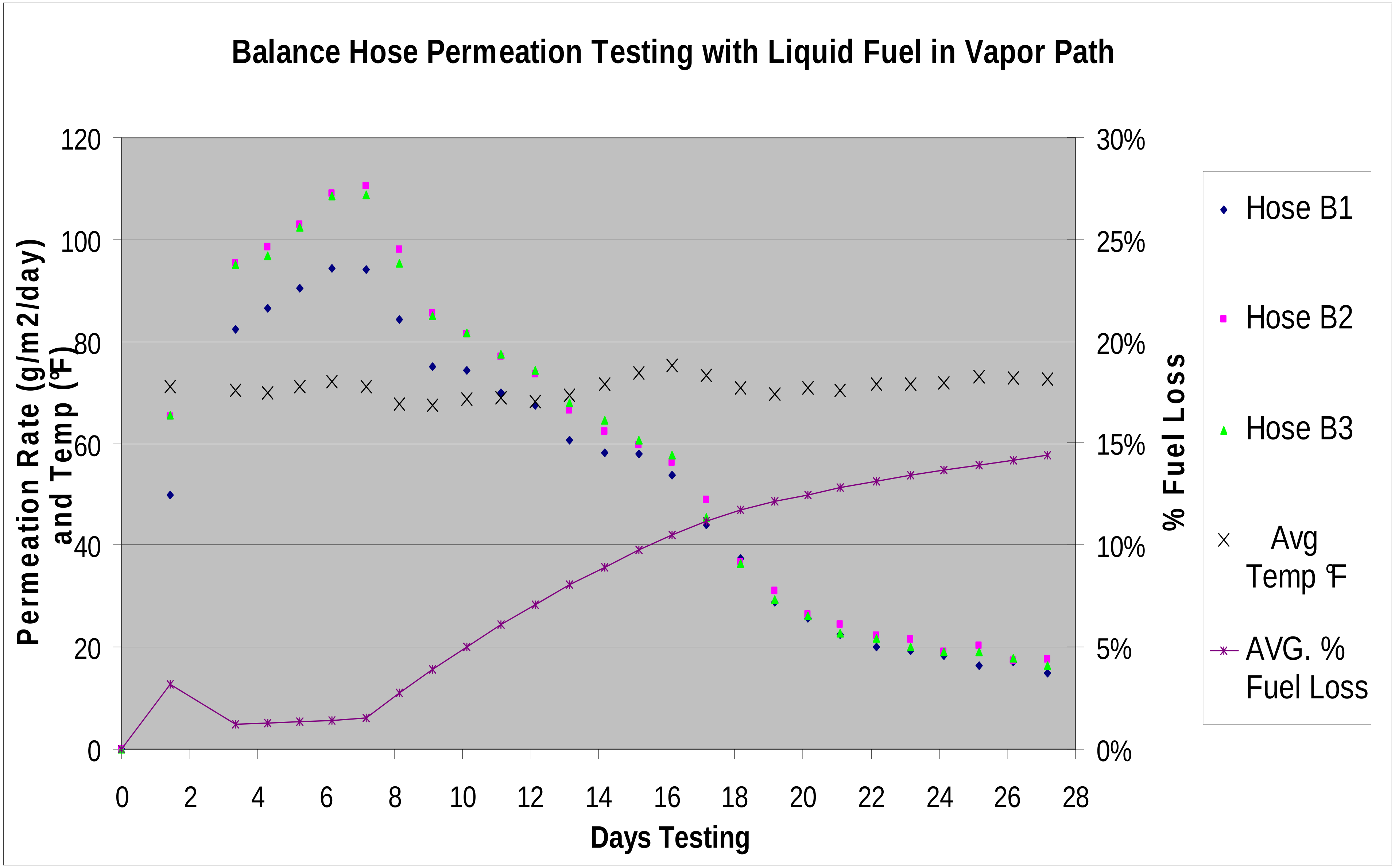
GDF Balance Hose Testing Data

Date	Mass Loss (grams)			Initial Fuel Mass (grams)			Time of Permeation Period (days)	Average Temp (°C)	Maximum Temp (°C)	Minimum Temp (°C)
	Hose B1	Hose B2	Hose B3	Hose B1	Hose B2	Hose B3				
11-Apr	N/A	N/A	N/A	732.07	735.66	732.98	N/A	N/A	N/A	N/A
12-Apr	19.35	25.29	25.39	N/A	N/A	N/A	2.86	21.75	24.50	20.38
13-Apr				N/A	N/A	N/A		21.75	24.50	20.38
14-Apr				953.57	943.65	946.1		21.75	24.50	20.38
15-Apr	10.64	12.3	12.27	962.89	950.98	953.54	0.95	21.37	22.81	19.75
16-Apr	11.11	12.68	12.46	955.66	950.92	952.55	0.95	21.06	22.56	19.75
17-Apr	11.59	13.18	13.11	956.27	956.67	949.05	0.95	21.76	23.19	20.38
18-Apr	12.03	13.91	13.84	963.47	955.12	949.99	0.94	22.28	23.88	20.38
19-Apr	13.03	15.29	15.07	N/A	N/A	N/A	1.02	21.67	22.56	19.75
20-Apr	10.81	12.55	12.22	N/A	N/A	N/A	0.95	19.79	23.19	20.38
21-Apr	10.03	11.45	11.37	N/A	N/A	N/A	0.99	19.76	23.88	20.38
22-Apr	10.02	10.96	10.99	N/A	N/A	N/A	1.00	20.41	21.44	19.00
23-Apr	9.62	10.6	10.64	N/A	N/A	N/A	1.02	20.56	21.44	19.38
24-Apr	9.06	9.86	9.97	N/A	N/A	N/A	0.99	20.04	21.19	18.63
25-Apr	8.47	9.3	9.49	N/A	N/A	N/A	1.03	20.76	21.81	19.38
26-Apr	8.02	8.59	8.91	N/A	N/A	N/A	1.02	21.94	23.13	20.38
27-Apr	7.68	7.88	8.02	N/A	N/A	N/A	0.98	23.19	24.50	21.81
28-Apr	7.12	7.44	7.63	N/A	N/A	N/A	0.98	24.09	25.69	22.50
29-Apr	6.1	6.76	6.28	N/A	N/A	N/A	1.02	22.92	24.56	21.38
30-Apr	4.9	4.81	4.78	N/A	N/A	N/A	0.97	21.57	23.19	20.00
1-May	4.1	4.44	4.19	N/A	N/A	N/A	1.06	20.99	22.13	19.75
2-May	3.19	3.27	3.23	N/A	N/A	N/A	0.92	21.60	22.81	20.38
3-May	2.96	3.22	3.01	N/A	N/A	N/A	0.98	21.29	22.81	20.00
4-May	2.99	3.32	3.24	N/A	N/A	N/A	1.10	22.00	23.19	20.75
5-May	2.47	2.75	2.56	N/A	N/A	N/A	0.94	21.98	23.50	20.38
6-May	2.49	2.6	2.59	N/A	N/A	N/A	1.01	22.14	23.94	20.75
7-May	2.28	2.83	2.65	N/A	N/A	N/A	1.03	22.82	24.13	21.38
8-May	2.37	2.4	2.46	N/A	N/A	N/A	1.02	22.69	24.13	21.38
9-May	1.88	2.22	2.08	N/A	N/A	N/A	0.94	22.50	24.13	21.13

Note: All positive mass numbers indicate mass loss.

Note: Initial fuel masses refer to initial fuel fill and fuel refreshing episodes.

______ Underlined dates indicate dates for which mass loss was taken over multiple dates.


Balance Hose Permeation Testing with Liquid Fuel in Vapor Path
Permeation Rate (g/m2/day) and Temp (°F)
% Fuel Loss
Days Testing
120
100
80
60
40
20
0
30%
25%
20%
15%
10%
5%
0%
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Hose B1
Hose B2
Hose B3
Avg Temp °F
AVG. % Fuel Loss

APPENDIX H

Gasoline Dispensing Facility (GDF) Balance Hose Vapor Quality and Permeation Analysis

Appendix H

Gasoline Dispensing Facility (GDF) Balance Hose Vapor Quality and Permeation Analysis

Introduction

The California Air Resources Board (ARB) staff conducted an analysis of gasoline vapor quality for balance gasoline dispensing facility (GDF) hoses (Figure 1) in 2008. The purpose of the analysis was to characterize the vapor quality from balance GDF hoses to estimate emissions due to permeation. The emissions estimates are used to support a proposed regulation to reduce permeation from GDF hoses. If adopted, the regulation would be fully implemented by 2014. The analysis showed that the 2014 average permeation rate for balance GDF hoses would be approximately 21.4 grams per square meter per day (g/m^2/day), given an average ambient temperature of 71.0℉ (21.7℃) when using California summer time pump fuel. Throughout this analysis, test results are expressed with different baseline temperatures. This is due to the testing parameters of the individual tests involved. However, the data have been normalized and the performance standard has been adjusted to the appropriate temperature.

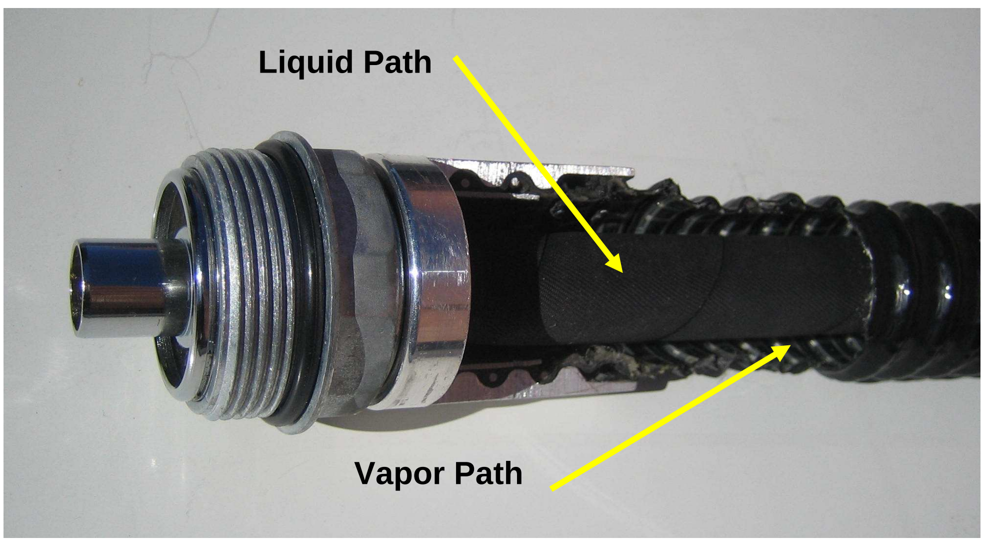


Figure 1. Cutaway of a balance GDF hose showing vapor and liquid paths.

Permeation

Permeation is defined as the diffusion of a liquid or vapor (the permeate) through a solid substance. Permeation rate, or flux, may be affected by temperature, permeate type, concentration gradient of the permeate across the solid, and the solid material type and thickness. Depending upon these factors, some common fuel hose materials can permeate at rates of over 500 g/m^2/day. For GDF hose permeation, the permeate is gasoline and the solid through which the permeate is diffused is the outer hose wall.

The Society of Automotive Engineers (SAE) has several test methods that have been used to determine permeation rates for fuel hoses.[1, 2] The methods generally measure permeation either directly or indirectly by weight loss of the specimen. In addition, research published by SAE suggests that a saturated vapor permeates at approximately the same rate as it would in liquid form under the same conditions.[3, 4, 5, 6] A saturated vapor is a vapor that when the substance is present in both liquid and vapor states, the substance is in equilibrium between the two states. The vapor in the fuel tank of a car is considered a saturated vapor as a state of equilibrium between the vapor and liquid states frequently exists.

The vapor that is being transferred in a balance GDF hose comes from a vehicle fuel tank and therefore is considered a saturated vapor. This is also the case immediately following the fueling event. However, due to the time between refueling events in which the vapor is stagnant and permeating through the outer hose wall, the vapor within a balance GDF hose cannot be characterized as a saturated vapor at all times. Therefore, a model is necessary to characterize permeation emissions from GDF hoses.

Balance GDF Hose Permeation Testing

Staff conducted two separate tests to determine balance GDF hose gasoline permeation rates. The first test was conducted in 2004 and the second test was conducted in 2008.

In 2004, a GDF hose permeation test was conducted to estimate the amount of emissions due to permeation from GDF hoses.[7] For balance GDF hoses, the test included filling the inner (liquid) path to 75 percent full and capping the hose assembly to separate the liquid and vapor paths. Testing exposed the hoses to ambient temperature conditions for a period of approximately one month while recording weight loss at regular intervals. Weight loss was attributed to fuel loss due to permeation. No attempt was made to control vapor quality in the hose vapor paths and the test did not address test fuel degradation. Because of these limitations the vapor quality in the vapor path never achieved a saturated vapor. Despite these short comings, balance GDF hose permeation rates of 22.6 $g/m^2/day$ were observed for an average ambient temperature of 69 °F (20.5 °C) when using California summer time pump fuel.

In 2008, staff conducted another balance GDF hose permeation test to measure the permeation of a saturated vapor from a balance GDF hose.[8] The Test included removing the inner (liquid) hose path, filling the hose assembly with liquid fuel to 90 percent capacity, and capping the hose assembly. The test exposed the hoses to room temperature for approximately one month while recording weight loss over regular intervals. Weight loss was attributed to fuel loss due to permeation. Staff controlled fuel degradation to less than 2 percent by refreshing the fuel daily. To approximate the saturated vapor permeation rate for balance GDF hoses, staff assumed a saturated vapor permeates at the same rate as liquids given the same conditions. The test determined a balance GDF hose saturated vapor permeation rate of 104.5 $g/m^2/day$ for an average ambient temperature of 71.0℉ (21.7℃) when using Californi a summer time pump fuel.

Balance GDF Hose Vapor Quality

To determine when a saturated vapor is present in a balance GDF hose, staff conducted an efficiency and emissions factor test in 2007.[9] Data was collected from fueling events of more than 200 cars over the course of five days (Attachment 1). As part of the test, return vapor quality was measured in the vapor return path at a point immediately proceeding where the hose terminates into the dispenser. A non-dispersive infrared (NDIR) absorbance sensor (Figure 2) was used to measure concentrations. The data were collected for the purpose of determining the efficiency of the vapor recovery system. However, staff found this information useful in characterizing the saturated vapor quality and typical operational vapor quality within the hose. Time between fueling events measured during this test ranged from 5 to 15 minutes.

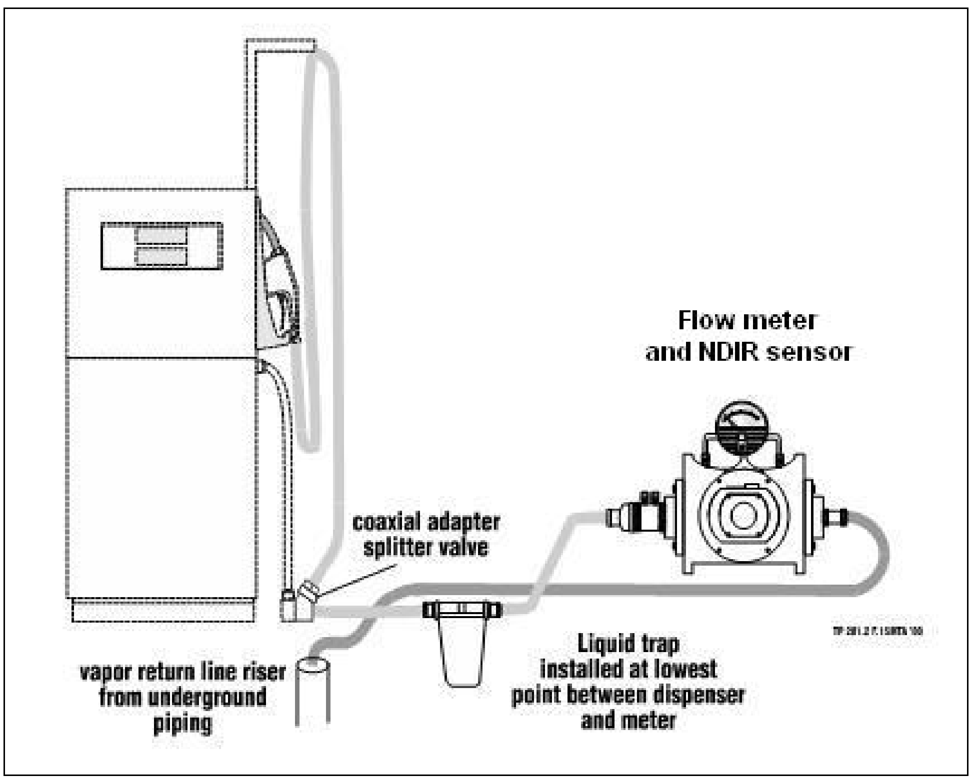


Figure 2 Test set up for measuring return vapor volume and quality at a GDF.

Staff looked at three specific fuel event characteristics associated with the test. These characteristics include: Vehicle class as On-Road Vapor Recovery (ORVR) or not, vapor to liquid ratio (V/L) of the returning vapors, and vapor quality as measured in percent propane (percent C_3H_8). These characteristics impact vapor quality as follows:

- ORVR vehicles, by design, should return very little, if any, vapor through the balance GDF hose during a fueling event. This is because the displaced vapors from the tank of an ORVR vehicle are routed to a carbon canister for storage until they can be purged during optimum vehicle running conditions. Theoretically, only air that leaks into the system at an improperly seated nozzle should be returned through the hose vapor return path during the fueling of ORVR vehicles. By contrast, fueling a non-ORVR vehicle would force displaced vapor in the vehicle fuel tank through the vapor return path of the balance GDF hose as they are drawn into the GDF tank.
- V/L ratios describe the ratio of the volume of the returning vapors to the volume of the dispensed liquid. For non-ORVR vehicles, a fueling event with a properly operating balance vapor recover system should result in a V/L of 1. This represents an equal volume transfer between the vehicle tank and the GDF tank. Also, an ORVR vehicle fueling event should result in a V/L approaching zero. For all fueling events conducted in the test, the average V/L for ORVR vehicles was 0.5 and the average V/L for non-ORVR vehicles was 1.4. This implies that during most fueling events, excess air was introduced into the system. This implies that the vapor quality would generally be less than saturated.
- Percent propane represents the equivalent HC concentration measured by the NDIR. Theoretically, the percent propane observed for a fueling event with a V/L of 1 for a non-ORVR vehicle, should represent the equivalent HC concentration of a saturated gasoline vapor for the conditions measured.

Determining Balance GDF Hose Saturated Vapor Quality

As previously discussed, staff assumes that the gasoline vapor immediately transferred into the vapor path of a balance GDF hose, during an ideal non-ORVR fueling event is a saturated vapor. For the purposes of this paper, an ideal fueling event is one in which there are no leaks in the vapor return path. An ideal fueling event for a non-ORVR vehicle is characterized as having a V/L of 1. Therefore, an HC concentration corresponding to a V/L of 1 should represent a saturated vapor. Staff calculated the average HC concentration for non-ORVR vehicle fueling events with a V/L ranging from 0.9 to 1.1. The results indicate average HC concentrations for a saturated vapor was 45 percent C_3H_8.

Determining Hose Vapor Quality for Normal Operating Conditions

Vapor quality within the hose degrades over time (due to permeation, air being drawn into the system, time between non-ORVR fueling events, etc.). Also, some

ORVR vehicles seem to be returning large quantities of air through the hoses. This is illustrated by the average V/L of 0.5 during ORVR fueling events. However, because ORVR vehicles should not be returning vapor during fueling events, and are likely ingesting some amount of air, observations taken from successive ORVR fueling events present an opportunity to observe the most extreme case of vapor quality degradation within balance GDF hoses.

Staff developed a trends model to evaluate the data. First, the average vapor quality for all non-ORVR fueling events performed during the test was calculated. The average HC concentrations were 36 percent C_3H_8, approximately 81 percent of a saturated vapor. This average HC concentration was used as the initial data point for determining the trend. For the next data point, staff looked at the average vapor quality for ORVR fueling events which directly followed a non-ORVR fueling event and found this average HC concentration to be 19 percent C_3H_8, approximately 43 percent of a saturated vapor. Staff continued this process for the 2nd, 3rd and 4th consecutive ORVR vehicles following a non-ORVR vehicle fueling event. The results of this analysis are an exponential trend shown in Figure 3.

The data shows that vapor quality degrades in a clear and predictable exponential manner. This is demonstrated by the square of the correlation coefficient (R^2) being close to 1 when fitted to an exponential curve (Figure 3). The predictive equation that was generated from these data to model exponential degradation of HC concentration with consecutive ORVR vehicle fueling events is as follows:

$$\textbf{\textit{HC concentration}} = \mathbf{34.45e^{-0.533x}\ \%\ C_3H_8}$$

Where the number of consecutive cars is denoted by x.

Staff did not factor into the analysis data for the 5th consecutive ORVR vehicle due to a small sample size. The exponential equation predicts that HC concentrations should approach zero, with the HC concentration being approximately 0.5 percent C_3H_8 for the 8th consecutive ORVR vehicle. Staff has determined it unrealistic to assume that the model would predict accurate HC concentrations below this point. This is due to uncertainty from potential spills and leaks near the nozzle interface, time between fueling episodes and permeation from the inner hose path into the outer hose path. For emissions modeling purposes, staff assumes the model for HC concentration in the vapor path of the balance GDF hose is valid for eight consecutive ORVR vehicle fueling events. Also, successive ORVR events should be assumed to have an HC concentration of 0.5 percent C_3H_8 (~ 1.1 percent of a saturated vapor).

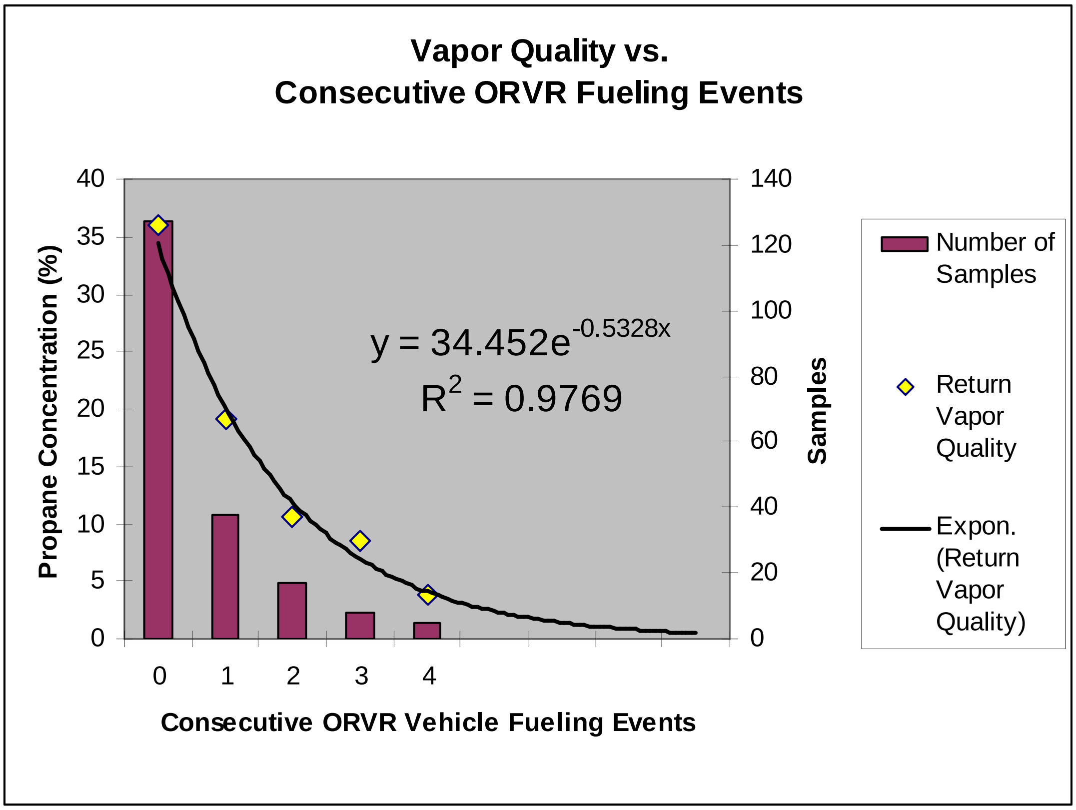


Figure 3 Chart displaying vapor quality degradation with successive ORVR fueling events.

The model to predict HC concentrations for balance GDF hoses requires the population of ORVR vehicles and an estimate of the number of fueling episodes per GDF fueling point per day.

ORVR vehicle populations are increasing yearly to meet federal mandates. Staff's proposal for regulating GDF hose permeation emissions are expected to take effect in 2014. This is the year the ORVR population data will be applied. Staff has completed an analysis of this trend, and predicts that ORVR vehicles will be approximately 85 percent of the 2014 California vehicle population by vehicle miles traveled.[10] Also, based on more than a years worth of data collected from multiple GDF internal system diagnostic logs of fueling events, staff estimates that there are roughly 65 fueling events per fueling point per day at the average GDF.

Given these factors, the equation for modeling HC concentrations may be applied to predict for HC concentrations in balance GDF hoses. The only remaining variable is to determine the proper distribution for ORVR and non-ORVR vehicles over the 65 fueling events per day. Staff approached this by determining the scenarios which would deliver both the highest and lowest HC concentrations, and then taking the average of the two scenarios.

Staff modeled the scenario for the highest average HC concentration (12 percent C_3H_8) by distributing the non-ORVR vehicle fueling events evenly through the 65 fueling events of a day. Because non-ORVR vehicles essentially reset the HC concentration curve to its highest value (34.5 percent C_3H_8), this leads to many more ORVR fueling events being near the middle of the HC concentration curve rather than at the bottom. This results to a higher average HC concentration for the day. Staff also modeled the scenario for the lowest average HC concentration (6 percent C_3H_8) by stacking the non-ORVR vehicle consecutively within the day. Because this leads to many more ORVR fueling events being at the bottom of the HC concentration curve rather than in the middle, this leads to a lower average HC concentration for the day. From these two scenarios, staff calculated the average balance GDF hose HC concentrations to be approximately 9 percent C_3H_8, roughly 20 percent of a saturated vapor. This is demonstrated graphically in Figure 4.

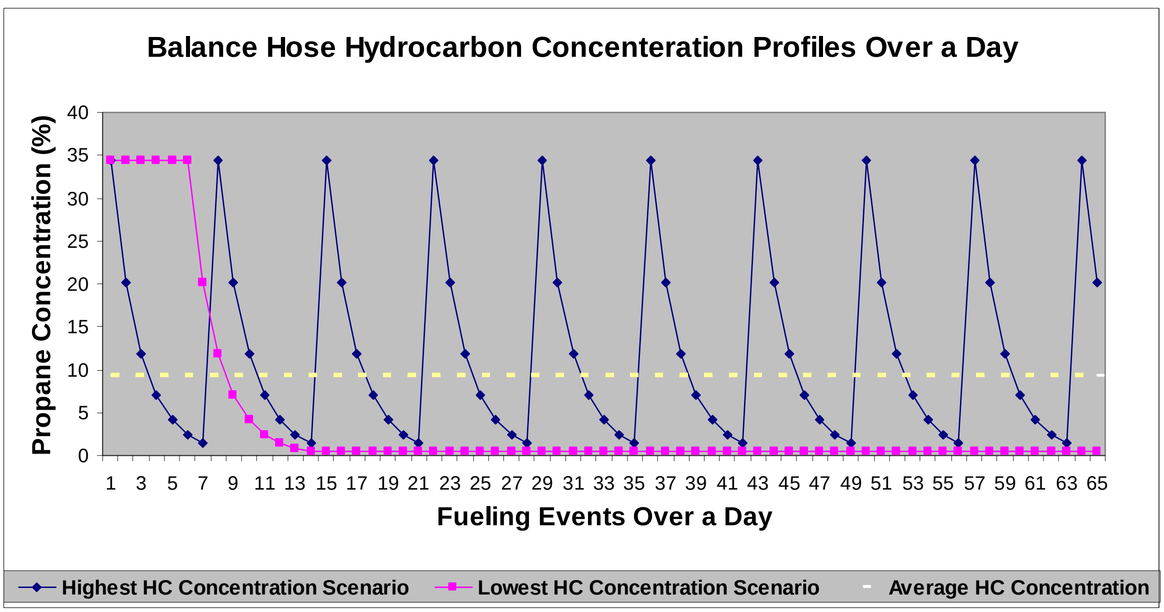


Figure 4 Highest, Lowest, and Average balance hose HC concentration profiles for a day.

The specific predictions given by the equation to model for HC concentration (percent C_3H_8) are valid for the specific testing conditions at which the 2007 EVR efficiency test was performed. The most important condition is temperature. However, staff assumes that the model will predict the correct distribution with respect to average vapor quality as it relates to percent of a saturated vapor at the given conditions. This is because temperature shifts which affect HC concentrations should proportionately shift the entire distribution. This would likely result in little effect when considering vapor quality as a percent of saturated vapor for a given set of conditions.

Estimating Permeation Rate Given Vapor Quality

As previously discussed, staff has determined through testing that a balance GDF hose containing a saturated vapor has a permeation rate of approximately 104.5 $g/m^2/day$ for an average ambient temperature of 71.0°F (21.7°C) when using California summer time pump fuel. Further, a hose with no vapor in it (having a vapor quality of zero) would permeate at a rate of zero. Given these two data points, and the previously mentioned ARB 2004 test results showing that an intermediate HC concentration that was less than saturated and greater than zero did not produce a permeation rate close to either of the extremes of 104.5 $g/m^2/day$ or zero, it is reasonable to assume that linear interpolation for HC concentrations between the two extremes can be used to approximate the permeation rates within balance GDF hoses. Interpolating the estimate for the 2014 average balance hose vapor concentration of 9 percent C_3H_8 (roughly 20 percent of a saturated vapor), predicts a permeation rate for balance GDF hoses of 21.4 $g/m^2/day$, given an average ambient temperature of 71.0°F (21.7°C) when using California summer time pump fuel.

Conclusion

Staff has determined that the 2014 average permeation rate for balance GDF hoses will be approximately 21.4 $g/m^2/day$, given an average ambient temperature of 71.0°F (21.7°C) when using California summer tim e pump fuel. With increasing ORVR populations, the average permeation rate of balance GDF hoses will decrease in years subsequent to 2014 due to decreasing vapor quality within these hoses.

Works Cited

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[3] Tuckner, P., Baker, J., "Fuel Permeation Testing using Gravimetric Methods," Society of Automotive Engineering Technical Paper 2000-01-1096, pp. 5.

[4] Nulman, M., Olejnik, A., Samus, M., Fead, E., Rossi, G., "Fuel Permeation Performance of Polymeric Materials," Society of Automotive Engineering Technical Paper 2001-01-1999, sec. IV.

[5] Samulski, Michael J., Characterization and Control of Evaporative Emissions from Fuel Tanks in Non-road Equipment. Society of Automotive Engineering Technical Paper 06SETC-92, pp. 14.

[6] Nulman, M., Olejnik, A., Samus, M., Fead, E., Rossi, G., Fuel Permeation Performance of Polymeric Materials Analyzed by Gas Chromatography and Sorption Techniques. Society of Automotive Engineering Technical Paper 981360, pp. 3.

[7] California Air Resources Board (CARB), GDF Hose Permeation Study Review. 29, Oct. 2007. <http://www.arb.ca.gov/vapor/gdfhe/gdfpermreport07.pdf>.

[8] California Air Resources Board (CARB), Gasoline Dispensing Facility (GDF) Balance Hose Permeation Study. 19, June 2008. <http://www.arb.ca.gov/vapor/gdfhe/arb_gdf_balancehose_permeation_report_08_posted.pdf>.

[9] California Air Resources Board (CARB), Source Test Report: Test Number 07-01. 13, March 2007.

[10] California Air Resources Board (CARB), MEMO:MILES TRAVELED BY ORVR VEHICLES IN CALIFORNIA. 01, July 2008. <http://www.arb.ca.gov/vapor/ORVR%20Percent%20VMT%202008.pdf>

Attachment 1

The table given below is a presentation of the data collected in Source Test Report Number 07-01. It has been truncated to included only data that is relevant to the analysis of balance hose vapor quality. All samples marked Invalid in the matrix number column were excluded from consideration in this study with the exception of sample number 53, which was one of a series of consecutive ORVR vehicle fueling events. Because it was only excluded from the EVR efficiency test on the grounds that it was an extra vehicle, staff felt that its value as part of a consecutive series of ORVR fueling events warranted its inclusion in the data set. Samples marked conv under the vehicle fuel system type column refer to non-ORVR vehicles.

Source Test Report: Test Number 07-01 (Truncated)

Matrix No.	Vehicle Year	Vehicle Fuel System Type	Dispensed Fuel (Gallons)	Vapor Return Line Avg Conc (%C_3H_8)	Vapor Return Line Volume (ft^3)	V / L Ratio	Qual.
February 21, 2007							
1	2006	orvr	11.092	3.337	0.10	0.07	
2	1999	conv	7.406	25.995	1.45	1.46	
3	2004	orvr	6.759	11.576	1.39	1.54	
4	2001	conv	19.200	46.715	2.44	0.95	
5	1971	conv	8.802	38.190	1.68	1.43	
6	1999	orvr	6.759	13.338	1.02	1.13	
7	1999	conv	17.425	35.338	3.13	1.34	
8	2000	orvr	7.249	31.831	0.06	0.06	
9	1989	conv	10.127	39.306	1.70	1.26	
Invalid	1997	conv	3.356	41.943	0.49	1.09	<6 gal
11	2000	orvr	13.571	3.873	2.91	1.60	
12	2003	orvr	7.249	2.132	0.04	0.04	
Invalid	1995	conv	3.625	15.914	1.59	3.28	<6 gal
14	1997	conv	18.700	48.582	2.62	1.05	
15	2000	orvr	7.247	16.695	1.76	1.82	
16	2002	orvr	14.444	2.882	0.67	0.35	
17	1998	conv	6.405	21.158	1.62	1.89	
Invalid	1998	conv	1.812	26.024	0.30	1.24	<6 gal
19	1995	conv	15.728	56.440	2.04	0.97	
20	2005	orvr	13.545	44.789	0.40	0.22	
21	2001	orvr	7.249	10.194	0.34	0.35	
22	2004	orvr	12.239	6.690	0.10	0.06	
23	2007	orvr	14.682	6.880	0.05	0.03	
Invalid	1993	conv	7.249	38.364	2.06	2.13	Leak
25	2005	orvr	20.513	14.633	0.30	0.11	
26	1998	conv	7.930	22.89	2.08	1.96	
27	2002	orvr	7.249	17.810	0.08	0.08	
Invalid	1991	conv	4.349	34.662	0.56	0.96	<6 gal
29	2001	orvr	10.644	24.728	0.04	0.03	

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30	2001	orvr	13.164	17.378	0.15	0.09	
31	1999	conv	14.203	39.971	2.35	1.24	
32	2006	orvr	9.493	30.468	2.24	1.77	
33	2006	orvr	13.474	32.262	0.26	0.14	
34	1997	conv	14.803	39.639	2.56	1.29	
35	2006	orvr	19.056	13.227	2.07	0.81	
36	2003	conv	9.189	8.063	0.42	0.34	
37	2003	orvr	15.631	4.120	5.46	2.61	
38	2005	orvr	6.658	3.163	0.08	0.09	
39	2004	conv	25.582	43.211	4.03	1.18	
40	1996	conv	7.145	51.722	0.98	1.03	
41	1997	conv	11.768	53.849	1.62	1.03	
42	2003	orvr	10.874	26.805	0.06	0.04	
43	2003	orvr	10.087	6.512	3.16	2.34	
44	2005	orvr	17.331	3.209	1.10	0.47	
45	2002	orvr	7.349	2.879	0.77	0.78	
46	2001	orvr	8.945	1.919	0.29	0.24	
47	1990	conv	14.707	42.407	1.44	0.73	
48	2004	orvr	9.518	40.174	0.10	0.08	
49	2004	orvr	11.149	9.254	2.34	1.57	
February 22, 2007							
50	1999	conv	20.618	21.712	7.07	2.57	
51	2005	orvr	18.653	4.112	4.18	1.68	
52	2005	orvr	18.034	3.635	2.84	1.18	
Invalid	2006	orvr	13.427	1.089	0.08	0.04	Extra
54	2006	orvr	14.699	0.982	0.03	0.02	
55	2004	orvr	25.377	35.542	4.60	1.36	
56	2000	conv	11.170	47.868	1.47	0.98	
57	2002	orvr	14.798	12.226	3.02	1.53	
58	2004	orvr	14.188	3.997	0.15	0.08	
59	2005	orvr	15.33	3.557	0.10	0.05	
60	2004	orvr	12.147	2.215	0.07	0.04	
61	2004	orvr	13.382	1.816	0.17	0.10	
Invalid	2005	orvr	7.296	1.591	2.29	2.35	Extra
Invalid	2003	conv	19.573	41.497	2.80	1.07	Extra
64	2000	conv	7.095	37.440	1.20	1.27	
65	1993	conv	20.590	46.936	2.21	0.80	
66	2002	orvr	18.704	21.777	1.37	0.55	
67	1998	conv	15.448	40.065	2.07	1.00	
68	2004	orvr	23.887	33.408	0.14	0.04	
69	1999	conv	11.522	37.460	2.06	1.34	
70	1977	conv	6.852	33.727	1.00	1.09	
71	2003	orvr	15.668	12.611	1.10	0.53	
72	2004	orvr	7.095	5.550	0.22	0.23	
73	2004	orvr	17.476	15.718	0.56	0.24	
74	2003	orvr	14.793	5.767	0.40	0.20	
75	2005	orvr	14.188	4.107	1.42	0.75	
76	1997	conv	7.095	31.714	1.21	1.28	
77	2001	orvr	10.09	25.521	0.52	0.39	
78	2000	conv	8.072	32.368	1.28	1.19	
79	2002	conv	7.518	31.649	0.19	0.19	

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80	1988	conv	13.520	28.677	3.29	1.82	
81	2002	orvr	16.409	29.273	0.09	0.04	
82	1994	conv	16.103	42.830	2.41	1.12	
Invalid	2005	orvr	13.946	42.301	0.01	0.01	Extra
Invalid	2001	conv	10.909	47.942	1.48	1.01	Extra
85	1998	conv	11.791	53.362	1.57	1.00	
86	1988	conv	10.253	54.102	1.37	1.00	
87	1996	conv	7.095	32.015	1.16	1.22	
88	2000	orvr	7.095	25.121	0.12	0.13	
89	2004	orvr	17.108	18.840	0.25	0.11	
90	1998	orvr	13.469	14.759	0.02	0.01	
91	1998	conv	18.065	44.237	2.72	1.13	
92	1999	conv	12.781	56.196	1.24	0.73	
93	1996	conv	7.095	52.352	1.18	1.24	
94	1991	conv	7.095	49.566	0.26	0.27	
95	1992	conv	9.261	49.870	1.41	1.14	
96	2007	orvr	25.463	16.491	2.10	0.62	
97	2000	conv	16.341	43.606	2.04	0.93	
98	1990	conv	15.914	20.334	6.92	3.25	
Invalid	1994	conv	15.61	43.642	1.95	0.93	Leak
100	1999	conv	10.735	47.133	0.06	0.04	
February 23, 2007							
Invalid	2001	orvr	7.424	0.8	0.06	0.06	Shutoffs
102	2003	orvr	9.688	0.78	0.03	0.02	
103	2000	conv	9.461	22.64	2.20	1.74	
104	1992	conv	6.625	35.8	1.21	1.37	
105	1999	conv	17.422	36.9	3.25	1.40	
Invalid	2004	orvr	20.654	16.5	0.88	0.32	Extra
107	2001	conv	19.962	45.1	2.47	0.93	
108	1999	conv	9.372	33.8	2.39	1.91	
109	1998	orvr	14.590	3.6	0.81	0.42	
110	2000	orvr	8.884	2.8	0.26	0.22	
111	2003	orvr	17.203	11.2	0.26	0.11	
112	2000	conv	15.857	40.4	2.31	1.09	
113	1995	conv	10.641	31.9	1.85	1.30	
Invalid	1990	conv	3.548	32.0	0.58	1.22	<6 gal
115	1999	orvr	14.517	28.6	0.51	0.26	
116	1986	conv	7.095	36.1	1.13	1.19	
117	1988	conv	7.095	48.7	0.96	1.01	
118	1998	conv	7.095	44.0	1.04	1.10	
119	1996	conv	7.095	35.3	1.27	1.34	
120	1992	conv	12.367	49.7	1.66	1.00	
121	1991	conv	15.250	45.1	2.45	1.20	
122	1987	conv	7.095	43.3	1.03	1.09	
Invalid	1997	conv	13.199	38.6	2.55	1.45	Extra
124	1995	conv	6.008	39.0	1.05	1.31	
Invalid	2003	orvr	13.788	22.7	0.08	0.04	Extra
126	1990	conv	7.095	35.0	1.36	1.43	
127	2001	orvr	7.095	30.2	0.17	0.18	
Invalid	1996	conv	7.095	28.5	2.43	2.56	Leak
129	1997	conv	16.962	29.5	4.28	1.89	

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Invalid	2002	orvr	15.075	NA	NA	NA	Lost Data
131	1999	conv	7.095	40.568	1.08	1.14	
132	1987	conv	7.095	45.067	1.17	1.23	
133	2006	orvr	6.834	25.045	0.46	0.50	
134	1975	conv	7.095	16.824	2.92	3.08	
135	1988	conv	12.751	40.309	1.92	1.13	
Invalid	2001	orvr	5.321	26.384	0.12	0.17	<6 gal
Invalid	1973	conv	4.257	42.221	0.78	1.37	< 6 gal
138	1992	conv	13.911	38.012	2.57	1.38	
139	2005	orvr	12.245	37.471	0.40	0.24	
140	2002	orvr	8.432	27.120	0.33	0.29	
141	1998	conv	14.747	39.858	2.33	1.18	
142	1992	conv	7.668	45.335	1.15	1.12	
143	1994	conv	8.868	32.619	2.69	2.27	
144	1987	conv	7.095	41.647	1.13	1.19	
145	2005	orvr	24.345	36.764	0.53	0.16	
146	2006	orvr	20.546	24.864	0.27	0.10	
147	2002	orvr	7.095	12.374	0.11	0.12	
148	1989	conv	13.746	29.697	3.19	1.74	
Invalid	1998	conv	20.636	46.059	3.15	1.14	Extra
150	1988	conv	7.095	41.058	1.34	1.41	
151	1991	conv	7.095	35.375	1.50	1.58	
152	1988	conv	7.095	43.286	0.80	0.84	
153	1986	conv	7.095	44.272	1.56	1.64	
154	1994	conv	16.152	30.534	4.22	1.95	
155	2000	conv	15.954	45.704	2.04	0.96	
Invalid	1995	conv	11.408	NA	NA	NA	Lost Data
157	1987	conv	7.095	46.559	1.05	1.11	
158	1995	conv	7.095	39.499	1.05	1.11	
159	1995	conv	9.664	41.562	1.54	1.19	
February 24, 2007							
160	1993	conv	7.054	18.408	2.33	2.47	
161	1996	conv	11.503	20.735	4.21	2.74	
162	1999	orvr	6.581	3.309	1.93	2.19	
163	2001	orvr	14.244	2.368	0.01	0.01	
164	1965	conv	7.045	22.145	1.81	1.92	
165	1965	conv	7.045	36.259	1.18	1.25	
166	1993	conv	7.045	43.976	1.19	1.26	
167	1998	conv	6.284	36.456	0.83	0.99	
168	1999	conv	16.163	25.940	4.02	1.86	
169	1984	conv	7.045	33.262	1.35	1.43	
170	1992	conv	7.045	14.595	4.99	5.30	
171	1989	conv	7.045	29.836	1.27	1.35	
172	1999	conv	9.059	23.257	3.38	2.79	
173	1970	conv	6.581	31.462	1.20	1.36	
174	1984	conv	7.045	39.933	1.10	1.17	
175	2006	orvr	7.045	20.046	0.87	0.92	
Invalid	1988	conv	5.243	22.742	1.26	1.80	<6 gal
177	2002	orvr	11.363	12.819	0.08	0.05	
178	1989	conv	7.045	34.497	0.97	1.03	
179	1999	conv	7.045	33.613	0.27	0.29	

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180	1990	conv	7.045	43.111	0.87	0.92	
181	1994	conv	20.559	51.838	2.68	0.98	
182	1986	conv	13.162	41.673	3.40	1.93	
183	1994	conv	14.269	33.909	1.74	0.91	
184	1999	conv	21.134	49.217	2.88	1.02	
185	1995	conv	10.567	50.557	1.17	0.83	
186	1977	conv	6.581	29.476	2.14	2.43	
187	1990	conv	7.045	34.164	1.22	1.30	
188	1998	conv	16.573	47.016	2.23	1.01	
189	1989	conv	7.045	32.984	1.59	1.69	
Invalid	1998	conv	11.769	40.435	2.13	1.35	Extra
191	1995	conv	7.045	41.723	1.16	1.23	
192	2002	orvr	7.045	20.969	0.06	0.06	
193	2000	orvr	7.045	NA	NA	NA	
194	2001	conv	7.045	39.690	1.06	1.13	
Invalid	1991	conv	6.662	21.563	2.17	2.44	Extra
196	1991	conv	7.045	38.334	1.18	1.25	
Invalid	1978	conv	6.581	39.623	1.66	1.89	Spitback
198	1987	conv	7.045	42.335	1.10	1.17	
February 25, 2007							
199	1994	conv	7.045	19.849	1.99	2.11	
200	1994	conv	7.045	27.527	1.29	1.37	
201	1994	conv	7.045	31.946	1.08	1.15	
202	2001	conv	8.806	23.936	2.37	2.01	
203	1990	conv	10.592	34.007	1.62	1.14	
Invalid	1994	conv	4.271	36.733	0.52	0.91	<6 gal
205	2000	orvr	13.354	9.829	1.79	1.00	
206	1994	conv	7.045	30.412	1.30	1.38	
207	1986	conv	6.578	15.568	2.09	2.38	
208	1989	conv	7.045	34.386	0.97	1.03	
209	1988	conv	6.581	45.127	0.82	0.93	
210	2002	conv	7.045	44.236	1.07	1.14	
211	1994	conv	6.805	32.684	1.99	2.19	
212	1989	conv	7.045	20.608	2.65	2.81	
213	1989	conv	7.045	19.540	2.60	2.76	
214	2000	orvr	10.95	7.514	0.03	0.02	
215	1989	conv	7.045	20.194	2.84	3.02	
216	1989	conv	7.045	22.242	2.30	2.44	
217	2002	conv	7.045	31.664	1.72	1.83	
Invalid	2001	conv	6.805	30.257	1.50	1.65	Extra
219	1989	conv	6.085	6.244	0.04	0.05	
220	2000	orvr	7.045	7.676	0.06	0.06	
221	1986	conv	16.466	18.323	6.54	2.97	
222	1989	conv	7.045	20.742	3.11	3.30	
223	1987	conv	6.021	23.242	0.81	1.01	
224	1987	conv	7.045	45.274	0.89	0.95	
225	1987	conv	7.045	39.596	1.45	1.54	
226	1999	orvr	6.581	6.930	0.03	0.03	
227	1999	orvr	7.045	8.466	0.02	0.02	
228	1989	conv	13.527	4.628	2.45	1.35	

APPENDIX I

Gasoline Dispensing Facility (GDF) Hose Regulation
Economic and Fiscal Impact Analysis

APPENDIX I

Gasoline Dispensing Facility (GDF) Hose Regulation Economic and Fiscal Impact Analysis

Introduction

The Air Resources Board (ARB) staff conducted an analysis to show the economic and fiscal impacts expected from the proposed regulation limiting emissions from gasoline dispensing facility (GDF) hoses. Staff has determined the proposed regulation will not impose an unreasonable cost burden on retail businesses located in California or on implementing government agencies. Manufacturers are located outside California and are currently providing low permeation hoses for other source categories that are subject to similar performance standards for about half of the hose population. Staff has determined that the Statewide annual net cost of the proposed regulation for GDF owners and operators within California will be approximately $1.1 million. It is expected that some of this cost will be passed on to consumers. California GDFs dispense about 15.7 billion gallons of gasoline per year. This results in a cost increase of $0.000069 per gallon.

Economic Impact

This section addresses estimated private sector impacts, estimated costs, estimated benefits, and alternatives of the proposed regulation. The estimated net cost of the proposed regulation to affected California stakeholders is less than $10 million.

A) Estimate of Private Sector Impacts

The proposed regulation is expected to have Statewide impacts on GDF owners and manufacturers. Staff expects these impacts to affect approximately 9,900 retail GDFs and 3,000 private GDFs (Appendix C). Approximately 20 percent of the GDFs in California are small businesses. Staff has determined that this regulation will not lead to the elimination or creation of jobs within California, as the actual costs impact to any one GDF is small. The proposed regulation will not affect the competitiveness of California businesses because the impacts on any one California business are expected to be minor. Approximately eight GDF hose manufactures would be subject to the proposed regulation. These manufacturers are headquartered outside California.

B) Estimate of Costs

Staff surveyed GDF hose manufacturers (Appendix J), and has determined the retail costs increase for the balance and vacuum assist GDF hoses, would be $29 and $10, respectively. This amounts to about $20 per hose because staff estimates that in 2014, the year that the proposed regulation will achieve full compliance, the hose population will be split evenly between balance and vacuum assist GDF hoses. Staff has also determined from interviews with GDF hose manufacturers, that the average life of a GDF hose is approximately two years. Staff estimates that a small business is likely to have an average of four hoses while larger businesses are likely to have an average of 15 hoses. Also, staff estimates the average annual fuel savings per hose to be about $3.40 (gallons saved × $3.50 per gallon cost). Based on the above information the annual net cost to small businesses affected by the proposed regulation is approximately $26 and for larger businesses is approximately $99. See Table 1, Estimated Costs for California GDFs. In addition, GDF hose manufacturers will incur certifications costs.

Table 1, Estimated Costs for California GDFs

	Average Number of Hoses per GDF (a)	Average Costs per Hose (b)	Annual Costs per Hose Average/2 (c)	Annual Gasoline Costs Savings per Hose (d)	Total Annual Gross Costs (axc)* (e)	Total Annual Gasoline Costs Savings (axd) (f)	Annual Net Costs (e-f) (g)
Small Business	4	$20	$10	$3.40	$39	$13	$26
Larger Business	15	$20	$10	$3.40	$150	$51	$99

* Shown as a whole number, number is rounded.

The total costs of the proposed regulation are approximately $1.1 million (certification costs + compliance costs – costs savings). In 2007, California consumed over 15.7 billion gallons of gasoline. If most of these costs are passed on to consumers the cost increase of a gallon of gasoline will be $0.000069. This insignificant costs increase in the price of gasoline will have no impact on housing costs. These costs and costs savings are included in Appendix K.

The proposed regulation will amend current enhanced vapor recovery (EVR) requirements to require low permeation hoses. There are no proposed compliance tests after the hoses has been ARB certified, other than verification of the Executive Order number received upon ARB certification of the hose. Therefore, staff has determined that there will be no significant compliance reporting costs associated with the proposed regulation.

C) Estimate of Benefits

The proposed regulation will reduce over 1.4 tons per day (tpd) of reactive organic gases (ROG). These emission reductions benefit citizens of the State of California in contributing to cleaner air and the associated health benefits. It is difficult to assign a dollar value to the benefit of ROG and climate change emission reductions. The proposed regulation will also increase the possibility of meeting the State Implementation Plan (SIP) emissions reduction requirements and, thereby, receiving federal highway funds.

D) Alternatives to the Regulation

Staff has determined that the only alternative to the proposed regulation is to take no action. If no action is taken, California will continue to emit 1.4 tpd of ROG that is evaporating into the atmosphere. This will further contribute to smog and global climate change. No action may also impede the State in meeting its SIP goals.

APPENDIX I

Fiscal Impact

This section addresses estimated fiscal effect on local and State government.

A) Fiscal Effect on Local Government

Local agencies, such as school and fire districts, that are owners or operators of GDFs will incur costs similar to those of small business as mentioned above in Economic Impacts. The proposed regulation does not regulate GDFs employing aboveground storage tanks (ASTs). Many local governments operate GDFs employing ASTs and will therefore not be affected by the proposed regulation. As with small businesses, staff has determined that the effect of this regulation on local government will be insignificant.

B) Fiscal Effect on State Government

State agencies, such as the California Highway Patrol and the California Department of Transportation, that are operators of GDFs will incur costs similar to those of small business as mentioned above in Economic Impacts. Staff has determined that ARB will not incur any additional operating costs in the implementation of this regulation. As with small businesses, staff has determined that the effect of this regulation on State government will be small.

Conclusion

Staff has determined that the proposed regulation will not have a significant impact on the private sector or the government. Staff has determined that the Statewide annual net cost of the proposed regulation for GDF owners and operators within California will be approximately $1.1 million. It is expected that most of this cost will be passed on to consumers. Staff has determined that this would results in a cost increase to consumers of $0.000069 per gallon.

APPENDIX J

Gasoline Dispensing Facility (GDF)
Low Permeation Hose Upgrade Cost Report

California Environmental Protection Agency

Air Resources Board

Gasoline Dispensing Facility (GDF)
Low Permeation Hose Upgrade Cost Report

Prepared By:

Jason McPhee

Evaporative Controls and Certification Branch
Monitoring and Laboratory Division

October 6, 2008

Introduction

In June of 2007, the California Air Resources Board (CARB) conducted a survey of manufacturers of gasoline dispensing facility (GDF) hose to determine the cost to upgrade current GDF hose in California to include low permeation hose technology. CARB staff requested projected cost increases for both balance and vacuum assist styles of vapor recovery hose and conventional (non-vapor recovery) hose. Staff's criteria, within the survey, for low permeation included that the hoses would be approximately 10 feet in length and would permeate at a rate of no more than 5 g/m^2/day when tested at a constant temperature of 40 ℃ with CE-10 test fuel. Subsequent hose testing with manufactures involved in the survey has shown prototypes capable of meeting a slightly less rigorous standard of 10 g/m^2/day when tested at a constant temperature of 38 ℃ with CE-10 test fuel.

From the survey, staff concluded that the cost to upgrade either a conventional hose or a vacuum assist style vapor recovery hose would be approximately $10. Staff found that a balance style vapor recovery hose upgrade would be approximately $29. Staff estimates that the cost of these upgrades would lead to price increases of current products of 9% for vacuum assist hoses and 15% for balance hoses.

Background

It is part of CARB's mission to promote and protect the public health and welfare through the effective and efficient reduction of air pollutants. In carrying out this mission, CARB has sought to control hydrocarbon emissions at GDFs in California since 1975. Hydrocarbon emissions are reactive organic gases which can react in the atmosphere to form photochemical smog. Recently, CARB staff has identified GDF hoses as a sources of uncontrolled reactive organic gas emissions due to gasoline's ability to permeate through common GDF hose materials.

California GDFs, which are permitted by the local air pollution control districts, in most cases must use vapor recovery style hose. Vapor recovery hose is different from conventional fuel delivery hose in that it has two paths: one for fuel delivery and the other for vapor return. There are two different styles of vapor recovery hose: balance and vacuum assist. For permeation purposes, vacuum assist hoses are similar to standard fuel delivery hoses in that the liquid fuel is carried against the inside of the outer hose wall. Balance hoses are different, carrying vapor against the outer hose wall (Figure 1).

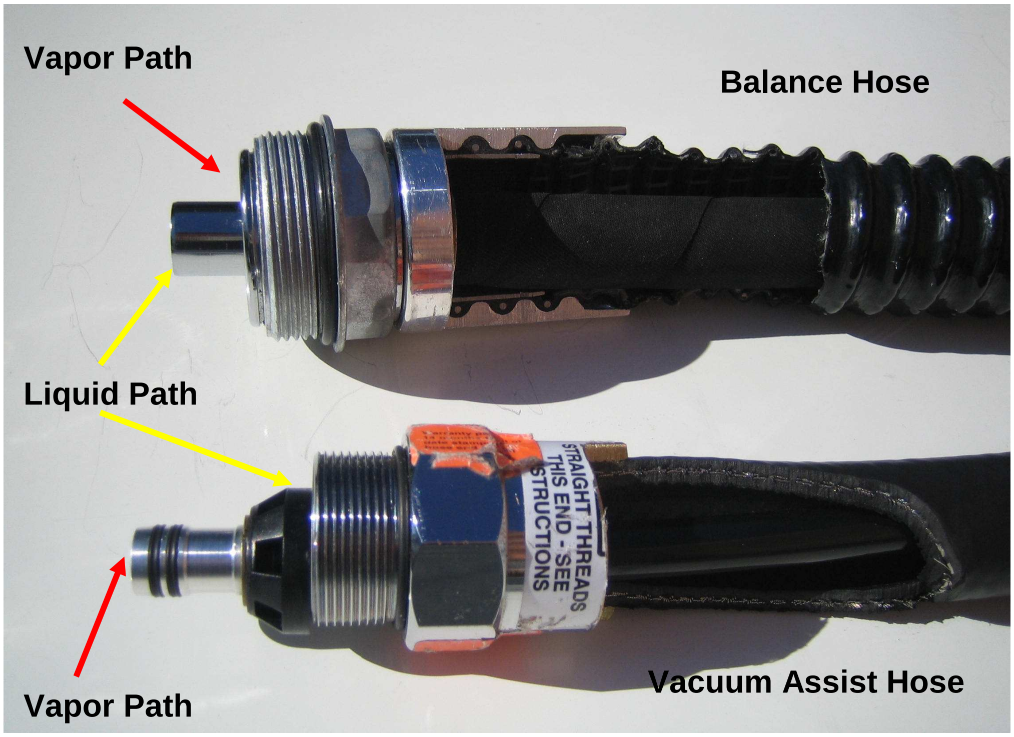

Figure 1 Cutaways of vapor recovery GDF hose showing vapor and liquid paths.

A common form of low permeation technology for fuel delivery hoses is the application of a barrier layer to the hose. The barrier layer is usually a material with a much lower permeation rate than the hose material which it is being added to. It is generally applied as an internal layer or the inner most layer of multi-layer hoses. It is generally a thinner layer than that of the hose it is being added to and it is generally more costly. CARB has certified over 40 such low permeation fuel delivery hoses for its small off road engine (SORE) program alone.[1]
.

Current GDF Hose Prices

To better understand the significance of the estimates received in this survey, staff requested quotes from distributors of GDF hoses that are representative of those currently in use. The results of this investigation can be seen in Table 1.

Table 1: 2007 Hose Prices

Hose Type	Average Price	Median Price	Models Quoted	Total Quotes Obtained
Balance with Liquid Removal	$194.60	$196.54	2	5
Vacuum Assist	$110.64	$111.54	2	5
Conventional (Non-Vapor Recovery)	$37.81	$37.86	2	5

The Survey

As part of staff's effort to quantify the cost effectiveness of applying low permeation hose technology to GDF hoses, staff conducted the 2007 survey (Attachment 1) discussed in this report. The hose manufacturers that were surveyed by ARB staff include; FLEX-ING, Gates Corporation, Goodyear Tire & Rubber Company, HBD/Thermoid Inc., OPW Fueling Components, Parker Hannifin, and Vapor Systems Technologies Inc.

Staff has also been participating in testing of low permeation hose technology in conjunction with Underwriter's Laboratory (UL) and the above listed manufacturers. This testing has demonstrated several GDF hoses that can meet a permeation standard of 10 g/m^2/day at a constant temperature of 38 ℃ with CE-10 test fuel. Although this standard is slightly less rigorous than that mentioned in the survey (Attachment 1), it is a very large reduction from current GDF hoses, which for the same testing conditions have been shown to permeate at rates of over 300 g/m^2/day during the same UL testing. Given these testing results, staff is very confident that the numbers submitted in the survey reflect careful consideration by the companies involved in the survey.

On the outset of this survey, staff agreed with manufacturers to keep numbers reported by participants confidential by not tying specific numbers to individual companies. Staff agreed to this restriction in order to gain the sensitive marketing information necessary to conduct this analysis. Further, due to low responses for some categories, staff will only discuss the averages of the submittals each category so as not to give a competitor of companies that submitted cost estimates an unfair insight into those companies' business costs/projections.

Survey Response

All seven of the GDF hose manufacturers contacted for this survey submitted responses. However, two were rejected completely. One was rejected as the cost increases submitted by that respondent were an extreme outlier, being above the average of the other submittals by a factor of more than 10. The other was rejected as the company refused to supply actual dollar figures, submitting only percentages. As mentioned previously, for confidentiality reasons, staff will not discuss the specifics of the submitted numbers further.

Conventional (Non-Vapor Recovery) Hose Survey Results

The cost increase estimates for adding low permeation technology to conventional GDF hoses are displayed in Table 2. One participant (Participant A) felt that their existing product would meet the permeation requirements given in the survey. This is evidenced by the zeros in the minimum column of Table 2. However, Participant A's existing product cost was more expensive than the average of the existing product costs of the other respondents. In order to correct for this, staff subtracted the average of the current manufacturer and end-user costs of current products of the other respondents from Participant A's current manufacturing and end-user costs. These differences were then applied as Participant A's cost increases. The averages* and medians* given in Table 2 reflect this correction.

Table 2: Low permeation cost increase for conventional hoses.

	Average*	Median*	Maximum	Minimum
Manufacturing Cost Increase	$5.52	$5.78	$6.15	$0.00
Cost Increase to Consumer	$9.89	$10.00	$17.72	$0.00

In applying the average cost increase to consumers of $9.89 given in Table 2 to the 2007 conventional hose price of $37.86 given in Table 1, the average cost increase as a percentage of current product costs is calculated to be 26 %.

Vacuum Assist Hose Survey Results

Although staff received less estimates for vacuum assist hose cost increases than for conventional hose, those that did respond noted to CARB staff that the technology applied to conventional hoses would be the same as that applied to vacuum assist hoses. Those respondents who submitted cost increases in both categories applied the same cost increases for vacuum assist and conventional hoses. Staff believes this is valid because the outer hose from which permeation would be controlled is essentially the same hose as a conventional hose with different fittings. Therefore, staff is applying the cost increase generated for conventional hoses of $9.89, as given in Table 2, as the vacuum assist hose cost increase to end-users. This leads to a cost increase of 9% from the original product price of $110.64, as given in Table 1.

Balance Hose Survey Results

Due to the low number of responses on this category, and the need for confidentiality, staff cannot provide as much information as provided in the previous categories. Because balance outer hoses are very dissimilar from that of vacuum assist hoses (see Figure 1) and conventional hoses, assumptions about cost increases cannot be drawn directly from the conventional hose survey results as with vacuum assist hoses.

The average cost increase from the survey for upgrading balance hoses with low permeation technology was $29.07. This leads to a cost increase of 15% from the original product price of $194.60, as given in Table 1. The higher cost is likely due to the balance hose's exotic design of having a metal helix inside of the hose material running the length of the hose. This leads to a corrugated profile.

In July of 2007, staff requested a quote from a distributor of a common vapor recovery outer hose. The hose was a Flexaust product called Dayflex MG-U. One of its specific uses listed in the product literature is vapor recovery hose. Staff received a quote of $2.76 per linear foot assuming a quantity of 100 ft would be purchased. Thus, for a hose of approximately 10 feet in length, the original cost of the balance outer hose to an end-user would be $27.60. Staff has determined that this cost increase is reasonable in light of the potential difficulty of applying a permeation barrier layer to the exotic design of the balance hose. Staff has not yet seen a prototype for low permeation balance hose.

Conclusion

Based upon the survey results and evidence collect through testing at Underwriter's Laboratory, CARB staff concludes that it is possible to upgrade GDF hoses with low permeation technology such that a hose 10 feet in length would permeate at a rate of no more than 10 $g/m^2/day$ when tested at a constant temperature of 38 ℃ with CE-10 test fuel. Staff b elieves that the costs of meeting this standard would be approximately $10 for either a conventional hose or a vacuum assist style vapor recovery hose, and approximately $29 for a balance style vapor recovery hose. Staff estimates that the cost of these upgrade would lead to price increases of current products of 9% for vacuum assist hoses and 15% for balance hoses.

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Attachment 1

Air Resources Board

Linda S. Adams
Secretary for Environmental Protection

Robert F. Sawyer, Ph.D., Chair
1001 I Street • P.O. Box 2815
Sacramento, California 95812 • www.arb.ca.gov

Arnold Schwarzenegger
Governor

June 8, 2007

To: Gasoline Dispensing Facility (GDF) Hose Manufacturers

The purpose of this letter is to request your help in collecting manufacturing cost information for low permeation GDF hoses. In March, 2005, the California Air Resources Board (ARB) conducted a cost effectiveness survey on low permeation GDF hoses, which specified a permeation limit of 2-5 g/m^2/day when tested with California commercial pump fuel at 28°C. ARB is now attempting to re-evaluate cost effectiveness estimates to reflect the current, more stringent, permeation standard that ARB is considering. Therefore, ARB is asking GDF hose manufacturers for an estimate on the manufacturing cost increase involved in producing GDF hose given the following parameters:

- The hose length is approximately 10 ft.
- The permeation standard is a maximum of 5 g/m^2/day.
- The test is performed at a constant temperature of 40°C.
- The test fuel is CE-10.

Please assist ARB in this endeavor by filling in the applicable sections of the enclosed survey.

Upon request, the source of the information provided to ARB regarding the enclosed survey can be kept confidential. Any confidential or proprietary information submitted will be handled in accordance with title 17 California Code of Regulations section 9100, which specifies the requirements for handling confidential information submitted to public agencies. The cost information provided will be used to help evaluate the cost effectiveness of setting permeation standards for GDF hoses.

If you have any questions concerning this request, please contact Jason McPhee at (916) 322-8116 or via email at jmcphee@arb.ca.gov, or contact me at (916) 327-1282 or via email at jwatson@arb.ca.gov.

Sincerely,

Jim Watson, Manager
Engineering Development and Testing Section
Monitoring and Laboratory Division

Enclosure

Attachment 1

Gasoline Dispensing Facility (GDF) Hose Upgrade Cost Survey

Purpose: The California Air Resources Board (ARB) is attempting to re-evaluate cost effectiveness estimates to reflect the current permeation standard that ARB is considering for GDF hose. Therefore, ARB is asking GDF hose manufacturers for an estimate on the manufacturing cost increase involved in producing GDF hose that will meet this permeation standard. Please assist ARB in this endeavor by filling in the applicable sections of this survey.

Date: ______________

Company Name: ________________________________

Please note that any reference to the term "permeation standard" in this survey refers to GDF hose that meets the general permeation hose parameters listed below.

General Permeation Hose Parameters:

1) The hose length (unit size) is approximately 10 ft.
2) The permeation standard is a maximum of 5 g/m2/day.
3) The test is performed at a constant temperature of 40℃.
4) The test fuel is CE-10.

Please fill in the table below. All costs are per unit, referring to a 10 ft. section of hose complete with end-fittings.

GDF Hose Type	Manufacturing Cost of Current Product	Manufacturing Cost Increase to Meet Permeation Standard	Final Manufacturing Cost to Meet Permeation Standard	End-User Cost of Current Product	End-User Cost Increase to Meet Permeation Standard	Final End-User Cost to Meet Permeation Standard
Balance	$	$	$	$	$	$
Vacuum Assist	$	$	$	$	$	$
Non-Vapor-Recovery	$	$	$	$	$	$

Comments and additional relevant GDF hose cost information : ________________________________

____

____

____

Confidentiality: Upon request, the source of the information provided to ARB regarding the above questions can be kept confidential. Any confidential or proprietary information submitted will be handled in accordance with title 17 California Code of Regulations section 9100, which specifies the requirements for handling confidential information submitted to public agencies.

APPENDIX K

Low Permeation Gasoline Dispensing Facility (GDF) Hose Cost Effectiveness Report

Appendix K

Low Permeation Gasoline Dispensing Facility (GDF) Hose Cost Effectiveness Report

Introduction

In 2008, California Air Resources Board (CARB) staff conducted a cost effectiveness analysis of the proposed regulation requiring low permeation hoses to be used at California gasoline dispensing facilities (GDFs). Staff determined the cost effectiveness to be approximately $1.08 per pound of reactive organic gases (ROG) reduced. As a comparison, the estimated cost effectiveness in 2002 for the Enhanced Vapor Recovery (EVR) program regulating emissions for California GDFs was $5.24 per pound of ROG reduced.[1] Attachment 1 provides a summary table for calculating cost effectiveness.

Staff based cost effectiveness calculations on emissions predictions for GDF hoses and vehicle population characteristics for 2014 to coincide with the expected implementation date. Because these characteristics are likely to change in years following 2014, the cost effectiveness for the proposed regulation will likely change for subsequent years.

Cost of Low Permeation Hoses

Staff conducted a survey of hose manufacturers to determine the cost increase to GDF owners for low permeation GDF hoses.[2] The survey defined the hose permeation limit to be 5 grams per square meter per day (g/m^2/day) using CE-10 test fuel at a constant temperature of 104℉ (40℃). Th e hose length was determined to be 10 feet. The responses to the survey indicated the upgrade cost to the end-user would be approximately $10 for a vacuum assist GDF hose and $29 for a balance GDF hose. Staff concludes these numbers are conservative, as the permeation standard that was proposed in the survey is more rigorous than that now proposed (10 g/m^2/day using CE-10 test fuel at a constant temperature of 38.0℃).

Average GDF Hose Life

Staff interviewed several manufactures and determined the average life of a GDF hose is approximately two years. Although there are many cases of a hose lasting longer than two years, customer drive-offs and driving over hoses leads to damage, and thus the shorter life.

GDF Hose Population

In 2008, staff conducted a survey the California Air Pollution Control and Air Quality Management Districts (Districts) to determine the 2007 population of vapor recovery hoses at permitted GDFs.[3] From the survey, staff estimates approximately 173,000 vapor recovery hoses in California. The population affected by the proposed regulation does not include hoses used at GDFs employing aboveground storage tanks (ASTs). These GDFs are regulated under a different set of rules than GDFs employing underground storage tanks (USTs). Staff determined approximately 5,000 vapor recovery hoses are employed at GDFs with ASTs. Therefore, the hose population affected by the proposed regulation is approximately 168,000. Although the number of GDFs will most likely increase by 2014, this may be offset by the number of GDFs replacing multiple hose dispensers (six-pack dispensers).

The District survey also indicated for 2007 approximately 15 percent (27,000) were vacuum assist GDF hoses and the remaining 85 percent (147,000) were balance GDF hoses. However, as discussed in the population survey report, recent trends in permitting of vacuum assist systems suggest that the GDF vapor recovery hose population will be split approximately evenly between vacuum assist and balance GDF hoses at 84,000 each.

Normalization of Permeation Emissions Results

Permeation is defined as the diffusion of gasoline in liquid or vapor through a hose wall and is reported in g/m^2/day. Because EVR testing is normalized to a temperature of 528°R (68.3°F or 20.2°C), [4] all permeation results must be normalized to this temperature in order to estimate emissions for quantifying cost effectiveness of the proposed regulation. Several technical papers published by the Society of Automotive Engineers (SAE) indicate a change in temperature of 1°C typically results in a permeation change of approximately 10%.[5, 6] Staff has employed the above SAE model for adjusting permeation rates when normalizing for temperature differences.

Uncontrolled GDF Hose Permeation Rates

Staff conducted two tests to determine GDF hose gasoline permeation rates. The first test was conducted in 2004 and the second was conducted in 2008.[7, 8] An analysis was also performed in 2008 for balance GDF hoses to account for permeation due to gasoline vapor in the outer path of the hose (Appendix H).

Normalizing the results from these analyses to 68.3°F (20.2°C), staff determined 2014 GDF hose permeation rates for California pump fuel. Staff determined 52.8 g/m^2/ day for vacuum assist GDF hoses and 18.6 g/m^2/day for balance GDF hoses. Staff determined that testing deficiencies in the 2004 test may have led to a significant underestimation of permeation rates for vacuum assist hoses. Additional testing is planned to address this issue.

Statewide Uncontrolled GDF Hose Emissions

Staff estimates the 2014 Statewide uncontrolled emissions from GDF hoses will be about 1.5 tons per day (tpd) of ROG. Approximately 0.9 tpd is attributed to vacuum assist GDF hoses and 0.6 tpd to balance GDF hoses. Staff calculated these numbers by applying the uncontrolled GDF hose permeation rates for both vacuum assist and balance GDF hoses to the respective population numbers and dimensional characteristics. Staff concludes the 1.5 tpd of ROG is conservative and plans to do further emissions inventory testing as resources become available.

Proposed GDF Hose Emissions Limit

Staff is proposing a GDF hose performance standard of 10 $g/m^2/day$ using CE-10 test fuel[9] at a constant temperature of 100°F (38.0°C). When normalized to a temperature of 68.3°F (20.2°C) for cost effectiveness analysis, staff estimates GDF hoses will be limited to a practical in-use permeation rate of approximately 1.9 $g/m^2/day$.

Statewide Controlled GDF Hose Emissions

Staff determined the proposed GDF hose performance standard would result in Statewide emissions to 0.1 tpd. This amounts to reductions of approximately 94% (1.4 tpd of ROG). Staff calculated this number by applying the proposed GDF hose emissions limit to both the vacuum assist and balance GDF hose populations while applying their respective dimensional characteristics.

Cost and Cost Savings

Staff determined the proposed regulation, before cost savings, will have an annual cost of $1.66 million. This was determined by multiplying both the vacuum assist and balance GDF hose populations by their respective upgrade cost increases, and dividing the total by the useful life of a GDF hose.

Staff estimates a yearly Statewide savings to consumers of $566,000 in 2014. This is due to gasoline savings that would otherwise have been emitted. Staff attributes $354,000 to vacuum assist GDF hoses and $212,000 to balance GDF hoses. Staff calculated these numbers using gasoline priced of $3.50 per gallon in 2014 and the estimated 1.4 tpd of gasoline saved by the proposed regulation.

Staff determined the annual net cost of the proposed regulation is $1.1 million. Staff calculated this by subtracting the cost savings of the proposed regulation from the expected costs.

Cost Effectiveness of Low Permeation GDF Hoses

Staff estimates the cost effectiveness of the proposed regulation in 2014 to be $1.08 per pound of ROG reduced. Staff calculated the cost effectiveness by dividing the annual net cost of the proposed regulation by the annual emissions controlled.

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[6] Lockhart, M., Nulman, M., Rossi, G., Estimating Real Time Diurnal Permeation from Constant Temperature Measurements. Society of Automotive Engineering Technical Paper 2001-01-0730, pp. 4.

[7] California Air Resources Board (CARB), GDF Hose Permeation Study Review. 29, Oct. 2007. <http://www.arb.ca.gov/vapor/gdfhe/gdfpermreport07.pdf>.

[8] California Air Resources Board (CARB), Gasoline Dispensing Facility (GDF) Balance Hose Permeation Study. 19, June 2008.
<http://www.arb.ca.gov/vapor/gdfhe/arb_gdf_balancehose_permeation_report_08_posted.pdf>.

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Attachment 1

Low Permeation GDF Hose Cost Effectiveness Summary Table for 2014

	Balance		*Vac assist*		*Total affected*	
HOSE POPULATION (2014)						
Population Mix	50%		50%			
Population	84,281	hoses	84,281	hoses	168,561	hoses
HOSE PERMEATION SURFACE AREA						
Statewide, assumes hose length of 10 feet	15374	m^2	28186	m^2	43560	m^2
AVERAGE HOSE LIFE	2	yr	2	yr		
PROPOSED HOSE EMISSION LIMIT						
With CE-10 Test Fuel @ 38℃	10	$g/m^2/day$	10	$g/m^2/day$		
Test Standard Normalized to 20.2℃	1.9	$g/m^2/day$	1.9	$g/m^2/day$		
COST INCREASE FOR UPGRADES						
Per Hose	29	$	10	$		
Statewide Cost To End-Users Per Year	1,233,017	$/yr	424,725	$/yr	1,657,742	$/yr
EMISSIONS BASELINE (2014)						
Per Hose of ROG	19	$g/m^2/day$	53	$g/m^2/day$		
Statewide Emissions of ROG	0.58	TPD	0.90	TPD	1.48	TPD
	1,156	lb/day	1,796	lb/day	2,952	lb/day
EMISSIONS ALLOWED BY REGULATION						
Statewide Emissions of ROG	0.06	TPD	0.03	TPD	0.09	TPD
	116	lb/day	63	lb/day	179	lb/day
EMISSION REDUCTIONS						
Statewide Percent Reductions	90.0	%	96.5	%	93.9	%
Statewide Emissions of ROG	0.52	TPD	0.87	TPD	1.39	TPD
	1,040	lb/day	1,733	lb/day	2,773	lb/day
	379589	lb/yr	632649	lb/yr	1012238	lb/yr
GASOLINE SAVINGS	212,262	$/yr	353,771	$/yr	566,033	$/yr
Assumes Gasoline priced at $3.50 per gallon						
COSTS EFFECTIVENESS						
Statewide Cost Effectiveness	2.69	$/lb	0.11	$/lb	1.08	$/lb
	5,378	$/Ton	224	$/Ton	2,157	$/Ton
NET COST OF LOW PERMEATION GDF HOSE REGULATION TO CALIFORNIA CONSUMERS	1,020,755	$/yr	70,954	$/yr	1,091,709	$/year

APPENDIX L

GDF Hose Stakeholder Concerns and Responses

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GDF Hose Stakeholder Concerns and Responses

1. When will gasoline dispensing facility (GDF) owners be required to have low permeation hoses?

- The effective date is January 1, 2010. The effective date is the date on which a provision has the effect of State law. The effective date "starts the clock" for the period of continuing use of installed vapor recovery systems/equipment under Health and Safety Code section 41956.1. For the proposed regulation, the period of continuing use of installed hoses is four years, after which noncompliant hoses may no longer be used.
- The operative date is January 1, 2011. The operative date is the date on which a regulated person is first required to act or is prohibited from acting. The operative date determines when new installations and facilities undergoing major modifications must use equipment that meets the applicable standard.

2. I am a GDF owner and have just purchased new hoses. Will I be forced to discard my old hoses when the proposed regulation comes into effect?

- Unless a GDF is undergoing major modifications, an owner/operator of an existing GDF would have 4 years from the proposed effective date to upgrade the existing hoses to low permeation hoses certified under this proposal. With the proposed effective date of January 1, 2010, GDF hoses at existing facilities not undergoing major modifications would be able to be used until January 1, 2014.
- Staff has determined from discussions with GDF hose manufacturers that the average GDF hose in use life is approximately 2 years. Therefore, staff has determined most existing GDF hoses will not need to be discarded before they achieve their useful potential.

3. Will permitted GDFs employing aboveground storage tanks (ASTs) be required to use low permeation hoses?

- Staff's proposal amends CP-201, *Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities*, which only applies to GDFs employing underground storage tanks (USTs). Therefore, hoses at GDFs employing ASTs would not be affected by this proposal.
- Permitted GDFs employing ASTs represents a very small segment of the GDF hose population. Further, stakeholders having GDFs with ASTs may have different concerns than stakeholders of GDFs employing USTs. The

AST stakeholders are much more likely to have applications related to agriculture or private fleets. For these reason staff decided not to pursue an amendment to CP-206, *Certification Procedure for Vapor Recovery Systems at Gasoline Dispensing Facilities Using Aboveground Storage Tanks* concurrently with CP 201.

- With a cost effectiveness of $1.08 per pound of Reactive Organic Gases (ROG) reduced, and technology that will be readily transferable from the proposed regulation, staff believes the feasibility of amending CP-206 to require low permeation hoses at GDFs employing ASTs should be investigated.

4. Is low permeation GDF hose technology available?

- The proposed regulation requires manufacturers of GDF hoses to use similar technologies now required in other source categories such as small off-road engines (SORE) and outboard marine tanks (OMTs) for about one half of the population. Many samples of low permeation hoses have been demonstrated for these programs.
- ARB staff has participated with hose and material manufacturers in testing of low permeation GDF hose prototypes. Two different manufacturers have submitted prototypes that passed the proposed permeation rate limits. These prototypes are a conventional GDF hose that are readily altered for use as part of a vacuum assist vapor recovery GDF hose assembly.
- Due to the difference in design of balance vapor recovery GDF hose assemblies, no low permeation prototype has yet been demonstrated for this type of GDF hose. Staff has received comments from GDF hose manufacturers in which estimations were made for the cost of producing a balance GDF hose which would meet the proposed low permeation limits.

5. Why does the proposal require removing the inner hose from vapor recovery GDF hose assemblies during permeation testing?

- Staff is concerned with permeation that ultimately results in emissions to the atmosphere and not with permeation that may be occurring within the inner hose of a vapor recovery GDF hose assembly.
- Removal of the inner hose allows for greater ease in testing and allows for longer testing periods before it is necessary to consider fuel degradation within the test.

6. Why is ARB proposing to use CE-10 test fuel to certify low permeation GDF hoses instead of CA RFG III with 10% ethanol?

- Emissions from this source category are almost entirely due to permeation. Staff is concerned with the permeation characteristics of the fuel and less so with Reid Vapor Pressure (RVP) characteristics that are crucial in modeling evaporative and liquid leak emissions.

- Considerable permeation data has been collected and published regarding permeation rates for different material using CE-10 fuel. This is not the case for CA RFG III with 10% ethanol. This information can assist hose manufactures in designing a product to meet the proposed permeation limits along with assisting staff in evaluating the submitted permeation test data.
- Test fuel CE-10 has higher levels of ethanol than current California pump fuel, and the same level of ethanol as CA RFG III with 10% ethanol. Staff estimates permeation rates from CE-10 will be higher than current pump fuel and comparable or higher to CA RFG III with 10% ethanol. Staff plans to do additional emissions inventory testing to correlate permeation rates for GDF hoses between using CE-10 test fuel and summer and winter blends of CA RFG III with 10% ethanol.
- Also, CE-10 is a test fuel made up of only three components, toluene (45%), isooctane (45%), and ethanol (10%). CE-10 is a simple, obtainable, and repeatable fuel for conducting permeation testing.

7. Why do balance GDF hoses need to have permeation limits when they only contain gasoline vapor in their outer path and not a liquid gasoline?

- Staff has researched published information by the Society of Automotive Engineers (SAE) and found a consensus that a saturated vapor permeates at the same rates as a liquid of the same substance given the same set of conditions. Further, staff has done an analysis on vapor quality within balance GDF hoses (Appendix H), and found they are a source of significant ROG emissions due to permeation.

8. Why do balance GDF hoses need to have permeation limits when vapor recovery systems are generally operating at a negative pressure?

- The theoretical model governing permeation mass transport is Fick's Law. Pressure is only a consideration under Fick's Law as it relates to concentration of the substance permeating through the barrier material. While it is possible that extreme pressures may cause the barrier material to stretch or collapse, possibly changing its resistance to permeation, GDF systems are typically operating under a negative gauge pressure of only a few inches of water. Because an inch of water is less than 1 percent of an atmosphere, the vapor recovery system is still operating at an absolute pressure that is over 99 percent of atmospheric conditions. Therefore, this pressure condition is not expected to create any significant change is vapor concentrations within the vapor recovery system and balance hoses. Thus, the slight negative pressure that exists within vapor recovery systems should not have any significant affect on permeation rates from GDF hoses.
- Staff has requested data from interested stakeholders showing a correlation between negative pressure and permeation rates. None has been given.

9. Why do balance GDF hoses need to have permeation limits when there is an increasing population of vehicles equipped with On Road Vapor Recovery (ORVR) that do not return any gasoline vapors through the GDF hose?

- Staff has conducted an analysis on the vapor quality in balance GDF hoses, the impact of ORVR vehicles upon GDF hose vapor quality, and how permeation correlates to the measured level of vapor quality (Appendix H).
- While permeation emissions are lower for balance GDF hoses than vacuum assist GDF hoses due to vapors instead of liquid occupying the outer hose path, staff has found that the proposed regulation is well within acceptable cost effectiveness criteria at $1.08 per pound of ROG emissions reduced, projected for the year 2014.

10. Why is ARB working with Underwriter's Laboratories (UL) in developing a low permeation GDF hose certification test procedure?

- Staff initially investigated the possibly or working with UL to develop a certification test procedure due to a request from a stakeholder.
- Staff has found that the open and transparent process of working with UL to develop a standard low permeation GDF hose test procedure has increased stakeholder participation and cooperation in the regulatory development process.
- By working with stakeholders, the US EPA, and UL, staff expects the GDF hose permeation standard and test procedure will be robust and widely accepted in California.
- Staff intends to allow UL test data to be used in the certification of low permeation GDF hoses provided that ARB is made a beneficiary of the related test data within the contract between UL and its client that is seeking ARB certification.

11. Why did ARB choose a permeation limit of 10 $g/m^2/day$?

- Staff has participated in extensive permeation testing of low permeation GDF hoses in cooperation with stakeholders, the US EPA, and Underwriters Laboratories. This testing has demonstrated two prototypes from two different companies that could reliably meet a permeation of 10 $g/m^2/day$ when filled with CE-10 test fuel at a constant temperature of 38.0℃ (100.4℉).
- The proposed permeation standard would result in a reduction of approximately 94 percent from maximum permeation rates of currently employed GDF hoses.

- This is comparable to fuel hose permeation rate limits allowed in ARB's Small Off-Road Engines (SORE) program of 15 g/m^2/day when filled with the proscribed test fuel at a constant temperature of 40.0℃ (104℉).