EPA-420-R-94-008
January 1994

Onboard Refueling Vapor Recovery (ORVR) Regulations for Light-Duty Vehicles and Trucks and Heavy-Duty Vehicles

SUMMARY AND ANALYSIS OF COMMENTS

January 22, 1994

TABLE OF CONTENTS

LIST OF COMMENTERS

A.W. Eichelberg, Club Construction Company, AL
AAA of Tidewater, Virginia
Agri-Business Council of Arizona, Inc.
Alabama Department of Environmental Management
American Trucking Association
American Honda Motor Corporation
American Petroleum Institute
American Coalition for Traffic Safety, Inc.
American Automobile Manufacturers Association
American Express, AL
American Lung Association
Arkansas Sheriffs Association
Arkansas Traffic Safety Now
Associated Builders and Contractors, Delaware
Associated General Contractors of Washington
Associated Builders and Contractors, Inc., NJ
Association of International Automobile Manufacturers
Bellevue (Nebraska) Police Department
Better Nebraska Association
California Travel Parks Association
Center for Auto Safety
Chrysler Corporation
Colorado Motor Carriers Association
Delaware Highway Users Conference
Dick Strauss Ford-Isuzu, Inc.
Donald W. Riegle, Jr., United States Senate
Dorothy Walton
Dowty Woodville Polymer, Limited
DWI Strategic Metro Area Reduction Team
Engine Manufacturers Association
Eric Kendall Banks, St. Louis, MO
Fischer Construction Company
Florida Fire Equipment Dealers Association
Florida Citrus Mutual
Ford Motor Company
Fred J. Heller, Easton Consultants
Fuel Merchants Association of New Jersey
General Motors Corporation
Georgia Farm Bureau Federation
Georgia Beer Wholesalers Association, Inc.

Harris & Associates, Inc.
Harry Mullins
Home Builders Association of Tennessee, Inc.
Home Builders Association of Greater Little Rock
Hon. Max Baucus
Hullett, Kellum and McKinney, P.C.
IACP Highway Safety Advisory Committee
Illinois EPA
Independent Cattlemen's Association of Texas, Inc.
Independent Insurance Agents of Delaware, Inc.
Indiana Manufacturers Association
Indiana Chamber of Commerce
Insurance Institute for Highway Safety
Insurance Institute for Highway Safety
J.A. Montgomery Insurance, Inc.
John D. Dingell, United States House of Representatives
Kansas Farm Bureau
Kansas Lawn and Garden
Kansas Skeet Shooting Association
KOA Kampgrounds, Nashville, Tennessee
Lamborghini
Louisiana Electric Cooperatives, Inc.
Lt. Col. L. N. Thompson
Lyons Insurance Agency, Inc.
M. J. Harrigan
Marine Industries Association of South Florida
Missouri Safety Council, Inc.
Missouri Chamber of Commerce
Missouri Safety Council
Mitsubishi Motors America, Inc.
National Travelers RV Center
National Vehicle Conversion Association, Inc.
National Association of Convenience Stores
National Concrete Masonry Association
National Truck Equipment Association
National Automobile Dealers Association
National Grange
Natural Resources Defense Council
Navistar International Transportation Corporation
Nebraska Chamber of Commerce and Industry
Nebraska Grain and Feed Association
Nebraska Farm Bureau Federation

New York Coalition
New Castle County Department of Public Safety
New Jersey State Safety Council
New Hampshire Governor's Office of Energy and Community Services
Nielsens, Inc.
Nissan Motor Company, Ltd.
North Carolina Department of Agriculture
Ohio Campground Owners Association
Ohio Chamber of Commerce
PACCAR, Inc.
Petroleum Marketers Association of America
Port City Development Center
Recreation Vehicle Dealers Association
Recreation Vehicle Industry Association
Rolls-Royce Motor Cars
Rover Group
San Joaquin Safety Council
Senior Management Consultants, Inc.
Sheet Metal Contractors Association
Society of Independent Gasoline Marketers of America
State of Rhode Island
Tennessee Association of Business
Tennessee Department of Environment and Conservation
Texaco, Inc.
The Business Council of New York State, Inc.
The Gordy Insurance Agency, Inc.
Tidewater Horse Council
Toyota Technical Center, U.S.A., Inc.
Toyota Motor Corporation
Trail Wagons, Inc.
United Seniors Association, Inc.
Virginia Farm Bureau Federation
Virginia Travel Council
Wally Myam Caravan Club International, Inc.
Washington Contract Loggers Association
Washington Refuse and Recycling Association
Washington State Farm Bureau
Washington State Council of Farmer Cooperatives
Wisconsin Department of Natural Resources

LIST OF KEY ACRONYMS

AAMA	American Automobile Manufacturers Association
AIAM	Association of International Automobile Manufacturers
ALA	American Lung Association
API	American Petroleum Institute
ATA	American Trucking Association
°C	degrees Celsius
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAS	Center for Automobile Safety
CO	carbon monoxide
DoT	Department of Transportation
EPA	Environmental Protection Agency
°F	degrees Fahrenheit
FMVSS	Federal Motor Vehicle Safety Standards
FR	Federal Register
FTP	Federal Test Procedure
g/gal	grams per gallon
GM	General Motors Corporation
GVWR	Gross Vehicle Weight Rating
HDV	heavy-duty vehicle
HHDV	heavy HDV
ILEV	Inherently Low-Emission Vehicle
I/M	Inspection and Maintenance
LDT	light-duty truck
LDV	light-duty vehicle
LHDV	light HDV
MIL	malfunction indicator light
mm	millimeter
NACS	National Association of Convenience Stores
NADA	National Automobile Dealers Association
NHTSA	National Highway Traffic Safety Administration
NPRM	Notice of Proposed Rulemaking

(continued)

LIST OF KEY ACRONYMS
(continued)

NAA	Nonattainment Area
NPV	net present value
NRDC	Natural Resources Defense Council
NTEA	National Truck Equipment Association
OBD	on-board diagnostics
ORVR	onboard refueling vapor recovery
PMA	Petroleum Marketers Association
RIA	Regulatory Impact Analysis
RPE	Retail Price Equivalent
RVP	Reid Vapor Pressure
SHED	Sealed Housing for Emissions Determination
SIGMA	Society of Independent Gasoline Marketers of America
Td	Dispensed fuel temperature
UST	underground storage tank
VOC	volatile organic compound

DISCUSSION OF ISSUES

I. Applicability Issues

A. Applicability to Light-Duty Trucks and Heavy-Duty Vehicles

Summary of Issue

In the 1987 notice, EPA proposed that the ORVR standards apply to light-duty trucks (LDTs) and heavy-duty vehicles (HDVs) as well as light-duty vehicles (LDVs). EPA reiterated this proposal in the 1991 and 1993 notices. Between 1987 and the present, the 1990 CAA amendments addressed ORVR controls, explicitly mandating onboard controls only for LDVs in section 202(a)(6).

Thus, to apply the ORVR requirement beyond LDVs, EPA proposed to rely on the general authority under section 202(a)(1) of the Act. This permits the Administrator to put forth regulations for emissions which "cause or contribute to air pollution which may be reasonably be anticipated to endanger public health or welfare."

Summary of Comments

The commenters agreed that EPA has the authority to promulgate an ORVR requirement for LDTs/HDVs under CAA section 202(a)(1) general authority. The National Resources Defense Council (NRDC) and American Petroleum Institute (API) specifically commented that 202(a)(6) did not prohibit the use of the general authority in 202(a)(1) to include LDTs and HDVs. The regulated industry (vehicle manufacturers) asserted that, to use this authority, EPA must justify the rule with analyses of cost, technical feasibility, lead-time, energy, and safety factors, as well as perform a cost-benefit analysis as directed by Executive Order 12291. Some commenters asserted that this cost-benefit analysis must include a comparison of ORVR cost and benefits to those of Stage II controls.

Feasibility of Technology

Several manufacturers stated that developing ORVR technology for trucks could be more difficult than for LDVs, due to the unique nature of some fuel system configurations and increased fuel capacity. However, not a single commenter stated that ORVR control for LDTs or HDVs would not be possible. The manufacturers did request additional lead time to aid in the development of such systems. They felt that simultaneous development of ORVR systems on both LDVs and trucks would overburden their engineering, facility and financial resources.

API asserted that the basic technology for ORVR is the same as that for current evaporative systems (i.e., hydrocarbon adsorption onto a bed of activated carbon), and that application of ORVR controls to LDTs and HDVs would be only a modest extension of evaporative control systems. They pointed out that evaporative controls are currently required on LDTs and HDVs, as well as LDVs, and that the enhanced evaporative standard effective in 1996 will make them even more similar to ORVR control systems.

Cost Effectiveness

Comments regarding costs of implementing ORVR on trucks were limited. The American Trucking Association (ATA) estimated truck costs to be greater than $300. However no supporting data or detailed analysis was provided with this comment and it was later determined through a discussion with ATA, that the costs were based on outdated assumptions. NRDC agreed with earlier EPA cost data from the 1988 cost memorandum of incremental costs of $1.50 for LDTs and $5.20 for gasoline HDVs. The American Automobile Manufacturers Association (AAMA) stated that it had commissioned an independent study of costs and benefits. Their analysis did not reach EPA until after the comment period closed and did not include any ORVR cost data. API's cost-benefit analysis estimated ORVR costs to be $5 per vehicle with little supporting basis. Sensitivity analyses performed by API showed that even if these costs increased to $10 or $20 (or even $25 for gasoline HDVs), cost effectiveness and cost-benefit ratios were still favorable.

Vehicle manufacturers stated that the potential benefits of including trucks in the ORVR requirement would be small, especially with Stage II controls in effect. On the other hand, NRDC stated that exempting trucks from the standard would be a major environmental loss, because ORVR would he the only refueling control in the majority of the country. Therefore, omitting trucks from the ORVR requirement would expose citizens to ozone and to air toxics from the fuel vapors.

Analysis of Comments

There is no doubt that trucks have been part of the ORVR rulemaking, even from its earliest stages in the 1984 Gasoline Marketing Study. Each cost and emission reduction benefit analysis has included trucks, and trucks have been a central part of the technology assessments conducted by EPA. The docket contains over 30 items pertaining to trucks.

EPA has prepared a detailed Regulatory Impact Analysis (RIA) in support of this rule, focusing particularly on the extension of the requirement to LDTs and HDVs (see docket section

V-B). This analysis builds on an earlier (1987) draft RIA and on a cost memorandum[1] prepared in 1988. The final RIA examines the costs of implementing ORVR controls on vehicles incremental to enhanced evaporative emission controls, the costs of retaining Stage II controls, and the VOC reductions expected to be provided by ORVR systems incremental to Stage II. The analysis also examines the energy savings (in gallons of gasoline), as well as other health and welfare benefits, resulting from ORVR controls. It includes cost effectiveness and benefit-cost rates analyses as well

Feasibility of Technology

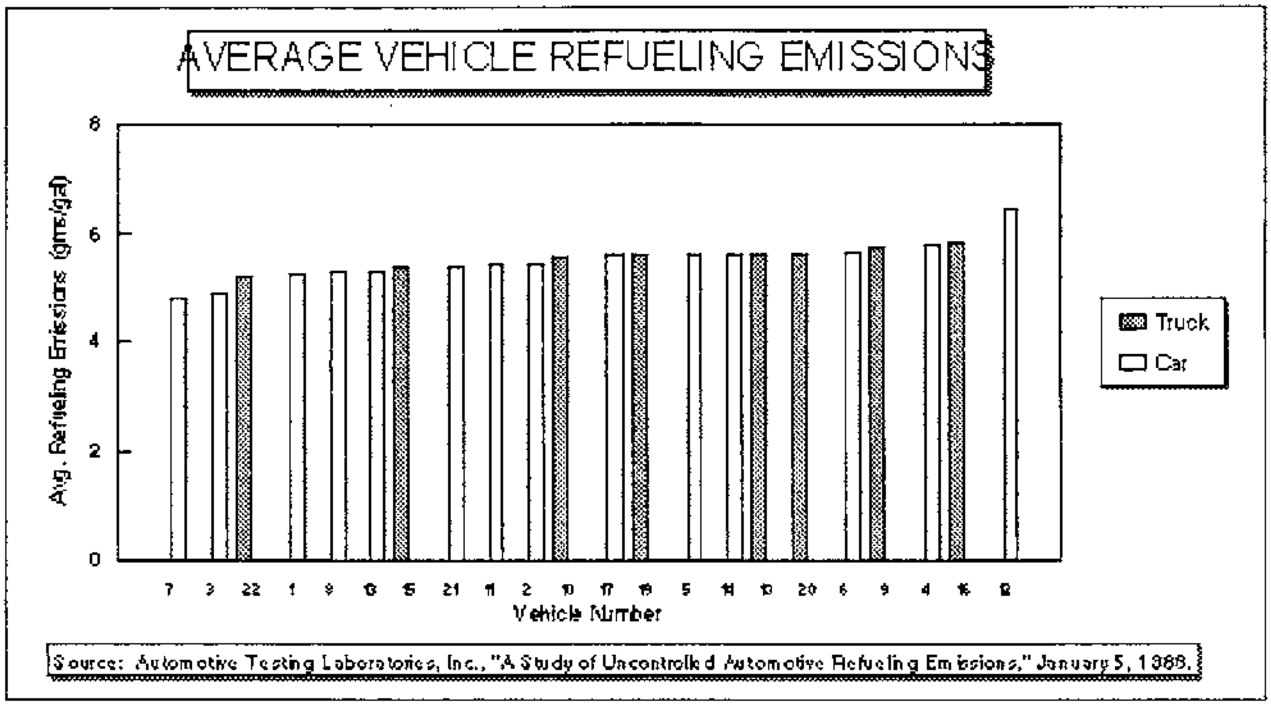
Materials submitted to the docket over the course of the rulemaking process indicate that the prototype ORVR systems have been installed on many passengers cars and even a number of light trucks (IV-A-06, IV-D-680 685, 682, 688, 864, 701, 712, 718, 720, 721, IV-E-50, 73). Although there are some specific differences between LDVs, LDTs, and HDVs, general fuel system design concepts and configurations are similar. Furthermore, LDTs and HDVs, as well as LDVs, are required to meet the enhanced evaporative emission control requirements beginning in the 1996 model year. EPA anticipates that the same hydrocarbon adsorption technology used in evaporative systems will be used for ORVR, in both cars and trucks. No comments were received identifying specific parts of an ORVR system that would not be feasible for LDTs or HDVs, nor were any comments provided that different hardware or a different approach would be used. The prototype LDT ORVR systems built by the manufacturers applied the same technology as was used on their LDV prototypes.

Although there are some vehicle-to-vehicle differences in fuel system designs, EPA does not expect LDTs or HDVs to pose insurmountable challenges in the development of ORVR systems. While commenters expressed uncertainty about the ability to design a successful ORVR truck system, no commenter provided data or substantiated arguments that the systems would be fundamentally different. Testing by Automotive Testing Laboratories (ATL) show no significant difference in the uncontrolled refueling emission rates for LDTs and LDVs. A graph showing this data is in Figure 1, below. Note that the trucks are fairly evenly distributed throughout the spectrum and how little variation there is in uncontrolled refueling emission rates from one vehicle to the next.

Trucks may require larger canisters due to their larger fuel tank size, but this larger hydrocarbon storage capacity will also be needed to meet the requirements of the enhanced evaporative emission standard. EPA expects the same canister will meet both requirements.

[1]Memorandum from Jean Schwendeman to the Record, "Onboard and Evaporative Control System Cost Estimates for the Supplemental Notice of Proposed Rulemaking," December 22, 1988. (docket A-87-11, item IV-B-19).

Figure 1



Cost Effectiveness

The costs of implementing ORVR in LDTs, LHDVs, and HHDVs are presented in Figure 2. These costs are made up of hardware costs, development costs, and operating costs, and include manufacturer markup and overhead. Hardware costs are those incurred by the manufacturer for additional or modified components. Development costs include research and development expenses and are amortized over the first five years of ORVR-equipped vehicle production. For the first five years of production, when development costs are included, net incremental costs of ORVR are less than $5 for LDVs and light HDVs, and less than $15 for heavy HDVs. Long term incremental costs are even less.

Figure 2. Incremental Per-Vehicle ORVR Costs

	LDT	LHDGV	HHDGV
Hardware Cost	$4.79	$6.29	$21.15
Development Cost	$2.65	$2.60	$4.57
Operating Cost	-$3.70	-$5.50	-$11.00
Short-Term Net Cost	$3.74	$3.39	$14.72
Long-Term Net Cost	$1.09	$0.79	$10.15

Trucks represent over 40 percent of the nation's gasoline consumption, and a corresponding percentage of the emissions from refueling. With the test procedure recommended in this Summary and Analysis of Comments document, EPA expects in-use efficiencies of ORVR on trucks in nonattainment areas to exceed 95 percent. Incremental to Stage II controls, ORVR on LDTs alone will provide average annual emission reductions of about 115,000 tons nationwide (31,000 tons in nonattainment areas). Implementation of ORVR in HDVs would provide an additional average annual emission reduction of about 22,000 tons nationwide (6,000 tons in nonattainment areas). If widespread use of ORVR systems permitted Stage II to be discontinued, the average annual emission reduction in nonattainment areas attributable to LDT controls would increase to 68,000 tons. Similarly, the average reductions attributable to ORVR systems in HDVs would rise to 13,000 tons annually.

For LDTs, the cost effectiveness of controlling VOCs via ORVR incremental to Stage II is about $200 per ton if Stage II is discontinued when ORVR is in widespread use (2010), and is still only about $700 per ton even if Stage II is never discontinued. For comparison, the cost effectiveness of retaining Stage II solely for the purpose of controlling refueling emissions from LDTs and HDVs is approximately $3400 per ton. Whether or not Stage II is eventually discontinued, the cost effectiveness of ORVR on trucks is very attractive relative to other control strategies.

Taking into account the societal benefits of reductions in VOC emissions, the benefit-cost ratio of ORVR control in LDTs is greater than 1.5. The benefits of ORVR clearly outweigh the costs.

The CAA mandated two forms of refueling control. However, once the fleet has sufficiently turned over, ORVR and Stage II controls will be largely duplicative. If ORVR is not implemented on at least the majority of trucks, it is unlikely that ORVR control would become sufficiently widespread to enable the Administrator to eliminate the Stage II requirements of Section 183(b)(3) (under the provisions of Section 202(a)(6)). As indicated above, ORVR control is more cost effective than Stage II control, and if it is implemented on trucks will allow Stage

II controls to be discontinued at some point in the future, eliminating duplicative control programs and greatly reducing the costs of refueling vapor control to the nation by wiping out Stage II operating costs paid by the service station owners and ultimately consumers.

Staff Conclusions/Recommendations

The emissions impact of LDTs and HDVs is significant (43 percent of refueling emissions in 2010). Stage II controls some of these vapors, but it is less efficient than ORVR and is not implemented in all areas. The control of refueling emissions by ORVR on trucks is technologically feasible, a modest extension of enhanced evaporative systems. In addition, the incremental cost of control is very low (less than $5 per LDT and less than $15 per gasoline HDV). Combined with the relatively large emission reductions, this results in a very cost effective program, even incremental to Stage II controls.

EPA staff would therefore recommend that the ORVR standard apply to LDTs in addition to LDVs. The staff recognizes that the design and production of ORVR systems for HDVs could be more difficult than for LDVs and LDTs. Implementation of ORVR systems in HDVs could be complicated by the fact that these vehicles not only have larger fuel tanks than LDVs and LDTs, but also tend to have a greater degree of variability with regard to fuel/vapor system component designs and fuel tank configurations. Furthermore, HDV engines would be certified separately from the ORVR system, and thus there could be additional challenges in matching the canister purge provided by the engine with the needs of each ORVR system. Finally, a large proportion of gasoline-fueled HDVs are also multi-stage vehicles, i.e., involving more than one manufacturer in the vehicle's production. As discussed in the next section, a number of concerns have been raised regarding the possibility that some secondary manufacturers could improperly modify the fuel system or might have inadequate expertise to correctly install ORVR systems.

These concerns probably do not present insurmountable technical obstacles in the long term. However, given these concerns, the resources and effort needed to implement ORVR systems in LDVs and LDTs, and the fact that the application of ORVR standards to HDVs would be discretionary, it would not be unreasonable to defer requirements for ORVR systems in HDVs. Since ORVR controls would still apply to 97 percent of all gasoline-fueled vehicles (94 percent of all gasoline vehicle refueling emissions), this deferral would not dramatically reduce the effectiveness of the ORVR program.

B. Multi-Stage Vehicles

Summary of the Issue

EPA proposed that the ORVR requirement apply to LDTs and HDVs as well as LDVs. Many HDVs and a few LDTs involve more than one manufacturer in the completion of the vehicle. About 1.5 percent of LDTs, 24 percent of LHDVs (8,500-14,000 GVWR), and almost 100 percent of HHDVs (over 14,000 lbs GVWR) are incomplete. The primary manufacturer provides an incomplete vehicle (chassis cab, cab cutaway, stripped chassis, etc.) to the secondary manufacturer, which completes the vehicle by modifying the body, adding a passenger compartment, or adding load carrying capacity/container. Commenters stated that the ORVR requirement should not be applied to incomplete trucks.

Summary of the Comments

LDT/HDV manufacturers and trade associations representing second-stage vehicle manufacturers all commented that the ORVR requirement should not be applied to incomplete trucks. The concerns were based primarily on uncertainty about the technical capability of second stage manufacturers who modify or complete the fuel system to correctly install the ORVR hardware and maintain its integrity and effectiveness and the liabilities which accompany in use problems. Commenters also stated that the number of incomplete vehicles was not large enough to justify control on this unique subgroup or the effects on small business (IV-D-799, 807, 822, 836, 854, 858, 905).

Analysis of Comments

Vehicle emission control requirements such as exhaust and evaporative emission controls apply to all vehicles whether they are completed by a primary or secondary manufacturer. In order not to apply the ORVR requirement to incomplete trucks, some basis would have to be established as to why the ORVR requirement presents unique issues as compared to exhaust or enhanced evaporative control requirements. As indicated by the comments, EPA expects that most vehicles will use integrated enhanced evaporative/ORVR control systems, and that ORVR system design will require only minor modifications to enhanced evaporative controls. It is not clear from the comments as to which parts of the ORVR system create a unique problem beyond enhanced evaporative systems.

EPA understands the points raised by the commenters regarding the concerns about the technical capabilities of secondary manufacturers and the potential liabilities manufacturers may face from incorrect ORVR system installations or inadvertent changes to an installed system. As presently occurs, it is the primary manufacturer's obligation to provide the second-stage manufacturers explicit instructions on the system implementation and prohibited adjustments and modifications. Incomplete vehicles must be certified to meet EPA emission and DoT safety requirements, and the manufacturer would have to provide instructions to the secondary manufacturer along with all parts to be installed to be certain that the emission and safety certification is not violated. Incremental to enhanced evaporative controls, the additional concerns would involve primarily the fillneck seal. If a mechanical fillneck seal is used new hardware would be required, but if a liquid seal is used only installation would need to be addressed. With a submerged fill, there may be no issue with the fillneck seal. EPA recognizes that the ORVR system will require upgrades to the fuel tank vapor vent valve and vapor vent line. However, these are present on most current vehicles and will be included in the enhanced evaporative system. Thus, there are no unique hardware issues, only installation concerns. For incomplete vehicles delivered with complete fuel systems (e.g., incomplete LDTs), the issues are of even less concern.

EPA recognizes that written installation instruction and prohibitions against certain modifications do not guarantee that a second-stage manufacturer will comply in all cases. With a reasonable amount of effort on the part of the primary manufacturers and training by the secondary manufacturers, there is no technical reason why ORVR controls cannot be provided for or installed on incomplete vehicles and handled correctly and implemented effectively by the second-stage manufacturers. Certainly, there are no problem issues for incomplete LDTs, which in most cases are delivered to the secondary manufacturer with the fuel system complete.

Staff Conclusion/Recommendation

Incomplete vehicles constitute about two percent of refueling emissions. While there is no technical reason why ORVR controls would not be feasible in the long term for incomplete vehicles (i.e., capable of controlling their refueling emissions), as discussed above, the manufacturers have some uncertainty about the ability of second stage manufacturers to install ORVR systems correctly in each case or to not inadvertently alter systems partially installed by the primary manufacturer. These problems could present potential legal liability risks for the primary manufacturer. Given the manufacturers' liability concerns, the fact that the percent of the refueling emission inventory is relatively small, and application of the requirement to incomplete vehicles is discretionary under the CAA, it is reasonable to defer action on this portion of the rule pending further study.

C. Applicability to California Vehicles

Summary of Issue

In the 1987 NPRM and 1993 Notice, EPA proposed that onboard controls would be required nationally as a fifty-state program. The Agency also acknowledged that compliance with the California vehicle program constitutes compliance with the Federal vehicle requirements, in California and states which have adopted the California vehicle program under CAA section 177, if California has received a waiver for its program pursuant to section 209. EPA noted that a waiver existed for a California program without onboard controls, then vehicles sold in California would not be required to be equipped with onboard controls. Finally, EPA noted that the question of whether the proper waiver existed and would survive the development of the Federal onboard program was not a question for this rule.

Summary of Comments

Comments were received on this issue from the automobile industry (Honda, Mitsubishi, AAMA, AIAM), the oil industry (National Association of Convenience Stores, Petroleum Marketers Association of America, Society of Independent Gasoline Marketers of America, American Petroleum Institute) and environmental groups (National Resources Defense Council, Center for Automobile Safety and the American Lung Association). There were largely two issues addressed: the effect of the current waiver status, and the impact of Stage II controls in California and elsewhere.

Current Waiver

The automobile industry largely felt that the current waiver prohibited onboard from being finalized as a 50-state program, or that the waiver should be expanded to include a waiver of any onboard requirements. The oil industry believed that there was no waiver applicable to onboard since the existing waiver was an exhaust waiver and onboard is an evaporative standard.

Stage II

The automobile industry argued that the existence of Stage II in California met the requirement that California's standards be at least as stringent as Federal standards contained in § 209 of the Act. Further, they argued that Stage II and onboard combined could be less effective than either alone. The oil industry and the environmentalists argued that the "at least as stringent" requirement applied only to vehicle controls. Further they claimed that because other states might opt to have California vehicles without omnipresent Stage II California's use of Stage II was irrelevant.

Staff Analysis and Conclusions

EPA's consistent and long-standing interpretation is that once a state program receives a section 209 waiver, it operates in place of the federal program in that state. Thus, the onboard requirement does not automatically apply in California by virtue of their section 209 waiver. EPA is not reopening this interpretation in this proceeding. However, waivers can be reopened and reevaluated. EPA understands that California may submit an amended waiver application assessing its program against new federal evaporative emission controls. The onboard controls are a type of evaporative emission for this purpose (given the physical similarities of the emissions and the control technologies), and so the California program can be reassessed when (and if) California submits a revised waiver request. Obviously, there is legitimate questions as to whether Stage II is a valid motor vehicle control technology under section 209.

D. Applicability to Fuels Other than Gasoline

Summary of Issue

EPA proposed that vehicles operating on all fuels, including gasoline and diesel and the alternative fuels, would need to comply with the onboard refueling requirements. Vehicles capable of operating on more than one fuel would be required to comply with the requirements on each fuel. EPA proposed to provide manufacturers an ability to request waivers of the testing requirements for fuels which inherently complied with the ORVR requirements. Such waivers would be granted at EPA's discretion. This approach would provide balance between the Act's requirement that all fuels comply, the nature of low volatility fuels, and the burdens of testing.

Summary of Comments

Diesel Fuel

Manufacturers of diesel engines generally claimed that extremely limited environmental benefits would be gained through control of refueling emissions from their engines and that the cost of even applying for the waiver outweighed those benefits. Further, they pointed out that even if small emissions could be found that would be controlled through onboard controls, that these controls were unproven for diesel fuels. Several environmental groups, however, argued in favor of EPA's position that the Act requires control of refueling emissions from all fuels. Some argued that a 95 percent reduction in refueling emissions was required from each vehicle-fuel combination.

Methanol and other alcohol fuels

The comments were unclear regarding this point because only very rarely were methanol or alcohol fuels mentioned by name. However, they implied that extra time was needed to comply for these fuels due to the differences between gasoline and alcohols. They also claimed that additional requirements would harm commercialization of alternative fuels and would provide small benefits because there are so few of them.

Gaseous Fuels

Commenters claimed that gaseous fuels, because of the dispensing equipment used, had very few refueling emissions. Additionally, they claimed that the test was improper for gaseous fueled vehicles and could be unsafe to perform.

Staff Analysis and Conclusions

Diesel Fuel

EPA maintains that, on its face, the CAA's requirement for ORVR in light-duty vehicles includes control of refueling emissions from any fuel. However, control of refueling emissions for a vehicle which had none, such as an electric vehicle, would be nonsensical. While EPA does not believe that diesel vehicles have as little refueling hydrocarbon emissions as do electric vehicles, vapor emissions from today's diesel vehicles and today's diesel fuels are far below the standards set for gasoline vehicles. Gasoline evaporates approximately 100 times more rapidly than diesel fuel and thus there is potentially 100 times as much fuel vapor per gallon available to be displaced from gasoline vehicles as from diesel vehicles during refueling. Although today's rule will reduce gasoline refueling vapors to less than 5 percent of their uncontrolled level, it will still not reduce these vapors to the low level of refueling emissions from diesel vehicles.

EPA therefore does not believe that Congress meant to try to reduce the level of refueling emissions from diesel vehicles by 95 percent. In fact, EPA could not determine whether diesel vehicles complied with such a standard because current measurement devices are not accurate to such low levels. The benefit of a 95 percent standard for diesel fuel would be minuscule compared to its cost, particularly since (as the manufacturers noted) no research has been done to determine whether current onboard refueling controls would be effective with diesel fuel. However, EPA cannot be sure that future diesel vehicles or diesel fuels will continue to have the low levels of evaporation that they have today. Additionally, the Act does require that all refueling emissions be controlled.

For these reasons, EPA originally proposed granting a waiver where manufacturers could show that a vehicle-fuel combination inherently complied with the refueling standard (i.e., complied without controls). EPA is sensitive to the needs of the industry regarding certification burden associated even with a waiver. For this reason, EPA has revised its requirement in response to comments and has adopted an engineering evaluation criteria for manufacturers to use in their waiver request. That is, so long as manufacturers can claim that their vehicle is similar to today's vehicles in the characteristics which would affect refueling emissions (volatility of all recommended fuel and additive combinations, temperature of fuel tank under all operating conditions), no engineering analysis is necessary to apply for a waiver.

Notwithstanding any waivers granted under EPA's engineering evaluation or otherwise, EPA may conduct its refueling test as part of confirmatory or recall testing of vehicles. Further, if EPA finds at any time in the future that diesel fuel sold has changed such that its engineering evaluation is no longer appropriate, it may rescind it.

Methanol and other alcohol fuels

As described above, the CAA requires control of refueling emissions from vehicles operating on all fuels. EPA has rules in place for methanol fueled vehicles. EPA is currently developing rules for other alcohol fuels and believes that it is more appropriate to consider the application of refueling controls to these other alcohol fuels in the context of developing a full regulatory framework for such fuels. EPA will therefore apply the CAA requirement for refueling emission control to all vehicles which are required to be certified. At this time, methanol is the only such alcohol fuel.

Vehicles operated on blends of methanol and gasoline have refueling emissions on the order of those from gasoline vehicles, or even higher, depending on the blend used. Therefore, EPA believes that control of these emissions is important to maintaining air quality and that such control was contemplated by Congress when it required general control of refueling emissions. EPA believes that the lead time and phase-in programs provided by Congress allow manufacturers sufficient time and flexibility to control emissions from methanol vehicles. Methanol-fueled vehicles must meet evaporative emission requirements, and no evidence was provided to EPA that current gasoline refueling control systems would not work for methanol blends. In fact, testing has shown that evaporative canisters, on which refueling canisters will likely be based, are not significantly detrimentally affected by alcohol fuels. Therefore, EPA does not believe that additional lead time is necessary.

Gaseous Fuels

As described above, EPA believes it is best to regnlate refueling emissions as part of a full regulatory strategy for a fuel. Therefore, EPA is putting off final decisions on this point until the final rule on gaseous fuels. All comments will be considered at that time.

II. Implementation

A. Lead Time

Summary of the Issue

The 1990 CAA Amendments require that LDV ORVR be implemented beginning in the fourth model year after the model year in which the rule is promulgated and phased in over three model years at a rate of 40 percent, 80 percent, and 100 percent, respectively. Since, under settlement agreement, the rule is to be promulgated in the 1994 model year, EPA indicated that the rule would be effective in the 1998 model year and phase in over model years 1998, 1999 and 2000. In the June 1993 Federal Register notice, EPA also proposed that the requirements for LDTS and HDVs would be implemented with the same lead time and phase-in schedule as for LDVs.

Summary of the Comments

Few comments were received regarding the implementation model year and phase-in for LDVs. One commenter asked that the first model year be delayed to 1999 to allow for consistency with that individual manufacturer's projected model turnover schedule and asked for a four model year phase-in instead of three. (IV-D-790) As is discussed elsewhere in the Summary and Analysis of Comments, several small volume manufacturers also asked for a delay in the LDV requirement.

Many LDT/HDV manufacturers commented that the requirements for LDTs/HDVs should not be promulgated at this time, but, if so, the initial model year should be delayed until after the LDV requirement is fully phased in and that the phase-in period for trucks should occur after that time. The commenters claimed that more time was needed to assess technology and that a delay would reduce overall facility and development costs. They also maintained that resource constraints made a longer lead time advisable for trucks.

Analysis of Comments

The lead time and phase-in schedule for the LDV ORVR requirement is prescribed in section 202(a)(6) of the Clean Air Act. With the exception of small volume manufacturers, no commenter provided a compelling argument as to why more than 4 model years of lead time would be needed to implement the ORVR requirement for the first 40 percent of production. Similar requirements have been implemented fully with equal or less lead time, and the scope of the work required is simplified by the implementation of the enhanced evaporative control requirement in the same timeframe (model years 1996-1999) for the same vehicles.

Since the application of ORVR requirements to LDTs and HDVs would be under the general authority in section 202(a)(1), the specific lead time and phase-in requirements of section 202(a)(6) would not automatically apply. Rather, the standard "shall take effect after such period as the Administrator finds necessary to permit the development and application of the requisite technology, giving appropriate consideration to the cost of compliance" (Section 202(a)(2)). (Arguably, section 202(a)(3)(C) specifies the lead time for gasoline-fueled HDVs, although EPA believes that this provision was intended to apply to tailpipe emissions. That section specifies a lead time "beginning no earlier than the model year commencing 4 years after such revised standard is promulgated." The analysis below would not change if this provision is invoked.)

Staff believes and the manufacturers' comments indicate that the same basic technology could be applied regardless of vehicle class. The basic control approach will be a liquid or mechanical seal in the fillneck to prevent vapors from escaping through the fillneck to the atmosphere. Instead, vapors will be routed to an activated carbon canister for storage and air stripped during vehicle operation. Incremental to enhanced evaporative controls, which will be required in the same time in all three vehicle classes, the only hardware changes required are the fillneck seal, an upgraded fuel vapor vent valve on the fuel tank, and a slightly larger diameter vapor vent hose. This basic technology is already used in evaporative control systems.

With the prior or simultaneous application of enhanced evaporative controls, the costs of ORVR would be very small. As is described in the RIA, costs for LDTs and LHDVs would be less than $6 per vehicle and, for HHDVs, costs would be about $21 per vehicle. These costs are a negligible percentage (<0.1 percent) of initial acquisition costs. A delay in the ORVR requirement would not reduce these costs substantially. The only potential savings could be in the possibility of using LDV facilities for LDT/HDV development. However, this amounts to only $.40 per vehicle over five years.

It should also be noted that emission control requirements of similar or greater complexity (such as the requirement of sections 202(g), 202(i), 202(l)) are being implemented in equal or less time and evaporative emission control requirements and regulations affecting fuel system safety have been implemented effectively in less time in the past (II-A-17). The recently promulgated rule for enhanced evaporative emissions control is being implemented with a three model year lead time and a four year phase-in. No participant in the rulemaking establishing the enhanced evaporative standard questioned that the requisite technology would be available when required. While several commenters requested a delay in the ORVR requirement for trucks, commenters on this rulemaking did not indicate that ORVR systems could not be developed for trucks during this timeframe.

Staff Conclusions/Recommendations

Based on technology and cost considerations alone, the staff believes that manufacturers could implement ORVR controls in LDTs in about the same timeframe as specified for LDVs. However, given the large resource demands now placed on the industry to meet other CAA mandates, the staff agrees that it is not unreasonable to provide more lead time for LDTs. This will provide a small cost savings, and is acceptable from an environmental perspective because of Stage II controls.

B. Vehicle Sales Averaging

Summary of the Issue

Section 202(a)(6) of the Clean Air Act Amendments of 1990 specifies a lead time and phase-in schedule for light-duty vehicles (LDVs) to implement ORVR controls. Under these requirements, 40 percent of each manufacturer's LDVs would have to meet the refueling emission standard in model year 1998, 80 percent in model year 1999, and 100 percent in model years 2000 and beyond. Since ORVR for LDTs/HDVs were proposed to be implemented under the authority of sections 202(a)(1) and (2), specific lead time and phase-in provisions do not exist for these vehicle classes. EPA proposed implementing LDT/HDV ORVR controls with the same lead time and phase-in as provided in the statute for LDVs. However, EPA also sought comment on a vehicle sales averaging program during the phase-in, which would allow manufacturers to meet the sales requirements of the regulation by treating their combined LDV, LDT, and HDV sales as a set and allowing any combination of LDV, LDT, HDV sales to meet the 40 and 80 percent requirements of the regulation.

EPA also proposed to exclude inherently low refueling emission vehicles from the program so that environmental benefits would not be lost.

Summary of the Comments

Comments were received both in support of and in opposition to the proposed concepts. One auto industry commenter supported the vehicle averaging provision, suggesting it would add flexibility during the phase-in period and would encourage earlier implementation of controls (IV-D-833). NRDC et al commented that the provision proposed was in violation of the language of section 202(a)(6) which requires minimum sales percentages to be met for LDVs (IV-D-834).

Analysis/Conclusions

EPA acknowledges that the comments provided by NRDC et al are technically correct. However, as discussed in the preamble to the final rule, implementation of ORVR systems in the various vehicle classes will be phased in over different time periods. Onboard controls in LDTs will not begin until 2001, when the three-year phase-in period for LDVs is complete. Further, the phase-in period for heavy LDTs (6,001-8,500 lbs GVWR) will not begin until model year 2004, when the phase-in period for light LDTs (up to 6,000 lbs GVWR) is complete. Thus, a potential sales averaging program is no longer a relevant issue in this rule.

C. Small Volume Manufacturers

Summary of the Issue

Several small volume manufacturers (Rolls Royce, Lamborghini, and Rover), supported by the Association of International Automobile Manufacturers and the National Automobile Dealers Association, requested that they be granted a delay in compliance until the last model year of the phase-in. Toyota asked that small volume families be exempt entirely, to encourage development of new technology. (IV-D-864)

Summary of the Comments

Small volume manufacturers requested that the ORVR phase-in requirement be deferred from 40/80/100 percent in the 1998/1999/2000 model years, respectively, to 100 percent in model year 2000 and later. As precedent, they cited recent EPA actions implementing the Tier 1 exhaust emission standards, cold CO exhaust emission standards, and the enhanced evaporative emission standard.

In support of their request, the commenters, most notably Rolls Royce, presented a number of technical factors. These included lack of engineering and testing resources to apply to a number of different emission control requirements coming into effect in the late 1990s and the business need to maintain the traditional approach of relying on the larger manufacturers to develop and implement the new technology before it is applied to vehicles produced by small volume manufacturers. Absent this relief, the small volume manufacturers stated that they would effectively have to meet the requirement for all of their vehicles in the first model year and that significant economic hardships would be likely.

Analysis of Comments

EPA believes that these are valid concerns. As a practical matter, small volume manufacturers cannot phase in their compliance due to their small size and limited product offerings of only one or two vehicle families. As is described in three recent Federal Register notices, EPA has allowed small volume manufacturers to delay compliance with other requirements until the last model year of the respective phase-in period. These instances include the Cold CO emission rule (57 FR 31888, July 17, 1992), the Tier 1 exhaust emission standard rule (June 5, 1991, 56 FR 26724) and the recent enhanced evaporative emission standards rule (March 24, 1993 58 FR 16003). This relief can reasonably apply to the ORVR requirement for LDVs, as well. In addition to the reasons raised by the manufacturers, it would be inconsistent to require ORVR compliance before evaporative emission compliance when the comments indicate that most manufacturers plan to use integrated refueling/evaporative control systems and these are desirable for both cost and safety reasons. Also, requiring phased compliance for these manufacturers effectively denies them the opportunity Congress intended to phase in the control technology, surely not Congress's intent. (cf. State of Ohio v. EPA, 997 F. 2d 1520, 1535 (D.C. Cir. 1993) (de minimis exception to seemingly literal statutory language can be allowed where failure to allow the exception frustrates a Congressional goal or leads to absurd results). These comments relate only to LDV phase-in, since the final rule delays phase-in for all manufacturers' LDTs until after full LDV phase-in.

The environmental impact of a small volume manufacturer delay is relatively minimal. In total, there are less than 12 manufacturers certifying under the small volume manufacturer provisions each year, and their total sales amount to only a few thousand units each year. Thus, the environmental impact of the phase-in delay requested by the small volume manufacturers would be de minimis.

Finally, there is no legal basis to entirely exempt a small volume LDV family as requested by Toyota.

Staff Conclusion/Recommendations

For the reasons stated above, and given the minimal environmental impact, EPA staff recommend allowing small volume manufacturers to delay compliance with the ORVR requirement in LDVs to the third model year of the phase-in period (2000). However, 100 percent LDV compliance should be required in model year 2000 and subsequent model years. Because the nature of the situation is different for small volume LDV engine families certified by large manufacturers, the phase-in delay should not include those families. Also, these provisions for small manufacturers should not apply to LDTs, since they have been provided ample lead time and can use modified LDV technology.

III. Economic Impact

Summary of the Issue

In the May 25, 1993 Federal Register notice, EPA requested comments on its latest assessment of ORVR control costs. These were provided in a memo in the public docket (IV-B-19). This memo indicated ORVR control system costs of $0.90 for LDVs, $1.50 for LDTs, and $5.20 for HDVs incremental to improved evaporative controls. It also indicated a net cost savings for vehicles in each class if fuel recovery credits were included.

Summary of the Comments

Few comments were received regarding the costs of ORVR controls. NRDC et al supported the values contained in the above mentioned EPA memo (IV-D-834)(IV-D-851), while General Motors (GM) took exception to these values, stating that they were too low (IV-D-854). Only one commenter, the American Trucking Association (ATA), provided a different estimate than that presented by EPA: $300 for HDV ORVR (IV-D-801).

API comments included a comprehensive cost/benefit analysis for LDT/HDV ORVR controls (IV-D-861). The American Automobile Manufacturers Association (AAMA), GM, and Chrysler indicated that an independent consultant had been hired to prepare a cost/benefit analysis for LDT/HDV ORVR, although the study was not received by EPA until after the close of the comment period (IV-D-858, IV-D-854, IV-D-860).

The National Truck Equipment Association (NTEA) commented that EPA needed to prepare a Regulatory Flexibility Analysis since, in their view, the proposed rule would "adversely impact a significant number of small entities" i.e., companies in the truck and body industry.

Analysis of Comments

EPA has prepared a final Regulatory Impact Analysis assessing the costs, benefits, and cost effectiveness of ORVR controls for LDVs, LDTs, and HDVs. This analysis takes into account the factors that have changed since the 1987 proposal, such as the implementation of new rules affecting ORVR designs and costs (e.g., enhanced evaporative emission controls) and the implementation of Stage II in many nonattainment areas.

In response to the comments from ATA regarding HDV costs, EPA contacted ATA (summarized in docket item IV-E-III) to ascertain whether there was any supporting information for their estimate. The ATA representative indicated that the estimate was several years old, based on inspection of a prototype truck system developed by Ford Motor Company. He indicated that it did not take into account the integrated system designs expected as a result of the revised test procedure and that costs would likely be lower by some unspecified amount.

EPA staff has reviewed the cost/benefit analysis prepared by API for LDT/HDV ORVR controls. The analysis employs point estimates of onboard costs and various Stage II scenarios plus reasonable estimates of ORVR and Stage II efficiency to calculate cost/benefit values. One unique step in the analysis is that it calculates not only cost effectiveness values for LDTs and HDVs, but also focuses on cost/benefit values. The cost effectiveness values ($/Metric Ton) determined by API are more attractive than those calculated by EPA, presumably because fuel recovery credits were valued at $1.00 per gallon versus $0.82 by EPA and the uncontrolled emission factor was about 20 percent greater than that used by EPA. An interesting aspect of API's analysis was the calculation of the cost/benefit ratio. To calculate this ratio, API assumed a range of $/metric ton reduction benefit values in the various ozone nonattainment areas, ozone transport regions, and attainment areas. Where the benefits from these reductions are compared to the net costs, the benefits exceed the costs in even the worst cases. EPA agrees with the general approach used by API, but is uncertain about how the benefits should be quantified in the various areas. EPA's analysis indicates that even a modest benefit value of $250-$500 per metric ton is enough to demonstrate that benefits would exceed costs.

EPA did not receive the study mentioned in the AAMA, GM, Chrysler comments before the close of the comment period. When the study was received in early November, it did not include costs. EPA has decided to address the contents of this report in a separate response in the public docket.

Comments provided by NTEA stated their view that EPA had neglected the impact on truck body and equipment manufacturers and had erred in its assessment in the NPRM that the rule would not have a significant impact on a substantial number of small entities. EPA disagrees with both assessments. First, it should be noted that EPA met with NTEA representatives at least twice after the NPRM to discuss their concerns (see docket items IV-E-24 and IV-E-31). EPA's views regarding the minimal effects of the rule on truck body and equipment manufacturers is supported by two points. Diesel-fueled vehicles comprise many of U.S. commercial truck sales, and EPA expects the ORVR rule to have no impact on diesel vehicle fuel systems or fuel tanks (since they can meet the standard without installing controls). Thus, for all of these vehicles there would be no effect on the truck body and equipment industry. EPA also expects no impact for truck body and equipment manufacturers working with gasoline-powered trucks. As is discussed in both the preamble to the rule and the RIA, EPA expects that most vehicles will use integrated enhanced evaporative/refueling control systems. This will allow the evaporative and refueling control systems to make use of the same canister, purge line, and purge value. The addition of an internal liquid or mechanical fillneck seal and the upgrade of the vapor line and vent valves should not present significant problems for those modifying truck chassis or adding bodies or other equipment to them. If there are concerns related to emission control equipment such as the larger carbon canister, these are more directly associated with the enhanced evaporative emission control requirement, which is now in place and phases in for the 1996 model year. NTEA commented on the enhanced evaporative control NPRM, but even though the issues were the same, did not raise the issues to the same degree in that response (compare A-84-18 and IV-D-14).

Since the ORVR requirement is a performance standard, not a design standard, EPA cannot preclude the possibility of the use of control system designs using separate refueling and evaporative control systems (non-integrated) or some other unique design. However, given the cost and other benefits of integrated systems, EPA considers this unlikely, especially with the leadtime and phase-in period provided. If any other system approaches are used they will be rare. Thus, EPA does not believe that the ORVR requirement will have a significant economic impact on a substantial number of small entities.

IV. Vehicle Safety

Summary of Issue

In the May 27, 1993 Federal Register notice, EPA once again raised the issue of potential concerns about ORVR system safety and sought comment on how to assure that ORVR controls are implemented safely. The notice discussed how EPA could use its authority under sections 206(a)(3)(A) and (B), it suggested risk assessments that manufacturers might want to conduct and provide as part of their certification application, and it emphasized the role of FMVSS 301 as part of the overall safety assessment. The notice was clear that manufacturers had broad design discretion in implementing ORVR systems, and emphasized that EPA had not precluded the use of canister-based controls.

Subsequent to the publication of EPA's May 27, 1993 Federal Register notice (58 FR 30731), EPA held technical discussions with representatives of AAMA regarding the ORVR test procedure. The purpose of these discussions was to identify potential changes to the ORVR test procedure which, if enacted, would facilitate the use of an integrated evaporative/refueling control system approach with a liquid seal in the fillneck. An integrated system approach would allow manufacturers to make use of the upgraded evaporative control hardware (common carbon canister, purge system, vapor hoses, etc.) as part of their ORVR control strategy and thus address both system complexity and cost issues. This approach would be used in lieu of the nonintegrated control system approaches which were characterized as being complex and potentially less safe.

ORVR test procedure changes were identified which would ease the use of integrated evaporative/refueling control systems with a liquid fillneck seal. EPA explained this option at the July 22, 1993 public hearing and requested additional public comment.

Summary of Comments

Comments received from the auto manufacturers were supportive of the proposed test procedure changes as a resolution of their safety concerns (see, for example, comments provided by GM (IV-D-854), Ford (IV-D-836), Chrysler (IV-D-860), AAMA (IV-D-858), and AIAM (IV-D-859)). An October 13, 1993 AAMA letter to NHTSA summarized the manufacturers position by stating:

> "We believe this procedure will allow the use of an integrated ORVR/evaporative emissions system including a common carbon canister. An integrated ORVR/evaporative emissions system will allow manufacturers to design and build safe, efficient ORVR systems."

The Insurance Institute for Highway Safety (IIHS) expressed concern about ORVR system safety at the July 22, 1993 public hearing (IV-D-798). Their comment was linked primarily to concerns about system size and complexity, which could be traced back to the types of systems which the manufacturers were projecting would have to be used if the proposed test procedure were not altered as discussed at the hearing. EPA asked IIHS to reassess their concerns in light of the potential test procedure changes and views of the manufacturers. However, IIHS provided no further comments at the close of the comment period.

With regard to HDVs, the American Trucking Associating (IV-D-801), the Recreational Vehicle Industry Association (IV-D-799), and the National Truck Equipment Association (IV-D-905) raised concerns that incomplete vehicles and heavy-duty trucks present unique concerns beyond those associated with LDVS and LDTs. Several HDV manufacturers also expressed uncertainty.

Analysis of Comments

Under the provisions of section 202(a)(6), EPA has consulted with DoT/NHTSA regarding ORVR system safety, and this consultation has continued through this portion of the rulemaking.

In response to the changed circumstances, DoT/NHTSA undertook an independent assessment of the effects of the test procedure changes on system complexity and vehicle safety concerns. In November, 1993, NHTSA completed a study entitled "An Assessment of Onboard Refueling Vapor Recovery System Safety" which reexamined the conclusions raised in their July 1991 study.

In this recent study, NHTSA revisited the principal findings of its July 1991 report to consider the positive safety impacts of the test procedure changes and other changed circumstances, such as enhanced evaporative control, RVP control, enhanced I/M, onboard diagnostics, and improved carbon technology. The NHTSA report reached the following general conclusion regarding ORVR safety:

> "Basically, there were three principal areas of concern pointed out in the July 1991 report: the increased size of vapor canisters to hold the fuel vapors, the mechanical complexity of the ORVR system, and the ability of the ORVR system to safely manage and purge the increased volume of vapors.
>
> As discussed above, technical developments, and test procedure and regulatory changes that have occurred since the July 1991 safety assessment, have had the net effect of reducing the safety concerns raised in the July 1991 report. The majority of vehicle manufacturers have stated that it is now possible to design safe ORVR systems that will function properly under all operating conditions. However, there still remains some small unquantifiable increase in safety risk due to the addition of the ORVR systems. This risk is unquantifiable since there are no data upon which to base a numerical estimate."

Thus, NHTSA views the changed circumstances, including the final test procedure and the use of integrated systems, as addressing many of their previous concerns. They also acknowledge that, absent actual data, they cannot determine the level of risk, and thus conclude that risks are unquantifiable. Nevertheless, NHTSA's report states that "if the ORVR system uses the same canister as the enhanced evaporative system there should be little or no increase in safety risk over that caused by currently required enhanced evaporative systems" (1993 Report p. 24). It is also important to note that the NHTSA report no longer describes safety risks associated with ORVR canister controls as inherent or unreasonable as compared to Stage II. And while the report briefly discusses why trucks might be different than LDVs, it cites no special safety risks for using ORVR canisters to control LDT/HDV refueling emissions.

EPA's "Summary and Analysis of Comments on the Potential Safety Implications of ORVR Systems" indicates that safety benefits are possible from ORVR systems (IV-H-04). These include removal of the external fuel vapor vent line from the fillneck of these vehicles, the expected move of the canister from the engine compartment to the rear of the vehicle, the resultant shortening of the vapor vent line, and the capture of fuel vapor previously vented at the service station during refueling. All of these actions directionally reduce the risk of vehicle fires in crash and non-crash situations. Clearly, with proper design and implementation, safe ORVR systems should be expected.

Several commenters expressed concern about applying the ORVR requirement to trucks and vehicles produced by multi-stage manufacturers. However, EPA does not believe the circumstances here to be any different than for LDVs. All trucks, including those produced by multi-stage manufacturers, are subject to the enhanced evaporative emission requirements and will have to upgrade their control systems in response to these new requirements. Also, the ORVR test procedure for these vehicles, as for LDVs, has been designed to facilitate the use of integrated evaporative/refueling control systems. Incremental to enhanced evaporative controls, the modifications needed for ORVR are minor, consisting primarily of a fillneck seal, an upgraded vapor vent valve, and a slightly larger diameter vapor vent line. Thus, there is no reason why the safety concerns for trucks should be any different than for LDVs. Also, the potential safety benefits of ORVR systems would accrue to these trucks and multi-stage vehicles as well as to LDVs. For the reasons discussed above, the manufacturers and EPA agree that there are no safety concerns for LDVs, and thus the same should apply for trucks. In fact, while the manufacturers opposed extending the ORVR requirement to trucks on several grounds, none indicated that safe LDT/HDV ORVR systems were infeasible.

Potential safety issues for incomplete vehicles are no different for integrated enhanced evaporative/refueling control systems than they are for enhanced evaporative control systems alone. As is presently the case, and will continue with enhanced evaporative control, the primary and secondary manufacturers will need to work closely together to ensure that systems are installed correctly and safely. Primary manufacturers will need to continue providing specific instruction on proper installation techniques and prohibited modifications, and second-stage manufacturers will need to continue providing training and initiating other quality control measures to assure that installations and modifications are done correctly. Incomplete vehicles and parts are certified to required safety standards of NHTSA and the FHWA. Potential issues incremental to enhanced evaporative controls can be addressed. The safety benefits of ORVR discussed above are available to incomplete vehicles as well. EPA sees no technical reason why ORVR systems cannot be installed safely on incomplete vehicles.

In the May 27, 1993 Federal Register notice, EPA asked for comment on whether any specific tests or other information should be required up front as part of the certification process and, if so, what information and in what form would be most appropriate. No commenter provided input on this point and, given the resolution of the safety issue, EPA has decided not to require any specific information at this time.

In the same notice, EPA also asked comment from auto manufacturers and other interested parties on the desirability of developing a process, after promulgation of the final rule, through which there could be a dialogue with EPA and NHTSA on design questions related to the in-use safety of ORVR systems. Manufacturers' comments indicated that resolution of the safety issue as part of the rule was most important, but they expressed little interest in establishing a dialogue. Therefore, no initiative will be taken in this area at this time.

Conclusions/Recommendations

Comments by the manufacturers indicate that implementation of the test procedure option discussed at the July 22, 1993 public hearing would resolve their longstanding vehicle safety concerns. The responsibility for the development and implementation of safe systems rests with the manufacturers, and the ultimate safety determinations on any given vehicle/system must await certification. Staff recommends that appropriate use of CAA section 206(a)(3)(A) and (B) authority be used when reviewing applications and that consultation with NHTSA be maintained during the review of certification applications. Technical staff knows of no safety factors which would prevent the certification of properly designed ORVR systems for LDVs, LDTs, or HDVs. However, the primary manufacturers still must resolve liability concerns about secondary manufacturers which might incorrectly install or complete the fuel system on incomplete HDVs.

V. Impact of ORVR on Emptying Losses

Summary of Issue

Emptying losses, sometimes known as "breathing losses", are defined as the emissions that are expelled from a service station underground storage tank (UST) through the UST vent pipe. These emissions form within the vapor space of the UST and, under certain conditions, they are vented through the vent pipe. While the amount of such emissions has not been measured with certainty, they are thought to be generated as follows.

The space above the fuel in a UST is a mixture of air and gasoline vapor. When fuel is dispensed, an amount of ambient air equal to the volume of fuel dispensed flows into the UST via the UST vent pipe. Vaporization of the fuel remaining in the UST then occurs until vapor/liquid equilibrium is reached. As the air in the UST becomes saturated with the gasoline vapors, it expands, and some air containing vapor emissions is pushed out of the vent pipe until the pressure between the tank and the atmosphere equalizes. Theoretically, the use of Stage II may help to control these emptying losses. When fuel is dispensed at Stage II stations, fuel vapor from the vehicle fuel tank is routed into the UST via a bellows on the fuel nozzle in place of some of the dispensed fuel volume. Because fuel vapor, as opposed to fresh air, replaces some of the lost liquid, less vaporization should occur. As a result, emptying losses from the vent pipe should be diminished. When an ORVR vehicle refuels at a Stage II station, however, the ORVR equipment captures the vehicle fuel tank vapor and fresh air again ends up replacing the total volume of dispensed fuel within the UST. The station would then act essentially as a non-Stage II station in regard to emptying losses. Key to this issue is whether vapor in the UST actually makes its way out of the vent pipe to the atmosphere, or whether station operating conditions cause the vapors to remain in the UST. If the bulk of UST fuel vapor generated during refueling remains in the UST, then there is no real Stage II benefit or ORVR detriment.

Summary of Comments

EPA has received a few comments concerning emptying losses from USTs at service stations. These comments, in response to the 1993 NPRM and the original 1987 NPRM, claim that Stage II effectively controls emptying losses as described above, and that ORVR controls will reduce this control.

Analysis of Comments

The difficulty in addressing this issue lies in the inadequate characterization and uncertain significance of emptying losses as a source of emissions. A few studies have been done on the subject; however, emptying losses are still not well characterized nor has an uncontrolled emission factor been identified. The data do suggest that emptying losses are most likely to occur during extended rest periods after dispensing activity has stopped. These rest periods allow the air within the UST to become saturated with fuel vapor. These gases then expand and some are vented until the pressure between the tank and atmosphere is stabilized. Stations with high throughput, steady business, and long business hours will have very few of these rest periods and therefore are not likely to experience significant emptying losses. Emission factors are likely to be different for each fuel grade due to the different dispensing frequencies and amounts sold throughout the country. Different patterns of losses from the various fuel tanks could also be expected.

Many other factors affect the formation and discharge of emptying loss emissions. Fuel properties and conditions, such as the fuel temperature and RVP (Reid Vapor Pressure), influence how susceptible the liquid fuel is to vaporization. As mentioned, larger stations with greater throughput will tend to have few extended non-dispensing periods and thus few emptying losses. Emptying loss emissions are also affected by the UST and pipe geometry. Fuel vapor will fill the UST vapor space and piping leading to the vent as long as ambient air is not continuously coming in. The larger the UST and underground piping, the less chance there will be for fuel vapor emissions to reach the opening of the pipe before another dispensing event occurs and ambient air is drawn in. This ambient air will push the fuel vapor back into the UST.

Still another key question is the degree to which, if at all, Stage II systems actually control emptying losses. The in-use efficiency with which Stage II systems control emptying losses is unknown and may vary with the type of Stage II technology.[2] If emptying losses are insignificant, then Stage II cannot be credited with controlling them. On the other hand, if emptying losses are real and somewhat significant and if a benefit can be credited to Stage II for controlling them, then the greatest volume of emissions is likely to occur at small service stations. Small stations have the lowest volume of business (least throughput and shortest business hours). There will likely be longer periods between refuelings (including during "closed" hours) and, hence, more opportunity for vaporization to occur in the UST and venting to take place. However, Clean Air Act (CAA) section 182(b)(3) states that the mandatory Stage II requirements do not apply to small service station gasoline marketers, i.e., facilities which sell less than 10,000 gallons of gasoline per month (50,000 gallons per month in the case of independent marketers of gasoline).[3] As a result, the stations at which Stage II could potentially achieve the greatest control of emptying losses are not subject to those requirements.

Furthermore, if the potential for significant emptying losses does occur at stations which have Stage II in place, the effectiveness of Stage II in reducing them is unknown. Given the Stage II control efficiency of 86 percent, some air must enter the UST during a refueling event through the vent pipe. Also, the hydrocarbon composition of the vapor returning from the vehicle fuel tank would be different from the liquid gasoline. Thus, differential evaporation would occur as each individual chemical compound sought to reach a liquid/vapor equilibrium--a phenomenon which resembles those thought to be responsible for breathing loss emissions in the absence of Stage II.

Staff Conclusions/Recommendations

EPA staff believe that the concern that ORVR-equipped vehicles will reduce the effectiveness of Stage II in controlling emptying loss emissions from USTs is at least exaggerated

---

[2]There are two types of Stage II systems: balanced and vacuum-assist. Vacuum-assist systems utilize a pump to draw the vehicle fuel tank vapor through the nozzle and into the UST. These systems have been shown to increase the amount of emptying losses emitted from the UST vent pipe. As a result, UST vent pipes at stations with these systems are equipped with pressure vacuum vent valves which prevent the outflow of such emissions and the inflow of fresh air. These valves are discussed below under Staff Conclusions/Recommendations.

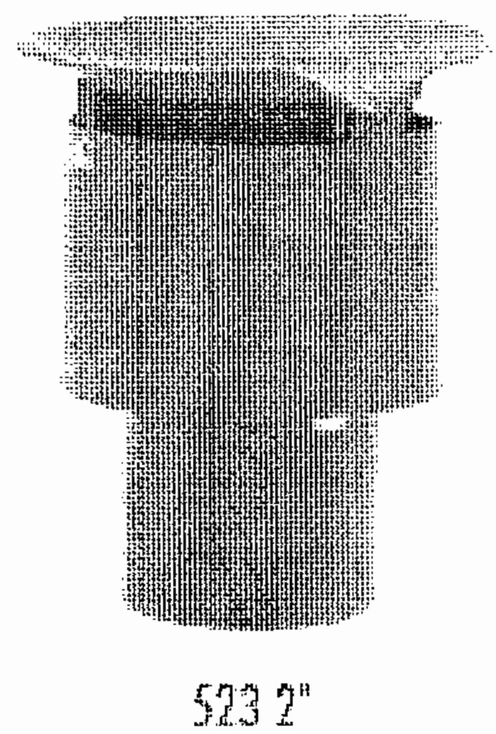
[3]CAA section 182(b)(3) permits waivers of Stage II requirements for small gasoline marketers, i.e., facilities which sell less than 10,000 gallons of gasoline per month (50,000 gallons per month in the case of independent marketers of gasoline). CAA section 324, which specifically addresses vapor recovery for small marketers, allows a state or local agency to establish an exemption from the Stage II requirement for independent small marketers at a level less than 50,000 gallons per month. Depending on the state, Stage II programs may thus provide waivers for stations with gasoline throughput ranging from zero (i.e., no waivers) to a single exemption level of 10,000 gallons per month for both branded and independent stations to 10,000 gallons per month for major brands and 50,000 gallons per month for independent small businesses.

and possibly unfounded. First, as described above, the magnitude and determinants of emptying loss emissions are poorly characterized. Secondly, the limited data available suggest that emptying loss emissions decrease as throughput increases. At larger stations with higher throughput, there would be few emptying loss emissions and therefore few if any potential benefits of Stage II. Thus, no ORVR detriment could logically occur. On the other hand, at smaller stations where emptying losses might be more likely to be generated, Stage II waivers are generally in effect. Again, this means that few if any Stage II benefits and no ORVR detriments could occur. In any event, even if emptying loss emissions do occur at stations where Stage II is in place, the effectiveness of Stage II in reducing them is unknown.

Clearly, there is much uncertainty about the emptying loss emission rate, the scope of emptying loss emissions, and the effects of Stage II. Given these unknowns, it is unreasonable to claim that ORVR takes away a benefit which may not exist.

Although much remains unanswered regarding the phenomenon of emptying losses, if concerns about emptying losses should persist, pressure vacuum vent valves installed on each UST vent pipe would represent a simple and inexpensive solution. There are not a lot of data to date, but studies conducted by Sun and Exxon suggest that little or no emissions are detected from UST vent pipes which have these valves. The valves are designed to open at certain vacuum and pressure settings, allowing the release of vapor and air when the tank pressure becomes too great or the ingestion of air when the tank pressure drops too far. OPW and Emco Wheaton are just two of the companies that offer several pressure/vacuum vent valve models for use with non-Stage II and Stage II systems. (For example, see Figure 3.) Their cost ranges from $35 to $57 per valve, depending on the model and the quantity purchased. Some models are certified for use in California by the California Air Resources Board. These vent valves are threaded and simply screw onto the vent pipe; little maintenance is required. An additional option demonstrated by the Sun study is the use of a limiting orifice valve on the UST vent pipe. This valve is a vent cap with a small permanent opening designed to restrict the inflow and outflow of vapor or air to or from the UST during instances of pressure differences between the UST and atmosphere. The Sun study indicated that this valve provided sufficient flow restriction to eliminate tank breathing. Installing either limiting orifice or pressure vacuum vent valves on UST vent pipes should alleviate any concerns regarding the possible impact of ORVR on Stage II effectiveness.

Figure 3: OPW 523 Pressure Vacuum Vent



References

"Service Station Vent Emissions," Sun Refining and Marketing Company, August 26, 1987.

"Determination of Mass Emissions from Underground Gasoline Storage Tanks," CARB, September 15, 1987.

"Phase II Vapor Recovery Evaluation Program," Robert Hilovsky, South Coast Air Quality Management District (SCAQMD).

"Service Station Storage Tank Vent Emissions," Exxon, April 15, 1988.

"Canadian Service Station Fuel Transfer Emissions," R. A. Nichols, January 1983.

"Emissions from Underground Gasoline Storage Tanks," Chass, Holmes, Fudurich, Burlin. Journal of the Air Pollution Control Association, Vol. 13, No. 11, November 1963.

"Technical Guidance - Stage II Vapor Recovery Systems for Control of Vehicle Refueling Emissions at Gasoline Dispensing Facilities, Volume I," EPA-450/3-91-022a, November 1991.

VI. Onboard Diagnostics

Summary of the Issue and Comments

Over the course of the regulatory development of the ORVR program, several vehicle manufacturers have commented that they would expect to incorporate onboard diagnostics (OBD) into their ORVR systems. EPA staff have considered this issue and agree that incorporating OBD into ORVR systems is appropriate and in most cases will be accomplished by the same systems used for evaporative control systems.

Current OBD regulations do not specifically require OBD monitoring of evaporative control systems. However, any in-use vehicle found to have evaporative emissions of 30 g/test or higher measured over the first 24 hours of the three-day diurnal of the revised evaporative test procedure is to be flagged for further evaluation. That evaluation will consist of making any necessary repairs to ensure the integrity of the evaporative system and then introducing a 0.04 inch (1 mm) orifice anywhere in the system. When the vehicle is operated in this condition over the FTP, the malfunction indicator light (MIL) must illuminate for the vehicle to be considered in compliance. If the MIL fails to signal the presence of a problem, this could contribute to a decision to initiate a recall action.

Analysis of Comments

EPA staff believes that this same general approach will be sufficient to assure that significant malfunctions related to ORVR equipment either do not occur or are detected. This is in large part because of the close similarity between evaporative and ORVR technology. In reaching this conclusion, the staff has considered the following key issue: Whether malfunctions could occur in in-use vehicles which would significantly affect refueling emissions and yet not be flagged for further evaluation by an in-use evaporative emission test. We considered this issue separately for integrated and non-integrated ORVR systems.

The case of integrated systems is the most straightforward, since any failure in the system would affect both evaporative and refueling emissions. If 30 grams of vapor were measured during an in-use evaporative test, refueling emissions can also be expected to be higher during a refueling event (approximately 3 grams for a 0.04 incb orifice and average tank pressure during refueling of 10 inches of water). If the OBD system subsequently detected an intentionallyintroduced orifice somewhere in the system, this would indicate an ability of the OBD system to signal the owner of most malfunctions that could affect both evaporative and refueling emissions.

The possibility remains that a smaller break or leak in the system might not result in a 30 gram measurement in the first segment of an in-use evaporative test and yet permit refueling emissions to occur well above the certified levels. However, an emission level of 3g is still a very large reduction compared to uncontrolled levels (greater than 90 percent). Thus the OBD system for ORVR is more effective than for evaporative control in detecting and solving problems. The staff does not believe that the technology reasonably expected to be available for detecting evaporative and refueling malfunction will be capable of detecting breaks or leaks smaller than the equivalent of a 0.04 inch orifice. (The staff expects OBD systems for evaporative/refueling controls will use either the engine to draw a vacuum or a pump to generate a positive pressure for a short time throughout the integrated evaporative/refueling control system, and will then measure the rate of loss of vacuum or pressure.) If, in the future, OBD technology becomes available which could sense smaller leaks or breaks, the staff recommends that this issue be reconsidered for both evaporative and refueling emissions.

For non-integrated systems, an in-use evaporative test would not detect some malfunctions if they occurred only on the ORVR side of the system; only an in-use refueling test would do so. The exception to this would be a general failure of the purge system which, if detected by the in-use evaporative test, would usually indicate a failure of the system's ability to purge the ORVR system, as well. In this case, the ability of an OBD system to detect such a failure should usually lead to repairs that would fix the purge problem for both the evaporative and refueling systems. However, malfunctions such as breaks or leaks in hoses in the ORVR side of the system would not be detected by an in-use evaporative test.

One solution to this problem would be a separate in-use test for refueling emissions and a separate "trigger level" of refueling emissions which would result in further evaluation (i.e., the introduction of an orifice in the system). That trigger level should be about 3 grams of refueling emissions during the test to correspond to the 30 grams for evaporative emissions, as discussed above. Such an additional in-use refueling test could be avoided if there were some assurance that any OBD systems installed to monitor for evaporative problems would also monitor for problems in the non-integrated ORVR control system. The staff believes that it would be a simple matter to include the ORVR system in the OBD system. For example, the same vacuum or pressure applied to the evaporative system could be simultaneously applied to the ORVR system.

Staff Recommendations and Conclusions

OBD regulations should include an expectation that any OBD systems for evaporative emissions also monitor for malfunctions in the ORVR system, whether the system is integrated or non-integrated. While the current in-use evaporative test screening would not uncover a problem in a non-integrated ORVR system, the staff believes that a separate in-use refueling test is not necessary at this time for this purpose. Non-integrated evaporative/ORVR systems are not expected to be frequently used, and the simplicity of extending OBD monitoring of evaporative systems to non-integrated ORVR systems will result in such monitoring of refueling systems. If it later become clear that non-integrated systems are more common than expected or that non-integrated ORVR is not being incorporated in evaporative OBD systems, then a specific in-use test and "trigger" should be considered.

VII. Level of the Standard

Summary of the Issue

The 1990 CAAAs call for the onboard refueling emission standard to be set at a level which provides a minimum of 95 percent capture efficiency. In the May 27, 1993 Federal Register notice, EPA requested comment on setting the standard in the range of 0.10 to 0.25 grams per gallon (g/gal).

Summary of the Comments

Comments on the level of the standard varied. API supported a level of 0.20 g/gal, stating that this level was feasible with demonstrated technology (IV-D-861). NADA commented that EPA should set the standard at 0.25 g/gal to account for technical design, useful life, and driveability concerns (IV-D-835). Most auto manufacturer interests which commented on this issue supported a level of 0.22 g/gal as feasible and effective at addressing concerns regarding variability and in-use compliance (see, for example, IV-D-854, 858, 836, 860, 864). Honda stated that a 0.10 g/gal level was probably feasible with a mechanical fillneck seal but was uncertain what level could be achieved with a liquid seal. Toyota provided some test data on test to test and vehicle to vehicle variability with a liquid seal.

Analysis of Comments

The key issue to be decided is the level of the refueling emission standard. In setting the standard, it is appropriate to consider the capability of the available control technology, the potential for in-use deterioration in emission levels, and the effects of vehicle-to-vehicle, test-to-test, and lab-to-lab variability.

The statutory requirement which calls for a standard with at least a 95 percent capture efficiency leaves no room for ORVR systems intentionally designed for any allowable emissions. Fortunately, a properly designed activated carbon canister control system can cost effectively provide a system designed to achieve essentially 100 percent control. EPA expects that manufacturers will design systems for essentially zero emissions under test procedure conditions and will include a reasonable cushion as well. However, as is evidenced in comments and data provided by the manufacturers, some compliance margin is needed to account for variability and in-use factors. As was stated by the commenters, the standard must be set at a level which accounts for these effects.

These variability and in-use factors must be covered within the 0.10 to 0.25 g/gal range proposed for the emission standard in the May 25, 1993 Federal Register notice. Certification data indicate that the in-use deterioration of the canister effectiveness is very small, i.e., less than one percent. There is not as much data quantifying the effects of variability. Honda and API indicated that a 0.10 g/gal level was achievable for mechanical seal systems, but this did not seem to account for the possible decrease of the efficiency of the mechanical seal in use. Other commenters suggested that a level of 0.20 g/gal was appropriate for a liquid seal system, because the dynamic nature of the seal was expected to have a higher variability. However, there would be no in-use deterioration in the effectiveness of a liquid seal system.

Levels approaching zero g/gal are achievable with either fillneck seal approach and, for the reasons discussed above, it is expected that manufacturers will design systems to achieve that level on the test procedure. The level of the standard will have little or no impact on forcing the design of more efficient systems.

Within the range considered, it would not be prudent to set the standard at a level which would impact the choice of the technology used. A 0.10 g/gal level may be achievable for mechanical seal systems, but some comments have indicated that a level of 0.20 g/gal is needed for a liquid seal system. Given the cost, safety and other benefits of liquid seal systems it would not be advantageous to set the standard at a level which would discourage manufacturers from considering liquid seal systems.

Based on the rationale discussed above, the standard should be set at 0.20 g/gal. It provides an adequate compliance margin to account for in-use and variability effects, but ensures the design of systems with capture efficiency exceeding 95 percent, as required by the statute.

Conclusions/Recommendation

Setting the standard at 0.20 g/gal is appropriate to account for variability and is supported by the limited test data available as consistent with the 95 percent capture requirement. A standard level of 0.20 g/gal is so stringent as to force the design of systems with essentially zero emissions, and this is feasible and cost effective for activated carbon canister technology.

VIII. In-Use Control Efficiency

Summary of Issue

At the July 1993 ORVR Public Hearing, EPA requested comment on changing the test specification for dispensed fuel temperature (Td) from 81-84°F (as proposed in the August 1987 NPRM) to 67°F. Because the temperature specification is in some cases lower than in-use dispensed temperatures observed during the summer ozone season (May through September), questions have arisen about the possible effects of this change on the in-use control effectiveness for ORVR systems.

Summary of Comments

The automobile manufacturers supported the test temperature specifications proposed by EPA at the July 1993 hearing. Manufacturers commented that the lower Td proposed by EPA would allow the manufacturers to use canisters designed to meet the new evaporative emission requirements as a common storage medium for refueling vapors. Manufacturers further stated that the lower Td specification would go a long way towards removing any safety concerns with respect to the ORVR rulemaking.

Several commenters (API and joint comments from NRDC, CAS, and ALA) did not support the Td value set out at the July 1993 hearing, stating that the 67°F (19.4°C) dispensed temperature was not representative of in-use refueling conditions during the ozone season. These commenters stated that a test procedure which specifies a lower Td than occurs in the real world would result in ORVR systems which fail to meet the 95 percent control requirement of the Clean Air Act (CAA). These commenters further stated that they did not consider larger canisters to be a safety risk and that even if a safety risk existed, it would still be the manufacturers' burden to design a safe and effective system.

Analysis of Comments

Section 202 (a) (6) states that EPA must promulgate "standards...requiring that ...light-duty vehicles ....be equipped with [onboard] systems" and that "[t]he standards shall require that such systems provide a minimum evaporative emission capture efficiency of 95 percent." EPA views this requirement as applying to the test procedure used to measure performance, not to actual in-use control effectiveness. This is true of any of the "standards" developed to implement section 202 requirements.

Under section 206 (a) (1), certification vehicles are tested under designated test procedures to determine if they comply, before use, with section 202 standards. The test procedure cannot, by itself, ensure that the standards are met on every vehicle in-use. This is because the effects of other factors, such as tampering and malmaintenance, on in-use performance cannot be known with absolute certainty until after the vehicle has been operated in-use.

Furthermore, section 207 (b) allows tests of in-use performance to reasonably approximate the certification tests, which indicates that in-use performance is not the same thing as the standard itself. Because determination of in-use performance can be based on a test which is different than the certification test procedure, a particular in-use performance level cannot be guaranteed by a certification standard. Therefore, EPA staff do not consider the 95 percent capture efficiency requirement to relate directly to in-use performance. Rather, the 95 percent requirement relates to the test procedure itself, which must not only achieve a minimum efficiency of 95 percent, but must also be reasonably related to in-use conditions so as to achieve the Congressional goal of capturing almost all light-duty vehicle refueling emissions.

On the other hand, each individual test parameter need not necessarily be representative of in-use conditions as long as the test procedure as a whole ensures that control systems designed to meet the test procedure standard will perform well under in-use conditions. The refueling test procedure achieves this goal by ensuring adequate refueling emission storage capacity to control refueling emissions under nearly all in-use conditions. Thus, EPA strongly disagrees with commenters who contend that the changed temperature specification will result in low in-use efficiency for ORVR systems.

Chapter 4 of the Final RIA provides a detailed analysis of the expected in-use efficiency of ORVR systems based on the test procedure conditions proposed at the July 1993 hearing. In the analysis, in-use efficiency of ORVR systems was modeled by comparing in-use refueling emission load per refueling event to the canister capacity required to meet the refueling test procedure.

In-use refueling emission load (in grams) is the product of the in-use refueling emission factor (in grams per gallon) and estimates of the volume of gasoline dispensed during in-use refueling events. Similarly, canister capacity required to meet the refueling test procedure is the product of the test procedure refueling emission factor and the number of gallons dispensed during the refueling test. Refueling emission factors depend upon the RVP of the dispensed fuel, dispensed temperature (Td), and delta temperature (ΔT), defined as the difference between the temperature of the fuel in the vehicle tank (Tt) and the dispensed temperature of the fuel used to refill the tank (i.e. Tt-Td).

Although the test specification for dispensed temperature is less stringent than use of all available in-use temperature data suggests, specifications for fuel RVP and the amount of fuel dispensed are more severe than occur in use in many situations. In the RIA, in-use fuel RVP was estimated based on three recent federal and state actions which affect the RVP of fuel sold during the 5-month ozone season in nonattainment areas. These actions are federally mandated reformulated gasoline, Phase II volatility control, and California Phase 2 reformulated gasoline.

These programs, which either directly limit RVP or will likely force the use of lower RVP fuel, result in an average RVP of 7.3 psi in nonattainment areas (NAAs). Because in-use RVP is significantly lower than the 9 RVP refueling test specification, the effect of the Td specification is largely offset. The ΔT parameter of 13F° in the test procedure is somewhat larger than the 88°F average value in the data. This is insignificant, since the contribution of ΔT to the emission rate is very small. Fuel-injected vehicles have a higher ΔT than the carburetted vehicles which dominate the data base. With the current dominance of fuel-injected vehicles, the in-use value is likely nearer the 13F° value.

The effect of the Td specification on control effectiveness is further offset by the larger volume of fuel dispensed in the refueling test procedure than during many in-use refueling events. In the RIA analysis, in-use refueling amount was based on a survey of 1,184 vehicles refueling events conducted by General Motors. The average fill amount in the survey was only 65 percent, significantly lower than the test procedure specification of 90 percent. The larger dispensed volume compensates for the smaller refueling emission factor resulting from the Td specification.

Furthermore, due to the nature of canister-based control technology, ORVR systems are expected to have additional in-use capacity which is not accounted for in the test procedure. Refueling canisters operate at essentially 100 percent collection efficiency until the canister's breakthrough capacity is reached. When the vapor load to the canister exceeds breakthrough capacity, vapors are emitted from the canister. Once vapor begins escaping, the efficiency gradually decreases until the canister reaches saturation (zero percent collection efficiency). Thus, a canister continues to store some vapor even after its breakthrough capacity is exceeded. However, this additional capacity is not useful during certification tests because manufacturers must still meet the 0.20 g/gal refueling emission standard. As is discussed elsewhere in this document under "Level of the Standard" the standard is set primarily to allow for test variability in-use and deterioration losses, and is likely to result in designs with little or no breakthrough during the test. Thus, post-breakthrough capture of refueling emissions is an added in-use benefit and a byproduct of the nature of the control technology, and adds further to the assurance of high in-use efficiency.

The theoretical in-use efficiency of ORVR control is reduced somewhat due to systems that fail to operate properly in use. System failure may occur due to component failure, consumer malmaintenance, or tampering. Failure rates of ORVR systems used in the RIA analysis were based on evaporative system failure rates contained in EPA's MOBILE5 emission factor model and on the expected effects of the full useful life requirement of the CAA, Inspection and Maintenance (I/M) programs, and onboard diagnostic (OBD) systems. The above programs are expected to result in very low in-use failure rates for ORVR systems (less than 1 percent in NAAs).

Based on the stringency of the test procedure, available in-use data (temperature, RVP, and fill amount), the added benefit of post-breakthrough canister capacity, and the expected effects of other EPA programs on the failure rate of ORVR systems, EPA estimates that the control-effectiveness of ORVR systems will be 97 percent in NAAs over the summer ozone season (May through September). In attainment areas, which lack RVP control and enhanced I/M, the theoretical in-use efficiency is somewhat less, resulting in an all-areas (attainment and nonattainment areas combined) average efficiency of 92 percent.

Moreover, EPA notes that the predictions of in-use efficiency may be skewed downwards because data for the southeast U.S. region indicate that average dispensed fuel temperature in that region is seven degrees Fahrenheit higher than the average temperature reported for the southwest U.S. region. EPA technical staff know of no reason dispensed fuel temperature should be so much higher in the southeast. EPA based its theoretical predictions on this information because it was the only available data. If the same range of dispensed fuel temperatures were used for the southeast region as for the southwest U.S., the average all-areas theoretical in-use efficiency would be predicted to rise to 95 percent.

Because EPA's analysis indicates that the combination of test procedure conditions results in ORVR designs which are highly effective at controlling in-use refueling emissions, the 67±1.5°F (19.4±0.8°C) dispensed temperature specification is considered appropriate. Furthermore, the temperature specification is beneficial because it allows the use of similar hardware for both evaporative and refueling emission control.

Staff Recommendations/Conclusions

EPA staff recommend that the dispensed tank temperature specification of 67±1.5°F (19.4±0.8°C) be used.

IX. Test Procedure

A. Integrated System Preconditioning

Summary of Issue

EPA proposed three integrated system preconditioning options for the refueling test in the May 1993 Federal Register Notice (58 FR 30731). These options, labeled as A, B, and B1, are depicted in Figure 1 of the Notice (page 30736). All three of these options require loading of the canister followed by a predetermined amount of driving. The vehicle is then drained and fueled to within 10 percent of the fuel tank capacity and soaked for 6 to 24 hours in order to prepare the vehicle for the refueling event.

In order to simplify testing, EPA designed the integrated system preconditioning to be similar to the evaporative emissions procedure. Option A placed the refueling test after the exhaust emissions portion of the supplemental evaporative emissions test procedure. Option B placed the refueling test after the running loss portion of the evaporative emissions test sequence. As a logical extension to this, EPA considered adding more driving to Option A in order to allow for more purging of the canister (Option B1).

Summary of Comments

Commenters overwhelmingly supported test Option B1 as a preconditioning of the vehicle for the test refueling event. API commented that the automotive manufacturers should be able to choose which test option they would like to use for certification.

Analysis and Conclusions

EPA staff views any of the tests as being reasonably representative of in-use conditions. Option B1 includes the additional driving contained in the running loss test without the additional difficulty of the running loss test. Because Option B1 combines the most attractive features of Options A and B, EPA agrees with the commenters and is adopting Option B1 for preconditioning. It will provide a high level of in-use control and facilitate the use of integrated enhanced evaporation/refueling control systems.

B. Refueling Test Specifications

Summary of Issue

Under EPA's proposal, the test refueling event begins with a 6 to 24 hour soak at 80°F(±3°F) in order to stabilize the temperature of the fuel tank. During this soak, the fuel tank contains an amount of certification test fuel equal to 10 percent of the nominal fuel tank capacity. Within a SHED (Sealed Housing for Emissions Determination), 67°F (19.4°C) fuel is then dispensed into the tank at a constant rate ranging from 4 to 10 gpm until the first nozzle shutoff. If the nozzle shutoff occurs before 85 percent of the tank capacity is added, then the fueling is restarted. This process continues until the tank is at least 95 percent full.

Comments were received regarding the proposed temperature, dispense rate, and RVP specifications. Comments on the fuel dispense rate and RVP are discussed below. Comments on test temperature specifications may be found elsewhere in this document under "In-use Control Efficiency."

Summary of Comments

Some of the automobile manufacturers claimed that 10 gpm would be the most stringent test refueling rate since it is worst case. They claimed that having to design for all refueling rates between 4 and 10 gpm would be an unnecessary burden. One manufacturer asked for a range of 5 to 10 gpm because of the difficulty in designing liquid seals for a 4 gpm dispense rate and because gas stations with such a low dispense rate are rarely seen in use. Finally, one manufacturer claimed that 9 psi RVP certification test fuel is not typical of in-use fuel due to the reformulated fuel regulations.

Analysis of Comments

The CAA requires that ORVR systems "provide a minimum evaporative emission capture efficiency of 95 percent." As noted, EPA considers this requirement to be associated with the level of the standard rather than to in-use control effectiveness. However, even if the efficiency requirement applied to in-use control effectiveness, EPA analysis indicates that the test specifications proposed at the July 1993 public hearing would result in ORVR systems which are at least 95 percent efficient under most real-world conditions. (see discussion of "Level of the Standard" and "In-Use Control Efficiency", elsewhere in this document.

The dispense rate, dispensed and tank temperatures, and RVP specifications for the refueling test were chosen to assure ORVR designs which will result in effective in-use control of refueling emissions. EPA's goal in establishing test parameters is to ensure that the combination of test conditions results in designs that will achieve a very high level of control in use. Therefore, the representativeness of any one test parameter, such as dispensed fuel temperature or use of 9 psi RVP certification, is of less concern than the net effect of the total test.

Fuel RVP varies dramatically both over the course of the year and geographically. Values as low as 7.0 psi and in excess of 12 psi are seen. Setting the test RVP specification consistent with summer only conditions would provide inadequate control in the winter, while setting the RVP more consistent with winter values would result in an oversized system for many situations. While perhaps conservative, it is not clear that a larger system would be cost effective. Setting the RVP parameter at 9.0 RVP is reasonable for summer RVPs and is compatible with current test specifications for exhaust and evaporative emissions control

Staff is interested in ensuring good control over a range of expected in-use conditions and so continues to support the 4 to 10 gpm refueling rate. There is no proof that 10 gpm represents the worst case refueling rate in this range. For example, Toyota indicated that 4 gpm may in fact be the worst case for liquid seal designs. In addition, refueling stations currently have a wide range of maximum dispensing rates. Customers have the ability to reduce the rate further through manual operation of the dispenser and, in fact, this practice is not uncommon, though data are lacking on the frequency and degree to which this occurs. Therefore, staff considers the 4 to 10 gpm range appropriate for testing.

Staff Conclusions/Recommendations

Technical staff recommends a refueling rate of 4 to 10 gpm and the use of 9.0 RVP fuel for low-altitude testing.

C. Canister Loading

Summary of Issue

EPA proposed a number of options for refueling canister loading, focused primarily on methods established in evaporative emission testing. One proposed method required loading with a 50/50 mixture of butane and nitrogen, at a rate of 40 grams of butane per hour, until 2 grams of hydrocarbons are measured to be emitted from the canister (referred to as the 2-gram breakthrough point). Alternatively, the canister could be loaded to this point with gasoline vapors by conducting repeated diurnal heat builds. These loading procedures are consistent with those used in the final evaporative emissions rule.

Summary of Comments

Some of the manufacturers raised the issue of performance-based loading such as performance of a specified number of diurnal heat builds. They commented that loading to breakthrough would penalize them for using conservatively sized canisters. In addition, some manufacturers believed that performance-based canister loading would be more typical of in-use conditions.

Several of the commenters, including some manufacturers, supported the canister loading procedure proposed by EPA. One commenter stated that performance-based loading would be more burdensome than loading to breakthrough and would reduce the stringency of the test. Two manufacturers supported loading the canister to breakthrough for this rule, but requested that the EPA staff look into performance-based loading in the future.

In addition to performance-based loading, Toyota requested that EPA allow the manufacturer to have the option of using a performance-based bench purge of the canister in place of driving.

Analysis of Comments

EPA staff believes there is value in making the ORVR test procedure similar to the evaporative emissions test procedure in order to minimize the cost and complexity of the testing, and to facilitate use of integrated systems as a means of complying with the standard. The proposed canister loading methodologies are the same as those finalized for the evaporative emissions rulemaking. Although the technical staff is generally supportive of performance-based test conditions that simulate in-use experience, staff cannot support the alternatives suggested by manufacturers for performance-based loading. With the diurnal-induced loading sequence suggested, an exceptionally large canister could be used with a weak or non-existent purge strategy and the vehicle would still pass the test. Yet, this design strategy could obviously result in considerable emissions in use, because of the ineffective purge.

Staff is opposed to allowing manufacturers to bench purge canisters in certification testing, due to the variability that this could add to the refueling test procedure. The need to demonstrate that the bench purge is equivalent to the driving-induced purge negates any time and resource savings that might be involved.

Staff Conclusions/Recommendations

Staff recommends loading the canister to 2-gram breakthrough in preparation for the purge driving, consistent with the choice of option B1 for preconditioning integrated systems. Staff recommends that optional bench-purge not be allowed.

D. Testing of Non-Integrated Systems

Summary of Issue

Non-integrated ORVR systems store only refueling vapors and therefore warrant a preconditioning drivedown of at least 85 percent of the fuel tank capacity before being subjected to the minimum 85 percent refueling event. EPA proposed that this driving consist of repeated UDDS cycles, either on a track or on a dynamometer, until a volume of fuel equal to 85 percent of the fuel tank nominal capacity has been consumed. To shorten test time, manufacturers could exercise an option to do less driving in certification testing, and EPA would perform subsequent confirmatory and in-use testing using the same reduced driving schedule.

EPA proposed to test non-integrated systems with a partial refueling test procedure, at EPA discretion. This procedure would help to ensure control in those frequent in-use refueling events in which significantly less than a full tank of fuel is pumped. Because the non-integrated system test allows a nearly complete drivedown of the fuel tank capacity, it could enable purge design strategies that inappropriately minimize purge during the exhaust emissions test. In the partial refueling test, following the 10 percent fueling and soak, the vehicle would be fueled to automatic nozzle shutoff, driven some integer number of UDDS cycles chosen by EPA, and then subjected to the refueling emissions measurement with no intervening drain and fill. In addition, EPA proposed that a constant purge specification be adopted to preclude inappropriate non-integrated system purge strategies.

Summary of Comments

Manufacturers commented that they were not in favor of the partial refueling test for non-integrated systems. Their contentions were that: (1) the proposed test had too much variability and (2) the 85 percent fill-up represents the worst case refueling event, and so it would be unnecessarily burdensome to have to perform design verification testing over the wide range of possible partial fills. Manufacturers also stated that EPA should not require any sort of purge specification. They claimed that this would result in a design standard which may restrict the use of newer technologies that have not yet been anticipated.

Analysis of Comments

The partial refueling test serves two purposes: it allows for a shorter test, and it ensures that the purge strategy used is effective for a wide range of refueling events. If an 85 percent fill-up is the worst case, then the additional burden on the manufacturers to pass a partial refueling test should be minimal. If an 85 percent fill-up is not the worst case, the partial refueling test can help guard against designs that are not effective for partial fills.

Technical staff agrees that a purge specification is a design standard and should be avoided. With the partial refueling test being implemented, a purge specification is no longer necessary.

Staff Conclusions/Recommendations

Staff recommends adoption of the EPA option to conduct a partial refueling test for vehicles equipped with non-integrated systems. No purge specification is recommended. Staff also recommends taking several steps to minimize the variability of the partial refueling test. The test should have a minimum driving requirement that at least 10 percent of the nominal fuel tank capacity must be consumed. Fuel consumption should be determined from the fuel economy data for that vehicle. A one- to six-hour soak should be required between the driving and the refueling event to preclude hot soak emissions during the test. Finally, a metered amount of fuel should be dispensed rather than fueling to nozzle shut-off.

E. Seal Test

Summary of Issue

EPA proposed that it have the option of performing a seal test of integrated and non-integrated designs in order to verify the integrity of fillpipe seals and vapor lines. The seal test procedure is the same as the refueling test except that the canister is bench purged prior to the refueling event to eliminate potential canister emission artifacts. Alternatively, vapor from the canister port could be routed out of the SHED. The canister preconditioning and preparatory driving are eliminated. The refueling test standard would apply and failure of the seal test would be considered equivalent to failing the full refueling emissions test.

Summary of Comments

Ford disapproved of the application of a seal test. This was based on an argument that the evaporative emissions test, the refueling emissions test, and the use of onboard diagnostic (OBD) II systems would verify the integrity of fillpipe seals and vapor lines.

Analysis of Comments

Technical staff considers the seal test to be useful. It is simpler than the full refueling test, since the canister does not need to be loaded to 2 gram breakthrough and extensive driving for canister purge is also avoided. Because of its simplicity, the seal test would be appropriate for selective enforcement auditing (SEA) and in-use testing. The evaporative emissions test is unable to verify fillpipe seal integrity because the vapor seal is made by the fuel cap (which is left on for the evaporative emissions test) rather than by the nozzle/fillpipe interface. OBD II systems, as discussed in the preamble for this final rule, are not designed to check the integrity of the nozzle/fillpipe interface.

Staff Conclusions/Recommendations

Staff recommends that EPA retain the option of performing a seal test in place of a complete refueling test. To ensure that the seal test does not represent an increase in stringency over the refueling test, staff recommends specifying a very high level of purge (1200 bed volumes) in the seal test procedure. Under this approach, a vehicle failing the emission standard based only on its seal emissions could be deemed to fail the overall test since the results would be conservative in the favor of the manufacturers.

F. Cap Removal Emissions

Summary of Issue

In the May 1993 Notice, EPA requested comment on including a test to measure and control the "puff loss" emissions from a pressurized fuel tank when the fuel cap is removed for refueling. This test requires the removal of the fuel cap in the SHED, shortly after the preconditioning drive, with resulting emissions measured and combined with the other refueling emissions in determining compliance with the refueling standard. EPA proposed, but did not finalize, such a cap-off test in the evaporative emissions NPRM (55 FR 1914, January 19, 1990).

Summary of Comments

Manufacturers commented that the puff loss test would provide no additional control over that achieved by the refueling test and the evaporative emissions rule requirement that tanks pressurized to over 10" (25 cm) H_2O be vented to the canister upon cap removal.

GM also argued that the execution of a cap-off test involving a warm-up drive followed immediately by a cap-off step in a SHED would be complex and formidable. Hot soak emissions could confuse the puff loss measurement, and the time required to move a vehicle from a dynamometer cell to a SHED and remove the cap would be overly long compared to the actual in-use event, which typically involves less than a minute from key-off to cap-off. These two concerns would affect the measured emissions in opposite directions and would make it difficult to ascertain a puff loss emission corresponding to the in-use event.

Analysis of Comments

The refueling test does not measure emissions from cap removal directly after vehicle operation. The evaporative emissions requirement allows for the venting of tank pressures under 10" (25 cm) H_2O to the atmosphere. These emissions can be appreciable. GM calculated that the puff loss from venting a 10 percent full 20 gallon (76 liter) tank at 10" H_2O would be about 3 grams. Staff agrees with this estimate but disagrees with the contention that this is minor, given that this same vehicle would only be allowed to emit a little over 3 grams during the refueling test.

Staff agrees that the test has some difficulties but remains concerned about puff loss emissions, particularly considering that the new evaporative emission control requirements may prompt manufacturers to rely more heavily on pressurized tank designs in the future. However, staff believes it necessary to defer action on this issue for now, so that an effective approach can be developed, involving full public participation. Therefore, staff intends to take up this issue as part of the planned further action on pressurized designs announced in the evaporative emissions control final rule (58 FR 16002, March 24, 1993). It should also be noted that there will be some control of puff losses in use, because of the 10" H_2O specification.

Staff Conclusions/Recommendations

EPA staff recommends that the cap removal test be deferred until an effective approach can be developed.

G. Spitback Test

Summary of Issue

During the refueling portion of the ORVR test, any fuel spitback at nozzle shutoff would spill into the SHED, evaporate, and be counted as part of the emissions allowable under the refueling standard. Therefore, vehicles would not be expected to comply with the refueling emissions standard if they emitted significant spitback emissions during the refueling test. For this reason, EPA proposed a waiver for the separate spitback standard promulgated in the enhanced evaporative emissions control rule (58 FR 16002, March 24, 1993), provided these vehicles are certified to meet the ORVR requirements.

Summary of Comments

Manufacturers stated that the ORVR test already checks for spitback in a superior manner to the spitback test and that the spitback test should be dropped for ORVR equipped vehicles. API supported a waiver for the spitback test but felt that EPA could still use it for confirmatory testing.

Analysis of Comments

For the reason stated above, EPA staff agrees that the spitback test may not give any additional control of spitback beyond that which is already obtained by the refueling test.

Staff Conclusions/Recommendation

Manufacturers certifying vehicles with ORVR systems should be waived from performing an additional spitback test. However, EPA should retain the authority to use the separate spitback test during confirmatory and in-use testing for all vehicle models, including those covered under waivers.

H. Certification and Assembly Line Testing

Summary of Issue

In the Selective Enforcement Audit (SEA) program, a sample of assembly-line vehicles is tested in order to ensure conformity with emission standards and the terms of the applicable certificate. The SEA program has not included testing of evaporative emissions from new vehicles due to concerns that non-fuel background emissions from new vehicles might interfere with evaporative emissions measurements. However, because of the brevity of the refueling test and the fact that the refueling portion of the ORVR test occurs at a constant temperature, background emissions are not expected to significantly affect the refueling test measurements for new vehicles. EPA proposed that SEA testing be performed and that new vehicle background emissions be accounted for if it is demonstrated that they significantly exceed in-use vehicle background emissions.

Summary of Comments

Because refueling systems are similar to (or integrated with) the evaporative emissions systems, manufacturers commented that the refueling systems should similarly be exempt from SEA testing. They commented that the testing of new vehicles would be unrepresentative because of new vehicle background emissions. One manufacturer pointed out that activated carbon canisters require a number of hydrocarbon load and purge cycles to attain a stabilized condition. Therefore, the new canisters would be more efficient than aged canisters and the value of testing would therefore be diminished. Another manufacturer stated that the performance of the ORVR system depends on the system design and does not vary significantly due to production tolerances; fuel tank capacity and fuel dispensing rate have more of an effect on the system's effectiveness. The manufacturers concluded that the SEA testing would not be an effective use of time and test facilities due to the unrepresentativeness of the results.

Analysis of Comments

As mentioned above, there is no SEA testing for evaporative emission systems because background emissions from a new vehicle might affect the validity of the test. This is not true for the ORVR test since it is much shorter than the evaporative emission test and the vehicle is not heated in the ORVR test. To alleviate any concern manufacturers might have, however, non-fuel background emissions could be measured over a 10 minute period immediately prior to the refueling event and appropriately accounted for in the SEA test results. EPA staff agrees that canisters which have not been aged would be unrepresentative of in-use system operation. However, SEA tests would still be useful for ensuring sealing integrity and the seal test discussed above would fit well with this need. No proof has been shown to EPA that the ORVR systems are not susceptible to failure due to production variability.

Staff Conclusions/Recommendations

Staff recommends the adoption of SEA testing of ORVR systems with an optional procedure for accounting for non-fuel background emissions.

I. Nozzle Specifications

Summary of Issue

In the August, 1987 NPRM, EPA asked comment on the need for fuel nozzle geometry standards as part of an ORVR program and suggested that auto makers and nozzle manufacturers undertake a voluntary initiative to develop national consensus standards in this area. This initiative is being undertaken under the auspices of the Society of Automotive Engineers, in which a technical committee comprised of auto maker, fuel nozzle manufacturer, and other representatives are considering revisions to SAE standard J285 "Gasoline Dispenser Nozzle Spouts".

Summary of Comments

Manufacturers requested the standardization of nozzle geometries. GM commented that there is a wide span of air entrainment rates among production nozzles ranging from at least 0.10 to 0.15 gallons of air per gallon of fuel. This has a large effect on vapor generated with a liquid seal system. Manufacturers commented that EPA should standardize nozzle size and shutoff characteristics and, in some fashion, constrain air entrainment from in-use and test fuel nozzles in the final rule. The size and shape of the nozzle spout is important for an effective seal with a mechanical seal system. In addition, manufacturers stated that the nozzles should have specifications for surface roughness and durability and should be checked periodically for burrs and other damage in order to reduce the risk of the sealing mechanism being damaged on the vehicles.

Analysis of Comments

It is important that nozzles used in the design and testing of ORVR-equipped vehicles be similar to those found in use. Should the SAE committee reach consensus on fuel nozzle geometry specifications, EPA will use a nozzle meeting this standard in all refueling emissions compliance testing, if the nozzle manufacturers agree to adopt these specifications for future retail and commercial fuel nozzles and the auto manufacturers design their ORVR systems to accommodate a nozzle with this geometry. If no standard is developed for nozzle geometry or if the above agreements cannot be reached, EPA will use any commercially available nozzle in its testing.

Staff Conclusions/Recommendations

Staff recommends that nozzle geometry standards not be included in this rulemaking.

J. Other Test Procedure Issues

Summary of Issues

Two additional testing issues raised by commenters were 1) supplemental cooling during the additional driving, and 2) optional non-SHED measurement techniques for certification testing.

Summary of Comments

General Motors commented that supplemental cooling would be required during the additional driving following the exhaust test portion of Option B1. This additional cooling would be necessary to prevent fuel tank overheating during this portion of the test. GM stated that they measured a 50°F fuel tank temperature increase for this amount of driving when only a single Hartzell-type fan was used at lab ambient temperatures.

Chrysler requested that optional non-SHED measurement techniques be allowed for certification testing. They suggested a point source measurement at each of the areas on the vehicle where refueling emissions would be expected to be emitted from a vehicle with a failed system (i.e., nozzle/filler neck interface and canister vent). Chrysler stated that the existence of other such areas could be confirmed with a pressure check. In addition, Chrysler stated that the point source measurement systems are considerably less expensive than SHED measurement systems.

Analysis of Comments

Staff believes that additional cooling should be allowed for any of the additional driving for the integrated and non-integrated system refueling tests. The additional driving is meant to allow purging of the canister only and is not intended to challenge the vehicle design's ability to deal with high running loss vapor generation rates (which is measured in the running loss test).

Staff believes that point source measurement could increase the variability of the test by adding the potential of emissions that would be unaccounted for. Although point source measurement might perhaps be a viable option in the future, the staff recommends that SHED measurement only be adopted, because EPA did not propose non-SHED measurement techniques for the refueling test.

Staff Conclusions/Recommendations

EPA staff recommends the allowance of additional cooling during the additional driving. Staff also recommends that SHED measurement only should be used in the final test procedure.