The EPA Administrator signed the following final rule on September 13, 2002. It is being submitted for publication in the *Federal Register*. While EPA has taken steps to ensure the accuracy of this Internet version, it is not the official version of the rule. Please refer to the official version in a forthcoming *Federal Register* publication and on GPO's Web Site. The rule will likely be published in the *Federal Register* by October 11, 2002. You can access the *Federal Register* at: http://www.access.gpo.gov/su_docs/aces/aces140.html. When using this site, note that "text" files may be incomplete because they don't include graphics. Instead, select "Adobe Portable Document File" (PDF) files.

ENVIRONMENTAL PROTECTION AGENCY
40 CFR Parts 89, 90, 91, 94, 1048, 1051, 1065, and 1068
[AMS-FRL-xxxx-x]

RIN 2060-AI11

Control of Emissions from Nonroad Large Spark-ignition Engines, and Recreational Engines (Marine and Land-based)

AGENCY: Environmental Protection Agency (EPA).

ACTION: Final Rule.

SUMMARY: In this action, we are adopting emission standards for several groups of nonroad engines that have not been subject to EPA emission standards. These engines are large spark-ignition engines such as those used in forklifts and airport ground-service equipment; recreational vehicles using spark-ignition engines such as off-highway motorcycles, all-terrain vehicles, and snowmobiles; and recreational marine diesel engines. Nationwide, these engines and vehicles cause or contribute to ozone, carbon-monoxide, and particulate-matter nonattainment, as well as other types of pollution impacting human health and welfare.

We expect that manufacturers will be able to maintain or even improve the performance of their products when producing engines and equipment meeting the new standards. Many engines will substantially reduce their fuel consumption, partially or completely offsetting any costs associated with the emission standards. Overall, the gasoline-equivalent fuel savings associated with the anticipated changes in technology resulting from this rule are estimated to be about 800 million gallons per year once the program is fully phased in. Health and environmental benefits from the controls included in today's rule are estimated to be approximately $8 billion per year once the controls are fully phased in. There are also several provisions to address the unique limitations of small-volume manufacturers.

DATES: This final rule is effective **[insert date 60 days after publication in the Federal Register].**

The incorporation by reference of certain publications listed in this regulation is approved by the Director of the Federal Register as of **[insert date 60 days after publication in the Federal Register]**.

ADDRESSES: Materials relevant to this rulemaking are contained in Public Docket Numbers A-98-01 and A-2000-01 at the following address: EPA Docket Center (EPA/DC), Public Reading Room, Room B102, EPA West Building, 1301 Constitution Avenue, N.W., Washington DC. The EPA Docket Center Public Reading Room is open from 8:30 a.m. to 4:30 p.m., Monday through Friday, except on government holidays. You can reach the Reading Room by telephone at (202) 566-1742, and by facsimile at (202) 566-1741. The telephone number for the Air Docket is (202) 566-1742. You may be charged a reasonable fee for photocopying docket materials, as provided in 40 CFR part 2.

For further information on electronic availability of this action, see "SUPPLEMENTARY INFORMATION" below.

FOR FURTHER INFORMATION CONTACT: U.S. EPA, Office of Transportation and Air Quality, Assessment and Standards Division hotline, (734) 214-4636, asdinfo@epa.gov.

SUPPLEMENTARY INFORMATION:

Regulated Entities

This action will affect companies that manufacture or introduce into commerce any of the engines or vehicles subject to emission standards. These include: spark-ignition industrial engines such as those used in forklifts and compressors; recreational vehicles such as off-highway motorcycles, all-terrain vehicles, and snowmobiles; and recreational marine diesel engines. This action will also affect companies buying engines for installation in nonroad equipment. There are also requirements that apply to those who rebuild any of the affected nonroad engines. Regulated categories and entities include:

Category	NAICS Codes[a]	SIC Codes[b]	Examples of Potentially Regulated Entities
Industry	333618	3519	Manufacturers of new nonroad spark-ignition engines, new marine engines
Industry	333111	3523	Manufacturers of farm equipment
Industry	333112	3531	Manufacturers of construction equipment, recreational marine vessels
Industry	333924	3537	Manufacturers of industrial trucks
Industry	811310	7699	Engine repair and maintenance
Industry	336991	—	Motorcycle manufacturers
Industry	336999	—	Snowmobiles and all-terrain vehicle manufacturers
Industry	421110	—	Independent Commercial Importers of Vehicles and Parts

[a]North American Industry Classification System (NAICS)
[b]Standard Industrial Classification (SIC) system code.

This list is not intended to be exhaustive, but rather provides a guide regarding entities likely to be regulated by this action. To determine whether this action regulates particular activities, you should carefully examine the regulations. You may direct questions regarding the applicability of this action to the person listed in "FOR FURTHER INFORMATION CONTACT."

Obtaining Electronic Copies of the Regulatory Documents

The preamble, regulatory language, Final Regulatory Support Document, and other rule documents are also available electronically from the EPA Internet web site. This service is free of charge, except for any cost incurred for internet connectivity. The electronic version of this final rule is made available on the day of publication on the primary web site listed below. The EPA Office of Transportation and Air Quality also publishes *Federal Register* notices and related documents on the secondary web site listed below.

1. http://www.epa.gov/docs/fedrgstr/EPA-AIR/
   (either select desired date or use Search feature)
2. http://www.epa.gov/otaq/
   (look in What's New or under the specific rulemaking topic)

Please note that due to differences between the software used to develop the documents and the software into which the document may be downloaded, format changes may occur.

Table of Contents

I. Introduction

A. Overview

Emissions from the engines regulated in this rule contribute to serious air-pollution problems, and will continue to do so in the future absent regulation. These air pollution problems include exposure to carbon monoxide (CO), ground-level ozone, and particulate matter (PM), which can cause serious health problems, including premature mortality and respiratory problems. Fine PM has also been associated with cardiovascular problems, such as heart rate variability and changes in fibrinogen (a blood clotting factor) levels, and hospital admissions and mortality related to cardiovascular diseases. These emissions also contribute to other serious environmental problems, including visibility impairment and ecosystem damage. In addition, many of the hydrocarbon (HC) pollutants emitted by these engines are air toxics.

This rule addresses these air-pollution concerns by adopting national emission standards for several types of nonroad engines and vehicles that are currently unregulated. These include large spark-ignition engines used in industrial and commercial applications such as those used in forklifts and airport equipment; recreational spark-ignition vehicles such as off-highway motorcycles, all-terrain vehicles, and snowmobiles; and recreational marine diesel engines.[1] These new standards are a continuation of the process of establishing emission standards for nonroad engines and vehicles, under Clean Air Act section 213(a).

We conducted a study of emissions from nonroad engines, vehicles, and equipment in 1991, as directed by the Clean Air Act, section 213(a) (42 U.S.C. 7547(a)). Based on the results of that study, we determined that emissions of oxides of nitrogen (NOx), volatile organic compounds, and CO from nonroad engines and equipment contribute significantly to ozone and CO concentrations in more than one nonattainment area (59 FR 31306, June 17, 1994). Given this determination, section 213(a)(3) of the Act requires us to establish (and from time to time revise) emission standards for those classes or categories of new nonroad engines, vehicles, and equipment that in our judgment cause or contribute to such air pollution. We have determined that the engines covered by this final rule cause or contribute to such air pollution (see the final finding for recreational vehicles and nonroad spark-ignition engines over 19 kW published on December 7, 2000 (65 FR 76790), the final rule for marine diesel engines published on December 29, 1999 (64 FR 73301)[2], Section II of the preamble to the proposed rule (66 FR 51098, October 5, 2001), this preamble, and the Final Regulatory Support Document).

Where we determine that other emissions from new nonroad engines, vehicles, or equipment significantly contribute to air pollution that may reasonably be anticipated to endanger public health or welfare, section 213(a)(4) of the Act authorizes EPA to establish (and from time to time revise) emission standards from those classes or categories of new nonroad engines, vehicles, and equipment that cause or contribute to such air pollution. Pursuant

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[1]Diesel-cycle engines, referred to simply as "diesel engines" in this document, may also be referred to as compression-ignition (or CI) engines. These engines typically operate on diesel fuel, but other fuels may also be used. Otto-cycle engines (referred to here as spark-ignition or SI engines) typically operate on gasoline, liquefied petroleum gas, or natural gas.

[2]This rule also found that PM emissions from marine diesel engines contribute to PM nonattainment.

to section 213(a)(4) of the Act, we are finalizing a finding that emissions from new nonroad engines, including construction equipment, farm tractors, boats, locomotives, marine engines, nonroad spark-ignition engines over 19 kW, recreational vehicles (including off-highway motorcycles, all-terrain-vehicles, and snowmobiles), significantly contribute to regional haze and visibility impairment in federal Class I areas and where people live, work and recreate. These engines, particularly recreational vehicles such as snowmobiles, are significant emitters of pollutants that are known to impair visibility in federal Class I areas (see Section I.E of this preamble and the Final Regulatory Support Document). We have also determined that engines covered by this final rule, particularly recreational vehicles including snowmobiles, contribute to such pollution. Thus, we are finalizing HC standards for snowmobiles to reduce PM-related visibility impairment.

B. How Is This Document Organized?

This final rule covers engines and vehicles that vary in design and use, and many readers may be interested in only one or two of the applications. We have grouped engines by common application (for example, recreational land-based engines, marine diesel recreational engines, large spark-ignition engines used in commercial applications). This document is organized in a way that allows each reader to focus on the applications of particular interest.

Section II describes general provisions that are relevant to all of the nonroad engines covered by this rulemaking. Section III through VI present information specific to each of the affected nonroad applications, including standards, effective dates, testing information, and other specific requirements.

Sections VII and VIII describe a wide range of compliance and testing provisions that apply generally to engines and vehicles from all the nonroad engine and vehicle categories included in this rulemaking. Several of these provisions apply not only to manufacturers, but also to equipment manufacturers installing certified engines, remanufacturing facilities, operators, and others. Therefore, all affected parties should read the information contained in these sections.

Section IX summarizes the projected impacts and a discussion of the benefits of this rule. Finally, Sections X and XI contain information about public participation and various administrative requirements.

The remainder of this section summarizes the new requirements and the air quality need for the rulemaking.

C. What Categories of Vehicles and Engines are Covered in This Final Rule?

This final rule establishes regulatory programs for new nonroad vehicles and engines not yet subject to EPA emission standards, including the following engines:

- Land-based spark-ignition recreational engines, including those used in snowmobiles, off-highway motorcycles, and all-terrain vehicles. For the purpose of this rule, we are calling this group of engines “recreational vehicles,” even though all-terrain vehicles can be used for commercial purposes.

- Land-based spark-ignition engines rated over 19 kW, including engines used in forklifts, generators, airport baggage tow trucks, and various farm, construction, and industrial equipment. This category also includes auxiliary marine engines, but does not include propulsion marine engines or engines used in recreational vehicles. For purposes of this rule, we refer to this category as “Large SI engines.”
- Recreational marine diesel engines.

This final rule covers new engines that are used in the United States, whether they are made domestically or imported.[3] A more detailed discussion of the meaning of the terms “new” and “imported” that help define the scope of application of this rule is in Section II of this preamble.

D. What Requirements Are We Adopting?

The fundamental requirement for nonroad engines and vehicles is meeting EPA’s emission standards. Section 213(a)(3) of the Act requires that standards to control emissions related to ozone or CO achieve the greatest degree of emission reduction achievable through the application of technology that will be available, giving appropriate consideration to cost, noise, energy, and safety factors. Section 213 (a)(4) of the Act requires that standards for emissions related to other air pollution problems be appropriate and take into account costs, noise, safety, and energy impacts of applying technology that will be available. Other requirements such as applying for certification, labeling engines, and meeting warranty requirements define a process for implementing the program in an effective way.

With regard to Large SI engines, we are adopting a two-phase program. The first phase of the standards go into effect in 2004 and are the same as those adopted in October 1998 by the California Air Resources Board for 2004. These standards will reduce combined HC and NOx emissions by nearly 75 percent, based on emission measurements during steady-state operation. In 2007, we supplement these standards by setting limits that will require optimizing the same technologies and will base emission measurements on a transient test cycle. New requirements for evaporative emissions and engine diagnostics also start in 2007.

For recreational vehicles, we are adopting separate emission standards for snowmobiles, off-highway motorcycles, and all-terrain vehicles. For snowmobiles, we are adopting a first phase of standards for HC and CO emissions based on a mixture of technologies ranging from clean carburetion and engine modifications to direct fuel injection two-stroke technology and some conversion to four-stroke engines, and second and third phases of emission standards for snowmobiles that will involve significant use of direct fuel injection two-stroke technology and conversion to four-stroke engines. For off highway motorcycles and all-terrain vehicles, we are adopting standards based mainly on moving these engines from two-stroke to four-stroke technology with the use of some secondary air injection. We are also adopting requirements to address permeation emissions from all three types of recreational vehicles.

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[3]For this final rule, we consider the United States to include the States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, Guam, American Samoa, the U.S. Virgin Islands, and the Trust Territory of the Pacific Islands.

The emission standards for recreational marine diesel engines are comparable to those already established for commercial marine diesel engines. Manufacturers generally have additional time to meet emission standards for the recreational models and several specific rulemaking provisions are tailored to the unique characteristics of these engines.

We are also adopting more stringent voluntary Blue Sky Series emission standards for recreational marine diesel engines and Large SI engines. Blue Sky Series emission standards are more stringent than the mandatory emission standards and are intended to encourage the introduction and more widespread use of low-emission technologies. Manufacturers may be motivated to exceed emission requirements either to gain early experience with certain technologies or as a response to market demand or local government programs. For recreational vehicles, we are not adopting voluntary standards but rather providing consumers with consumer labeling, which will provide information and opportunity to buy lower-emissions models.

We have also conducted extensive analysis on the costs and benefits of this rulemaking effort, with specific details found in Section IX below and in the Final Regulatory Support Document. In summary, we estimate that annually, the cost to manufacturers is approximately $210 million, the social gain is approximately $550 million, and the quantified benefits are approximately $8 billion. Social gain is defined as the economic cost of the rule minus the estimated fuels savings. Quantified benefits reflect the health benefits primarily associated with particulate matter controls.

E. Why Is EPA Taking This Action?

There are important public health and welfare reasons supporting the new emission standards. As described below and in the Final Regulatory Support Document, these engines contribute to air pollution that causes public health and welfare problems.

Nationwide, these engines and vehicles are a significant source of mobile source air pollution. As described below, of all mobile source emissions in 2000 they accounted for about 9 percent of HC emissions, 4 percent of CO emissions, 3 percent of NOx emissions, and 2 percent of direct PM emissions. The emissions from Large SI engines contributed 2 to 3 percent of the HC, NOx, and CO emissions from mobile sources in 2000. Recreational vehicles by themselves account for about 6 percent of national mobile source HC emissions and about 2 percent of national mobile source CO emissions. By reducing these emissions, the standards will aid states facing ozone and CO air quality problems, which can cause a range of adverse health effects, especially in terms of respiratory disease and related illnesses. The engine categories subject to this rule contribute to regional haze and visibility impairment in Class I areas and near where people live, work and recreate. Within national parks, emissions from snowmobiles in particular contribute to ambient concentrations of fine PM, a leading cause of visibility impairment. States are required to develop plans to address visibility impairment in national parks, and the reductions required in this rule would assist states in those efforts.

The standards will also help reduce acute exposure to CO and air toxics for forklift operators, equipment users or riders, national and state park attendants, and other people who may be at particular risk because they operate or work or are otherwise in close proximity to this equipment due to their occupation or as riders. Emissions from these vehicles and equipment can be very high on a per-engine basis. In addition, the equipment using these engines (especially forklifts) is often operated in enclosed areas. Similarly, exposure to CO and air toxics can be intensified for snowmobile riders who follow a group of other rides along a trail, since those riders are exposed to the emissions of all the other snowmobiles riding ahead.

When the emission standards are fully implemented in 2030, we expect a 75-percent reduction in HC emissions, 82-percent reduction in NOx emissions, and 61-percent reduction in CO emissions, and a 60-percent reduction in direct PM emissions from these engines, equipment, and vehicles (see Section IX below). These emission reductions will reduce ambient concentrations of CO, ozone, and PM fine; fine particles are a public health concern and contributes to visibility impairment. The standards will also reduce exposure for people who operate or who work with or are otherwise in close proximity to these engines and vehicles.

We believe technology can be applied to these engines that will reduce emissions of these harmful pollutants. Manufacturers can reduce two-stroke engine emissions by improving fuel management and calibration. This can be achieved by making improvements to carbureted fuel systems and/or converting to electronic and direct fuel injection. In addition, many of the existing two-stroke engines in these categories can be converted to four-stroke technology. Finally, there are modifications that can be made to four-stroke engines, often short of requiring catalysts, that can reduce emissions even further.

1. Health and welfare effects

Exposure to CO, ground-level ozone, and PM can cause serious respiratory problems, including premature mortality and respiratory problems. Fine PM has also been associated with cardiovascular problems, such as heart rate variability and fibrinogen (a blood clotting factor) levels, and hospital admissions and mortality related to cardiovascular diseases. These emissions also contribute to other serious environmental problems, including visibility impairment and ecosystem damage. In addition, some of the HC pollutants emitted by these engines are air toxics. (The health and welfare effects are described in more detail in the Final Regulatory Support Document.)

CO enters the bloodstream through the lungs and reduces the delivery of oxygen to the body's organs and tissues. The health threat from CO is most serious for those who suffer from cardiovascular disease, particularly those with angina or peripheral vascular disease. Healthy individuals also are affected, but only at higher CO levels. Exposure to elevated CO levels is associated with impairment of visual perception, work capacity, manual dexterity, learning ability and performance of complex tasks.

Exposures to ozone has been linked to increased hospital admissions and emergency room visits for respiratory problems.[4] Repeated exposure to ozone can increase susceptibility to respiratory infection and lung inflammation. It can aggravate preexisting respiratory diseases, such as asthma. Prolonged (6 to 8 hours), repeated exposure to ozone can cause inflammation of the lung, impairment of lung defense mechanisms, and possibly

[4]U.S. EPA Review of the National Ambient Air Quality Standards for Ozone: Policy Assessment of Scientific and Technical Information OAQPS Staff Paper. EPA -452/R-96-007. June 1996. A copy of this document can be found in Docket A-99-06, Document II-A-22.

irreversible changes in lung structure, which over time could lead to premature aging of the lungs and/or chronic respiratory illnesses such as emphysema and chronic bronchitis. Children, the elderly, asthmatics and outdoor workers are most at risk from ozone exposure. Evidence also exists of a possible relationship between daily increases in ozone levels and increases in daily mortality levels. In addition to human health effects, ozone adversely affects crop yield, vegetation and forest growth, and the durability of materials.

PM, like ozone, has been linked to a range of serious respiratory health problems.[5] The key health effects associated with ambient particulate matter include premature mortality, aggravation of respiratory and cardiovascular disease (as indicated by increased hospital admissions and emergency room visits, school absences, work loss days, and restricted activity days), aggravated asthma, acute respiratory symptoms, including aggravated coughing and difficult or painful breathing, chronic bronchitis, and decreased lung function that can be experienced as shortness of breath. Observable human non-cancer health effects associated with exposure to diesel PM include some of the same health effects reported for ambient PM such as respiratory symptoms (cough, labored breathing, chest tightness, wheezing), and chronic respiratory disease (cough, phlegm, chronic bronchitis and suggestive evidence for decreases in pulmonary function). Symptoms of immunological effects such as wheezing and increased allergenicity are also seen.

PM also causes adverse impacts to the environment. Fine PM is the major cause of reduced visibility in parts of the United States, including many of our national parks and in places where people live and work. Visibility effects are manifest in two principal ways: (1) as local impairment (for example, localized hazes and plumes) and (2) as regional haze. The emissions from engines covered by this rule can contribute to both types of visibility impairment.

The engines covered by this rule also emit air toxics that are known or suspected human or animal carcinogens, or have serious non-cancer health effects. These include benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein.

2. What Is the Inventory Contribution From the Nonroad Engines and Vehicles That Would Be Subject to This Rule?

The contribution of emissions from the nonroad engines and vehicles that will be subject to this final rule to the national inventories of pollutants is considerable. To estimate nonroad engine and vehicle emission contributions, we used the latest version of our NONROAD emissions model, updated with information received during the public comment period. This model computes nationwide, state, and county emission levels for a wide variety of nonroad engines, and uses information on emission rates, operating data, and population to determine

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[5] U.S. EPA Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information OAQPS Staff Paper. EPA-452/R-96-013. 1996. Docket Number A-99-06, Documents Nos. II-A-18, 19, 20, and 23. The particulate matter air quality criteria documents are also available at http://www.epa.gov/ncea/partmatt.htm.

annual emission levels of various pollutants. A more detailed description of the model and our estimation methodology can be found in the Chapter 6 of the Final Regulatory Support Document.

Baseline emission inventory estimates for the year 2000 for the categories of engines and vehicles covered by this rule are summarized in Table I.E-1. This table shows the relative contributions of the different mobile source categories to the overall national mobile source inventory. Of the total emissions from mobile sources, the categories of engines and vehicles covered by this rule contribute about 9 percent, 3 percent, 4 percent, and 2 percent of HC, NOx, CO, and PM emissions, respectively, in the year 2000. The results for Large SI engines indicate they contribute approximately 2 to 3 percent to HC, NOx, and CO emissions from mobile sources. The results for land-based recreational engines reflect the impact of the significantly different emissions characteristics of two-stroke engines. These engines are estimated to contribute about 6 percent of HC emissions and 2 percent of CO from mobile sources. Recreational marine diesel engines contribute less than 1 percent to NOx mobile source inventories. When only nonroad emissions are considered, the engines and vehicles that will be subject to the standards account for a larger share.

Our draft emission projections for 2020 and 2030 for the nonroad engines and vehicles subject to this rule show that emissions from these categories are expected to increase over time if left uncontrolled. The projections for 2020 and 2030 are summarized in Tables I.E-2 and I.E-3, respectively. The projections for 2020 and 2030 indicate that the categories of engines and vehicles covered by this rule are expected to contribute approximately 25 percent, 10 percent, 5 percent, and 5 percent of mobile source HC, NOx, CO, and PM emissions, respectively, if left uncontrolled. Engine population growth and the effects of other regulatory control programs are factored into these projections. The relative importance of uncontrolled nonroad engines in 2020 and 2030 is higher than the projections for 2000 because there are already emission-control programs in place for the other categories of mobile sources which are expected to reduce their emission levels. The effectiveness of all control programs is offset by the anticipated growth in engine populations.

Regarding PM specifically, this information and information in Section I.3(ii) below show that the engines being regulated in this rule, snowmobiles and other recreational vehicles in particular, contribute to PM concentrations that may reasonably be anticipated to endanger public health and welfare both because of the health effects associated with PM and because of the effects on visibility discussed below.

Table I.E-1
Modeled Annual Emission Levels for
Mobile source Categories in 2000 (thousand short tons)

Category	NOx		HC		CO		PM	
	1000 tons	percent of mobile source	1000 tons	percent of mobile source	1000 tons	percent of mobile source	1000 tons	percent of mobile source
Total for engines subject to this final rule*	**351**	**2.6%**	**645**	**8.8%**	**2,860**	**3.8%**	**14.6**	**2.1%**
Highway Motorcycles	8	0.1%	84	1.2%	331	0.4%	0.4	0.1%
Nonroad Industrial SI > 19 kW*	308	2.3%	226	3.1%	1,734	2.3%	1.6	0.2%
Recreational SI*	5	0.0%	418	5.7%	1,120	1.5%	12.0	1.7%
Recreational Marine Diesel*	38	0.3%	1	0.0%	6	0.0%	1	0.1%
Marine SI Evap	0	0.0%	100	1.4%	0	0.0%	0	0.0%
Marine SI Exhaust	32	0.2%	708	9.7%	2,144	2.8%	38	5.4%
Nonroad SI < 19 kW	106	0.8%	1,460	20.0%	18,359	24.3%	50	7.1%
Nonroad diesel	2,625	19.5%	316	4.3%	1,217	1.6%	253	35.9%
Commercial Marine Diesel	963	7.2%	30	0.4%	127	0.2%	41	5.8%
Locomotive	1,192	8.9%	47	0.6%	119	0.2%	30	4.3%
Total Nonroad	5,269	39%	3,305	45%	24,826	33%	427	60%
Total Highway	7,981	59%	3,811	52%	49,813	66%	240	34%
Aircraft	178	1%	183	3%	1,017	1%	39	6%
Total Mobile Sources	13,428	100%	7,300	100%	75,656	100%	706	100%
Total Man-Made Sources	24,532	—	18,246	—	97,735	—	3,102	—
Mobile Source percent of Total Man-Made Sources	55%	—	40%	—	77%	—	23%	–

Table I.E-2
Modeled Annual Baseline Emission Levels for
Mobile source Categories in 2020 (thousand short tons)

Category	NOx		HC		CO		PM	
	1000 tons	percent of mobile source	1000 tons	percent of mobile source	1000 tons	percent of mobile source	1000 tons	percent of mobile source
Total for engines subject to this final rule*	**547**	**8.8%**	**1,305**	**24.1%**	**4,866**	**5.6%**	**34.1**	**5.2%**
Highway Motorcycles	14	0.2%	142	2.6%	572	0.7%	0.8	0.1%
Nonroad Industrial SI > 19 kW*	472	7.6%	318	5.9%	2,336	2.7%	2.3	0.4%
Recreational SI*	14	0.2%	985	18.2%	2,521	2.9%	30.2	4.6%
Recreational Marine Diesel*	61	1.0%	2	0.0%	9	0.0%	1.6	0.2%
Marine SI Evap	0	0.0%	114	2.1%	0	0.0%	0	0.0%
Marine SI Exhaust	58	0.9%	284	5.2%	1,985	2.3%	28	4.3%
Nonroad SI < 19 kW	106	1.7%	986	18.2%	27,352	31.7%	77	11.8%
Nonroad Diesel	1,791	28.8%	142	2.6%	1,462	1.7%	261	40.0%
Commercial Marine Diesel	819	13.2%	35	0.6%	160	0.2%	46	7.0%
Locomotive	611	9.8%	35	0.6%	119	0.1%	21	3.2%
Total Nonroad	3,932	63%	2,901	54%	35,944	42%	467	71%
Total Highway	2,050	33%	2,276	42%	48,906	56%	145	22%
Aircraft	232	4%	238	4%	1,387	2%	43	7%
Total Mobile Sources	6,214	100%	5,415	100%	86,237	100%	655	100%
Total Man-Made Sources	16,190	—	15,475	—	109,905	—	3,039	—
Mobile Source percent of Total Man-Made Sources	38%	—	35%	—	79%	—	22%	–

Table I.E-3
Modeled Annual Emission Levels for
Mobile source Categories in 2030 (thousand short tons)

Category	NOx		HC		CO		PM	
	1000 tons	percent of mobile source	1000 tons	percent of mobile source	1000 tons	percent of mobile source	1000 tons	percent of mobile source
Total for engines subject to this final rule*	**640**	**10.0%**	**1,411**	**23.5%**	**5,363**	**5.4%**	**36.5**	**4.8%**
Highway Motorcycles	17	0.3%	172	2.9%	693	0.7%	1.0	0.1%
Nonroad Industrial SI > 19 kW*	553	8.6%	371	6.2%	2,703	2.7%	2.7	0.4%
Recreational SI*	15	0.2%	1,038	17.3%	2,649	2.7%	31.9	4.2%
Recreational Marine Diesel*	72	1.1%	2	0.0%	11	0.0%	1.9	0.3%
Marine SI Evap	0	0.0%	122	2.0%	0	0.0%	0	0.0%
Marine SI Exhaust	64	1.0%	269	4.5%	2,083	2.1%	29	3.8%
Nonroad SI < 19 kW	126	2.0%	1,200	20.0%	32,310	32.4%	93	12.3%
Nonroad Diesel	1,994	31.0%	158	2.6%	1,727	1.7%	306	40.4%
Commercial Marine Diesel	1,166	18.1%	52	0.9%	198	0.2%	74	9.8%
Locomotive	531	8.3%	30	0.5%	119	0.1%	18	2.4%
Total Nonroad	4,521	70%	3,242	54%	41,800	42%	557	74%
Total Highway	1,648	26%	2,496	42%	56,303	56%	158	21%
Aircraft	262	4%	262	4%	1,502	2%	43	6%
Total Mobile Sources	6,431	100%	6,000	100%	99,605	100%	758	100%
Total Man-Made Sources	16,639	—	17,020	—	123,983	—	3,319	—
Mobile Source percent of Total Man-Made Sources	39%	—	35%	—	80%	—	23%	–

3. Why are Controls to Protect against CO Nonattainment and to Protect Visibility Needed From the Nonroad Engines and Vehicles That Would Be Subject to This Rule?

i. Why are We Controlling CO Emissions from Nonroad Engines and Vehicles that Would be Subject to this Rule?

Engines subject to this rule contributed about 3.8 percent of CO from mobile sources in 2000. Over 22.4 million people currently live in the 13 nonattainment areas for the CO National Ambient Air Quality Standard (NAAQS). Industry association comments questioned the need for CO control and snowmobile contribution, in particular. First, the statute envisions that categories should be considered in determining contribution because otherwise, it would be possible to continue to arbitrarily divide subcategories until the contribution from any subcategory becomes minimal while the cumulative effect of the air pollution remains. EPA previously determined that the category of Large SI engines and recreational vehicles cause or contribute to ambient CO and ozone in more than one nonattainment area (65 FR 76790, December 7, 2000). EPA also examined recreational vehicles separately and found that recreational vehicles subject to this rule contribute to CO nonattainment in areas such as Los Angeles, Phoenix, Anchorage, and Las Vegas (see RSD chapter 2). Thus, if considered as a category, recreational vehicles contribute to CO nonattainment.[6] Moreover, when we examined snowmobiles separately, they met the contribution criteria.

The International Snowmobile Manufacturers Association (ISMA) stated in its public comments that snowmobiles in particular are not operated in many of the CO nonattainment areas because of lack of snow (although they may be stored in those areas). The commenters also contended that northern areas have experienced improved CO air quality. Many areas are making progress in improving their air quality. However, an area cannot be redesignated to attainment until it can show EPA that it has had air quality levels within the level required for attainment and that it has a plan in place to maintain such levels. Until areas have been redesignated, they remain nonattainment areas.[7] Snowmobiles contribute to CO nonattainment in more than one of these areas.

Snowmobiles have relatively high per-engine CO emissions, and they can be a significant source of ambient CO levels in CO nonattainment areas. Despite the fact that snowmobiles are largely banned in CO nonattainment areas by the state of Alaska, the state estimated (and a National Research Council study confirmed) that snowmobiles contributed 0.3 tons/day in 2001 to Fairbanks' CO nonattainment area or 1.2 percent of a total inventory of 23.3 tons

[6] Likewise, Large SI equipment and recreational marine diesel engines also contribute to CO in nonattainment areas.

[7] There are important reasons to focus on redsignation status, as compared to just current air quality. Areas with a few years of attainment data can and often do have exceedances following such years of attainment because of several factors including different climatic events during the later years, increases in inventories, etc. Control of emissions from nonroad engines can help to avoid potential future air quality problems.

per day in 2001.[8, 9] While Fairbanks has made significant progress in reducing ambient CO concentrations, existing climate conditions make achieving and maintaining attainment challenging. Anchorage, AK, reports a similar contribution of snowmobiles to their emissions inventories (0.34 tons per day in 2000). Furthermore, a recent National Academy of Sciences report concludes that "Fairbanks will be susceptible to violating the CO health standards for many years because of its severe meteorological conditions. That point is underscored by a December 2001 exceedance of the standard in Anchorage which had no violations over the last 3 years."[10]

ISMA commented that it agreed with EPA that there is a snowmobile trail within the Spokane, WA, CO nonattainment area, although they noted that snowmobile operation alone would not result in CO nonattainment. However, emissions from regulated categories need only contribute to, not themselves cause, nonattainment. Concentrations of NAAQS-related pollutants are by definition a result of multiple sources of pollution.

Several states that contain CO nonattainment areas also have large populations of registered snowmobiles and nearby snowmobile trails in adjoining counties, which are an indication of where they are operated (see Table I.E-4). EPA requested comment on the volume and nature of snowmobile use in these and other CO nonattainment areas. ISMA commented on the proximity of trails to northern CO nonattainment areas, assuming that snowmobiles are operated only on trails. A search of the available literature indicates that snowmobiles are ridden in areas other than trails. For example, a 1998 report by the Michigan Department of Natural Resources indicates that from 1993 to 1997, of the 146 snowmobile fatalities studied, 46 percent occurred on a state or county roadway (another 2 percent on roadway shoulders) and 27 percent occurred on private lands. Furthermore, accident reports in CO nonattainment area Fairbanks, AK, demonstrate that snowmobiles driven on streets have collided with motor vehicles. On certain days there may be concentrations of snowmobiles operated in nonattainment areas due to public events such as snowmachine races (such as the Iron Dog Gold Rush Classic, which finishes in Fairbanks, AK), during which snowmobiles will be present and operated.

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[8] Draft Anchorage Carbon Monoxide Emission Inventory and Year 2000 Attainment Projections, Air Quality Program, May 2001, Docket Number A-2000-01, Document II-A-40; Draft Fairbanks 1995-2001 Carbon Monoxide Emissions Inventory, June 1, 2001, Docket Number A-2000-01, Document II-A-39.

[9]National Research Council. The Ongoing Challenge of Managing Carbon Monoxide Pollution in Fairbanks, AK. May 2002. Docket A-2000-01, Document No. IV-A-115.

[10]National Research Council. The Ongoing Challenge of Managing Carbon Monoxide Pollution in Fairbanks, AK. May 2002. Docket A-2000-01, Document IV-A-115.

Table I.E-4

Snowmobile Use in Selected CO Nonattainment Areas

City and State	CO Nonattainment Classification	2001 State snowmobile population[a]
Anchorage, AK	Serious	35576[b]
Fairbanks, AK		
Spokane, WA	Serious	31532
Fort Collins, CO	Moderate	32500
Medford, OR	Moderate	16809
Missoula, MT	Moderate	23440

[a]Source: ISMA US Snowmobile Registration History, May 15, 2001; various studies prepared for state snowmobile associations included in Docket A-2000-01.

[b]Point of sale registration was not mandatory in Alaska prior to 1998, so the statewide registered population is likely to underestimate the total population.

Exceedances of the 8-hour CO standard were recorded in three of seven CO nonattainment areas located in the northern portion of the country over the five year period from 1994 to 1999: Fairbanks, AK; Medford, OR; and Spokane, WA.[11] Given the variability in CO ambient concentrations due to weather patterns such as inversions, the absence of recent exceedances for some of these nonattainment areas should not be viewed as eliminating the need for further reductions to consistently attain and maintain the standard. A review of CO monitor data in Fairbanks from 1986 to 1995 shows that while median concentrations have declined steadily, unusual combinations of weather and emissions have resulted in elevated ambient CO concentrations well above the 8-hour standard of 9 ppm. Specifically, a Fairbanks monitor recorded average 8-hour ambient concentrations at 16 ppm in 1988, around 9 ppm from 1990 to 1992, and then a steady increase in CO ambient concentrations at 12, 14 and 16 ppm during some extreme cases in 1993, 1994 and 1995, respectively.[12]

In addition, there are 6 areas that have not been classified as nonattainment where air quality monitoring indicated a need for CO control. For example, CO monitors in northern locations such as Des Moines, IA, and Weirton, WV/Steubenville, OH, registered levels above the level of the CO standards in 1998.

ii. Why are Controls Needed From the Nonroad Engines and Vehicles That Would Be Subject to this Rule to Protect Visibility?

[11] Technical Memorandum to Docket A-2000-01 from Drew Kodjak, Attorney-Advisor, Office of Transportation and Air Quality, "Air Quality Information for Selected CO Nonattainment Areas," July 27, 2001, Docket Number A-2000-01, Document Number II-B-18.

[12] Air Quality Criteria for Carbon Monoxide, US EPA, EPA 600/P-99/001F, June 2000, at 3-38, Figure 3-32 (Federal Bldg, AIRS Site 020900002). Air Docket A-2000-01, Document Number II-A-29. This document is also available at http://www.epa.gov/ncea/coabstract.htm.

(1) Visibility is Impaired by Fine PM and Precursor Emissions From Nonroad Engines and Vehicles That Would Be Subject to This Rule

Visibility can be defined as the degree to which the atmosphere is transparent to visible light.[13] Visibility degradation is an easily noticeable effect of fine PM present in the atmosphere, and fine PM is the major cause of reduced visibility in parts of the United States, including many of our national parks and in places across the country where people live, work, and recreate. Fine particles with significant light-extinction efficiencies include organic matter, sulfates, nitrates, elemental carbon (soot), and soil.

Visibility is an important effect because it has direct significance to people's enjoyment of daily activities in all parts of the country. Individuals value good visibility for the well-being it provides them directly, both in where they live and work, and in places where they enjoy recreational opportunities. Visibility is highly valued in significant natural areas such as national parks and wilderness areas, because of the special emphasis given to protecting these lands now and for future generations.

To quantify changes in visibility, we compute a light-extinction coefficient, which shows the total fraction of light that is decreased per unit distance. Visibility can be described in terms of PM concentrations, visual range, light extinction or deciview.[14] In addition to limiting the distance that one can see, the scattering and absorption of light caused by air pollution can also degrade the color, clarity, and contrast of scenes.

Visibility effects are manifest in two main ways: as local impairment (for example, localized hazes and plumes) and as regional haze. In addition, visibility impairment has a time dimension in that it might relate to a short-term excursion or to longer periods (for example, worst 20 percent of days or annual average levels).

Local-scale visibility degradation is commonly seen as a plume resulting from the emissions of a specific source or small group of sources, or it is in the form of a localized haze such as an urban "brown cloud." Plumes are comprised of smoke, dust, or colored gas that obscure the sky or horizon relatively near sources. Impairment caused by a specific source or small group of sources has been generally termed as "reasonably attributable."

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[13] National Research Council, 1993. Protecting Visibility in National Parks and Wilderness Areas. National Academy of Sciences Committee on Haze in National Parks and Wilderness Areas. National Academy Press, Washington, DC. This document is available on the internet at http://www.nap.edu/books/0309048443/html/. See also U.S. EPA Air Quality Criteria Document for Particulate Matter (1996) and Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information. These documents can be found in Docket A-99-06, Documents No. II-A-23 and IV-A-130-32.

[14] Visual range can be defined as the maximum distance at which one can identify a black object against the horizon sky. It is typically described in miles or kilometers. Light extinction is the sum of light scattering and absorption by particles and gases in the atmosphere. It is typically expressed in terms of inverse megameters (Mm^{-1}), with larger values representing worse visibility. The deciview metric describes perceived visual changes in a linear fashion over its entire range, analogous to the decibel scale for sound. A deciview of 0 represents pristine conditions. Under many scenic conditions, a change of 1 deciview is considered perceptible by the average person.

The second type of impairment, regional haze, results from pollutant emissions from a multitude of sources located across a broad geographic region. It impairs visibility in every direction over a large area, in some cases over multi-state regions. Regional haze masks objects on the horizon and reduces the contrast of nearby objects. The formation, extent, and intensity of regional haze is a function of meteorological and chemical processes, which sometimes cause fine particulate loadings to remain suspended in the atmosphere for several days and to be transported hundreds of kilometers from their sources.

On an annual average basis, the concentrations of non-anthropogenic fine PM are generally small when compared with concentrations of fine particles from anthropogenic sources. Anthropogenic contributions account for about one-third of the average extinction coefficient in the rural West and more than 80 percent in the rural East. Because of significant differences related to visibility conditions in the eastern and western U.S., we present information about visibility by region. Furthermore, it is important to note that even in those areas with relatively low concentrations of anthropogenic fine particles, such as the Colorado plateau, small increases in anthropogenic fine particle concentrations can lead to significant decreases in visual range. This is one of the reasons Class I areas have been given special consideration under the Clean Air Act.

Nonroad engines that are subject to this final rule contribute to ambient fine PM levels in two ways. First, they contribute through direct emissions of fine PM. As shown in Table I.E-1, these engines emitted 14,600 tons of PM (over 2 percent of all mobile source PM) in 2000. Second, these engines contribute to indirect formation of PM through their emissions of gaseous precursors which are then transformed in the atmosphere into particles. For example, these engines emitted over 8 percent of the HC tons from mobile sources. Furthermore, recreational vehicles, such as snowmobiles and all-terrain vehicles emit high levels of organic carbon (as HC) on a per-engine basis. Some organic emissions are transformed into particles in the atmosphere and other volatile organics can condense if emitted in cold temperatures, as is the case for emissions from snowmobiles, for example. Organic carbon accounts for between 27 and 36 percent of ambient fine particle mass depending on the area of the country.

(A) Visibility Impairment Where People Live, Work and Recreate

The secondary PM NAAQS is designed to protect against adverse welfare effects such as visibility impairment. In 1997, the secondary PM NAAQS was set as equal to the primary (health-based) PM NAAQS (62 Federal Register No. 138, July 18, 1997). EPA concluded that PM can and does produce adverse effects on visibility in various locations, depending on PM concentrations and factors such as chemical composition and average relative humidity. In 1997, EPA demonstrated that visibility impairment is an important effect on public welfare and that visibility impairment is experienced throughout the U.S., in multi-state regions, urban areas, and remote Federal Class I areas.

In many cities having annual mean PM2.5 concentrations exceeding 17 ug/m^3, improvements in annual average visibility resulting from the attainment of the annual PM2.5 standard are expected to be perceptible to the general population (e.g., to exceed 1 deciview). Based on annual mean monitored PM2.5 data, many cities in the Northeast, Midwest, and Southeast as well as Los Angeles would be expected to experience perceptible improvements in visibility if the PM2.5 annual standard were attained. For example, in Washington, DC, where the IMPROVE monitoring network shows annual mean PM2.5 concentrations at about 19 ug/m^3 during the period of

1992 to 1995, approximate annual average visibility would be expected to improve from 21 km (29 deciview) to 27 km (27 deciview), a change of 2 deciviews. The PM2.5 annual average in Washington, DC, was 18.9 ug/m^3 in 2000.

The updated monitored data and air quality modeling presented in the RSD confirm that the visibility situation identified during the NAAQS review in 1997 is still likely to exist. Thus, the determination in the NAAQS rulemaking about broad visibility impairment and related benefits from NAAQS compliance are still relevant. Levels above the fine PM NAAQS cause adverse welfare impacts, such as visibility impairment (both regional and localized impairment).

Furthermore, in setting the PM NAAQS, EPA acknowledged that levels of fine particles below the NAAQS may also contribute to unacceptable visibility impairment and regional haze problems in some areas, and Clean Air Act Section 169 provides additional authorities to remedy existing impairment and prevent future impairment in the 156 national parks, forests and wilderness areas labeled as Class I areas.

In making determinations about the level of protection afforded by the secondary PM NAAQS, EPA considered how the Section 169 regional haze program and the secondary NAAQS would function together. Regional strategies are expected to improve visibility in many urban and non-Class I areas as well. The following recommendation for the National Research Council, Protecting Visibility in National Parks and Wilderness Areas (1993), addresses this point:

Efforts to improve visibility in Class I areas also would benefit visibility outside these areas. Because most visibility impairment is regional in scale, the same haze that degrades visibility within or looking out from a national park also degrade visibility outside it.

The 1999-2000 $PM_{2.5}$ monitored values, which cover about a third of the nation's counties, indicate that at least 82 million people live in areas where long-term ambient fine particulate matter levels are at or above 15 μg/m^3.[15] Thus, these populations (plus those who travel to those areas) could be experiencing visibility impairment that is unacceptable, and emissions of PM and its precursors from engines in these categories contribute to this unacceptable impairment.[16]

Because the chemical composition of the PM affects visibility impairment, we used EPA's Regulatory Model System for Aerosols and Deposition (REMSAD)[17] model to project visibility conditions in 2030 accounting

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[15]Memorandum to Docket A-99-06 from Eric O. Ginsburg, Senior Program Advisor, "Summary of 1999 Ambient Concentrations of Fine Particulate Matter," November 15, 2000. Air Docket A-2000-01, Document No. II-B-12.

[16]These populations would obviously also be exposed to PM concentrations associated with the adverse health impacts related to PM2.5.

[17]Additional information about the Regulatory Model System for Aerosols and Deposition (REMSAD) and our modeling protocols can be found in our Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, document EPA420-R-00-026, December 2000. Docket No. A-2000-01, Document No. A-II-13. This document is also available at http://www.epa.gov/otaq/disel.htm#documents.

for the chemical composition of the particles and to estimate visibility impairment directly as changes in deciview. Our projections included anticipated emissions from the engines subject to this rule, and although our emission predictions reflected our best estimates of emissions projections at the time the modeling was conducted, we now have new estimates, as discussed in the RSD Chapter 1. Based on public comment for this rule and new information, we have revised our emissions estimates in some categories downwards and other categories upwards; however, on net, we believe the modeling underestimates the PM air quality levels that would have been predicted if new inventories were used.

The most reliable information about the future visibility levels would be in areas for which monitoring data are available to evaluate model performance for a base year (e.g., 1996). Accordingly, we predicted that in 2030, 49 percent of the population will be living in areas where fine PM levels are above 15 $\mu g/m^3$ and monitors are available.[18] This can be compared with the 1996 level of 37 percent of the population living in areas where fine PM levels are above 15 $\mu g/m^3$ and monitors are available. Thus, a substantial percent of the population would experience unacceptable visibility impairment in areas where they live, work and recreate.

As shown in Table I.E-5, in 2030, we expect visibility in the East to be about 19 deciviews (or visual range of 60 kilometers) on average, with poorer visibility in urban areas, compared to the visibility conditions without man-made pollution of 9.5 deciviews (or visual range of 150 kilometers). Likewise, we expect visibility in the West to be about 9.5 deciviews (or visual range of 150 kilometers) in 2030, compared to the visibility conditions without man-made pollution of 5.3 deciviews (or visual range of 230 kilometers).

Nonroad engines contribute significantly to these effects. As shown in Tables I.E-1 through I.E-3, nonroad engines emissions contribute a large portion of the total PM emissions from mobile sources and anthropogenic sources, in general. These emissions occur in and around areas with PM levels above the annual PM2.5 NAAQS. The engines subject to the final rule will contribute to these effects. They are estimated to emit 36,500 tons of direct PM in 2030, which is 1.1 percent of the total anthropogenic PM emissions in 2030. Similarly, for PM precursors, the engines subject to this rule will emit 640,000 tons of NOx and 1,411,000 tons HC in 2030, which are 3.8 and 8.3 percent of the total anthropogenic NOx and HC emissions, respectively, in 2030. Recreational vehicles in particular contribute to these levels. In Table I.E-1 through I.E-3, we show that recreational vehicles emitted about 1.7 percent of mobile source PM emissions in 2000. Similarly, recreational vehicles are modeled to emit over 4 percent of mobile source PM in 2020 and 2030. Thus, the emissions from these sources contribute to the visibility impairment modeled for 2030 summarized in the table.

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[18] Technical Memorandum, EPA Air Docket A-99-06, Eric O. Ginsburg, Senior Program Advisor, Emissions Monitoring and Analysis Division, OAQPS, Summary of Absolute Modeled and Model-Adjusted Estimates of Fine Particulate Matter for Selected Years, December 6, 2000, Table P-2. Docket Number 2000-01, Document Number II-B-14.

Furthermore, for 20 counties across nine states, snowmobile trails are found within or near counties that registered ambient $PM_{2.5}$ concentrations at or above 15 μg/m^3, the level of the $PM_{2.5}$ NAAQS.[19] Fine particles may remain suspended for days or weeks and travel hundreds to thousands of kilometers, and thus fine particles emitted or created in one county may contribute to ambient concentrations in a neighboring county.[20,21]

Table I.E-5
Summary of 2030 National Visibility Conditions
Based on REMSAD Modeling (Deciviews)

Regions[a]	**Predicted 2030 Visibility**[b] **(annual average)**	**Natural Background Visibility**
Eastern U.S.	18.98	**9.5**
Urban	20.48	
Rural	18.38	
Western U.S.	9.54	**5.3**
Urban	10.21	
Rural	9.39	

[a] Eastern and Western Regions are separated by 100 degrees north longitude. Background visibility conditions differ by region.
[b] The results incorporate earlier emissions estimates from the engines subject to this rule, as discussed in the Final Regulatory Support Document. We have revised our estimates both upwards for some categories and downwards for others based on public comment and updated information; however, we believe that the net results would underestimate future PM emissions.

B. Visibility Impairment in Class I Areas

The Clean Air Act establishes special goals for improving visibility in many national parks, wilderness areas, and international parks. In the 1977 amendments to the Clean Air Act, Congress set as a national goal for visibility the "prevention of any future, and the remedying of any existing, impairment of visibility in mandatory class I Federal areas which impairment results from manmade air pollution" (CAA section 169A(a)(1)). The Amendments called for EPA to issue regulations requiring States to develop implementation plans that assure "reasonable progress" toward meeting the national goal (CAA Section 169A(a)(4)). EPA issued regulations in 1980

[19] Memo to file from Terence Fitz-Simons, OAQPS, Scott Mathias, OAQPS, Mike Rizzo, Region 5, "Analyses of 1999 PM Data for the PM NAAQS Review," November 17, 2000, with attachment B, 1999 PM2.5 Annual Mean and 98th Percentile 24-Hour Average Concentrations. Docket No. A-2000-01, Document No. II-B-17.

[20] This information also shows that snowmobiles contribute to concentrations of fine PM that are above the primary health-related NAAQS, which indicates that emissions from snowmobiles also contribute to primary and secondary PM pollution that may reasonably be anticipated to endanger public health and welfare.

[21] Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment for Scientific and Technical Information, OAQPS Staff Paper, EPA-452\R-96-013, July, 1996, at IV-7. This document is available from Docket A-99-06, Document II-A-23.

to address visibility problems that are "reasonably attributable" to a single source or small group of sources, but deferred action on regulations related to regional haze, a type of visibility impairment that is caused by the emission of air pollutants by numerous emission sources located across a broad geographic region. At that time, EPA acknowledged that the regulations were only the first phase for addressing visibility impairment. Regulations dealing with regional haze were deferred until improved techniques were developed for monitoring, for air quality modeling, and for understanding the specific pollutants contributing to regional haze.

In the 1990 Clean Air Act amendments, Congress provided additional emphasis on regional haze issues (see CAA section 169B). In 1999 EPA finalized a rule that calls for States to establish goals and emission reduction strategies for improving visibility in all 156 mandatory Class I national parks and wilderness areas. In this rule, EPA established a "natural visibility" goal. In that rule, EPA also encouraged the States to work together in developing and implementing their air quality plans. The regional haze program is focused on long-term emissions decreases from the entire regional emissions inventory comprised of major and minor stationary sources, area sources and mobile sources. The regional haze program is designed to improve visibility and air quality in our most treasured natural areas from these broad sources. At the same time, control strategies designed to improve visibility in the national parks and wilderness areas will improve visibility over broad geographic areas. In the 1997 PM NAAQS rulemaking, EPA also anticipated the need in addition to the NAAQS and Section 169 regional haze program to continue to address localized impairment that may relate to unique circumstances in some Western areas. For mobile sources, there is a need for a Federal role in reduction of those emissions, particularly because mobile source vehicles are regulated primarily at the federal level.

Visibility impairment is caused by pollutants (mostly fine particles and precursor gases) directly emitted to the atmosphere by several activities (such as electric power generation, various industry and manufacturing processes, truck and auto emissions, construction activities, etc.). These gases and particles scatter and absorb light, removing it from the sight path and creating a hazy condition. Visibility impairment is caused by both regional haze and localized impairment. As described above, regional haze is caused by the emission from numerous sources located over a wide geographic area.[22]

Because of evidence that fine particles are frequently transported hundreds of miles, all 50 states, including those that do not have Class I areas, participate in planning, analysis, and, in many cases, emission control programs under the regional haze regulations. Even though a given State may not have any Class I areas, pollution that occurs in that State may contribute to impairment in Class I areas elsewhere. The rule encourages states to work together to determine whether or how much emissions from sources in a given state affect visibility in a downwind Class I area.

The regional haze program calls for states to establish goals for improving visibility in national parks and wilderness areas to improve visibility on the haziest 20 percent of days and to ensure that no degradation occurs on the clearest 20 percent of days (64 FR 35722. July 1, 1999). The rule requires states to develop long-term strategies

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[22]U.S. EPA Review of the National Ambient Air Quality Standards for Particulate Matter: Policy Assessment of Scientific and Technical Information OAQPS Staff Paper. EPA-452/R-96-013. 1996. Docket Number A-99-06, Documents Nos. II-A-18, 19, 20, and 23. The particulate matter air quality criteria documents are also available at http://www.epa.gov/ncea/partmatt.htm.

including enforceable measures designed to meet reasonable progress goals toward natural visibility conditions. Under the regional haze program, States can take credit for improvements in air quality achieved as a result of other Clean Air Act programs, including national mobile source programs.[23]

In the PM air quality modeling described above, we also modeled visibility conditions in the Class I areas, and we summarize the results by region in Table I.E-6.

Table I.E-6

Summary of 2030 Visibility Conditions in Class I Areas Based on REMSAD Modeling (Annual Average Deciview)

Region[a]	Predicted 2030 Visibility[b]	Natural Background Visibility
Eastern		9.5
Southeast	25.02	
Northeast/Midwest	21.00	
Western		5.3
Southwest	8.69	
California	11.61	
Rocky Mountain	12.30	
Northwest	15.44	
National Class I Area Average	14.04	

[a] Regions are depicted in Figure VI-5 in the Regulatory Support Document for the highway Heavy Duty Engine/Diesel Fuel RIA (EPA 420-R-00-026, December 2000.) Background visibility conditions differ by region: Eastern natural background is 9.5 deciviews (or visual range of 150 kilometers) and in the West natural background is 5.3 deciviews (or visual range of 230 kilometers).

[b] The results incorporate earlier emissions estimates from the engines subject to this rule, as discussed in the Final Regulatory Support Document. We have revised our estimates both upwards for some categories and downwards for others based on public comment and updated information; however, we believe that the net results underestimate future PM emissions.

[23] In a recent case, American Corn Growers Association v. EPA, 291 F. 3d 1 (D.C. Cir 2002), the court vacated the BART provisions of the Regional Haze rule, but the court denied industry's challenge to EPA's requirement that state's SIPs provide for reasonable progress towards achieving natural visibility conditions in national parks and wilderness areas and the "no degradation" requirement. Industry did not challenge requirements to improve visibility on the haziest 20 percent of days. A copy of this decision can be found in Docket A-2000-01, Document IV-A-113.

Nonroad engines represent a sizeable portion of the total inventory of anthropogenic emissions related to PM2.5, as shown in the tables above. Numerous types of nonroad engines may operate near Class I areas (e.g., mining equipment, recreational vehicles, and agricultural equipment). We have reviewed contributions from snowmobile in particular.

Emissions from nonroad engines, in particular snowmobiles, contribute significantly to visibility impairment in Class I areas.[24] Visibility and PM monitoring data are available for eight Class I areas where snowmobiles are commonly used. These are: Acadia, Boundary Waters, Denali, Mount Rainier, Rocky Mountain, Sequoia and Kings Canyon, Voyageurs, and Yellowstone.[25] Fine particle monitoring data for these parks are set out in Table I.E-7. This table shows the number of monitored days in the winter that fell within the 20-percent worst visibility days for each of these eight parks. Monitors collect data 2 days a week for a total of about 104 days of monitored values. Thus, for a particular site, a maximum of 21 worst possible days of these 104 days with monitored values constitute the set of 20-percent worst visibility days during a year which are tracked as the primary focus of regulatory efforts.[26] With the exception of Denali in Alaska, we defined the snowmobile season as January 1 through March 15 and December 15 through December 31 of the same calendar year, consistent with the methodology used in the Regional Haze Rule, which is calendar-year based. For Denali in Alaska, the snowmobile season is October 1 to April 30.

[24]The results incorporate earlier emissions estimates from the engines subject to this rule, as discussed in the Final Regulatory Support Document. We have revised our estimates both upwards for some categories and downwards for others based on public comment and updated information; however, we believe that the net results would underestimate future PM emissions.

[25] No data were available at five additional parks where snowmobiles are also commonly used: Black Canyon of the Gunnison, CO, Grand Teton, WY, Northern Cascades, WA, Theodore Roosevelt, ND, and Zion, UT.

[26]Letter from Debra C. Miller, Data Analyst, National Park Service, to Drew Kodjak, August 22, 2001. Docket No. A-2000-01, Document Number. II-B-28.

Table I.E-7
Winter Days That Fall Within the
20 Percent Worst Visibility Days At National Parks Used by Snowmobiles

NPS Unit	States	Number of Sampled Wintertime Days Within 20 Percent Worst Visibility Days (maximum of 21out of 104 monitored days)			
		1996	1997	1998	1999
Acadia NP	ME	4	4	2	1
Denali NP and Preserve	AK	10	10	12	9
Mount Rainier NP	WA	1	3	1	1
Rocky Mountain NP	CO	2	1	2	1
Sequoia and Kings Canyon NP	CA	4	9	1	8
Voyageurs NP (1989-1992)	MN	1989 3	1990 4	1991 6	1992 8
— Boundary Waters USFS Wilderness Area (close to Voyaguers with recent data)	MN	2	5	1	5
Yellowstone NP	ID, MT, WY	0	2	0	0

Source: Letter from Debra C. Miller, Data Analyst, National Park Service, to Drew Kodjak, August 22, 2001. Docket No. A-2000-01, Document Number II-B-28.

According to the National Park Service, "[s]ignificant differences in haziness occur at all eight sites between the averages of the clearest and haziest days. Differences in mean standard visual range on the clearest and haziest days fall in the approximate range of 115-170 km."[27] We examined future air quality predictions to whether the emissions from recreational vehicles, such as snowmobiles, contribute to regional visibility impairment in Class I areas. We present results from the future air quality modeling described above for these Class I areas in addition to inventory and air quality measurements. Specifically, in Table I.E-8, we summarize the expected future visibility conditions in these areas without these regulations.

[27]Letter from Debra C. Miller, Data Analyst, National Park Service, to Drew Kodjak, August 22, 2001. Docket No. A-2000-01, Document Number. II-B-28.

Table I.E-8
Estimated 2030 Visibility in Selected Class I Areas

Class I Area	County	State	Predicted 2030 Visibility (annual average deciview)	Natural Background Visibility (annual average deciview)
				9.5
Eastern areas				
Acadia	Hancock Co	ME	23.42	
Boundary Waters	St. Louis Co	MN	22.07	
Voyageurs	St. Louis Co	MN	22.07	
Western areas				5.3
Grand Teton NP	Teton Co	WY	11.97	
Kings Canyon	Fresno Co	CA	10.39	
Mount Rainier	Lewis Co	WA	16.19	
Rocky Mountain	Larimer Co	CO	8.11	
Sequoia-Kings	Tulare Co	CA	9.36	
Yellowstone	Teton Co	WY	11.97	

[a] Natural background visibility conditions differ by region because of differences in factors such as relative humidity: Eastern natural background is 9.5 deciviews (or visual range of 150 kilometers) and in the West natural background is 5.3 deciviews (or visual range of 230 kilometers).

[b] The results incorporate earlier emissions estimates from the engines subject to this rule. We have revised our estimates both upwards for some categories and downwards for others based on public comment and updated information; however, on net, we believe that HD07 analyses would underestimate future PM emissions from these categories.

The information presented in Table I.E-7 shows that visibility data support a conclusion that there are at least 8 Class I Areas (7 national parks and one wilderness area) frequented by snowmobiles with one or more wintertime days within the 20-percent worst visibility days of the year, and in many cases several days. For example, Rocky Mountain National Park in Colorado was frequented by about 27,000 snowmobiles during the 1998-1999 winter. Of the monitored days characterized as within the 20-percent worst visibility monitored days, 2 of those days occurred during the wintertime when snowmobile emissions such as hydrocarbons contributed to visibility impairment.

The information in Table I.E-8 shows that these areas also are predicted to have high annual average deciview levels in the future. Emissions from snowmobiles and other recreational vehicles, as well as other nonroad engines contributed to these levels.[28]

Ambient concentrations of fine particles are the primary pollutant responsible for visibility impairment. The classes of fine particles principally responsible for visibility impairment are sulfates, nitrates, organic carbon particles, elemental carbon, and crustal material. Hydrocarbon emissions from automobiles, trucks, snowmobiles, and other industrial processes are common sources of organic carbon. The organic carbon fraction of fine particles ranges from 47 percent in Western areas such as Denali National Park, to 28 percent in Rocky Mountain National Park, to 13 percent in Acadia National Park.[29]

In the winter months, HC emissions from snowmobiles can be significant, and these HC emissions can be more than half of the organic carbon fraction of fine particles which are largely responsible for visibility impairment. In Yellowstone, a park with high snowmobile usage during the winter months, snowmobile HC emissions can exceed 500 tons per year, as much as several large stationary sources.[30] Other parks with less snowmobile traffic are also impacted although to a lesser extent by these HC emissions.[31]

Table I.E-8 shows estimated tons of four pollutants during the winter season in five Class I national parks for which we have estimates of snowmobile use. The national park areas outside of Denali in Alaska are open to snowmobile operation in accordance with special regulations (36 CFR part 7). Denali National Park permits snowmobile operation by local rural residents engaged in subsistence uses (36 CFR part 13).

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[28]See Chapter 1 in the RSD for a discussion or US EPA Technical Support Document for Heavy-duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements – Air Quality Modeling Analyses. December 2000. Docket No. A-2000-01, Docket Number IV-A-218. This document is also avaiable at www.epa.gov/otaq/hdmodels.htm

[29]Letter from Debra C. Miller, Data Analyst, National Park Service, to Drew Kodjak, August 22, 2001. Docket No. A-2000-01, Document Number. II-B-28.

[30]Emissions of NOx from snowmobiles contribute to the total amount of particulate nitrate, although the total NOx emissions from snowmobiles are considerably less than HC or direct PM emissions from these engines.

[31]Technical Memorandum, Aaron Worstell, Environmental Engineer, National Park Service, Air Resources Division, Denver, Colorado, particularly Table 1. Docket No. A-2000-01, Document Number II-G-178.

Table I.E-8

Winter Season Snowmobile Emissions (tons; 1999 Winter Season)

NPS Unit	HC	CO	NOx	PM
Denali NP & Preserve	>9.8	>26.1	>0.08	>0.24
Grand Teton NP	13.7	36.6	0.1	0.3
Rocky Mountain NP	106.7	284.7	0.8	2.6
Voyageurs NP	138.5	369.4	1.1	3.4
Yellowstone NP	492	1311.9	3.8	12

Source: Letter from Aaron J. Worstell, Environmental Engineer, National Park Service, Air Resources Division, to Drew Kodjak, August 21, 2001, particularly Table 1. Docket No. A-2000-01, Document No. II-G-178.

Inventory analysis performed by the National Park Service for Yellowstone National Park suggests that snowmobile emissions are a significant source of total annual mobile source emissions for the park year round. The proportion of snowmobile emissions to emissions from other sources affecting air quality in these parks is likely to be similar to that in Yellowstone.

Furthermore, public comments from an industry-initiated study contained modeling showing a 4 to 8 percent contribution to perceptible impairment from snowmobile exhaust in Yellowstone National Park. Although we believe the modeling technique may not be fully appropriate, the study still indicates a significant contribution from snowmobiles. EPA conducted independent modeling using a more appropriate visibility model, and we confirmed that snowmobiles would be creating perceptible plumes at all park entrances, impairing visibility. This evidence shows that snowmobiles contribute significantly to visibility impairment in several Class I area.

C. Regulation of HC is a Good Proxy for Regulation of Fine PM Emissions from Current Snowmobile Engines

We believe the best way to regulate the contribution to ambient concentrations of fine PM from current snowmobile engines is to set standards to control HC emissions. The current fleet of snowmobiles consists almost exclusively of two-stroke engines. Two-stroke engines inject lubricating oil into the air intake system where it is combusted with the air and fuel mixture in the combustion chamber. This is done to provide lubrication to the piston and crankshaft, since the crankcase is used as part of the fuel delivery system and cannot be used as a sump for oil storage as in four-stroke engines. As a result, in addition to products of incomplete combustion, two-stroke engines also emit a mixture of uncombusted fuel and lubricant oil. HC-related emissions from snowmobiles increase PM concentrations in two ways. Snowmobile engines emit HC directly as particles (such as droplets of lubricant oil). Snowmobile engines also emit HC gases, as well as raw unburned HC from the fuel which either condenses in cold temperatures to particles or reacts chemically to transform into particles as it moves in the atmosphere. As discussed above, fine particles can cause a variety of adverse health and welfare effects, including visibility impairment.

We believe measurements of HC emissions will serve as a reasonable surrogate for measurement of fine particles for snowmobiles for several reasons. First, emissions of PM and HC from these engines are related. Test data show that over 70 percent of the average volatile organic fraction of PM from a typical two-stroke snowmobile engine is organic hydrocarbons, largely from lubricating oil components.[32] The HC measurements (which use a 191° C heated flame-ionization detector (FID)) would capture the volatile component, which in ambient temperatures would be particles (as droplets).

Second, many of the technologies that will be employed to reduce HC emissions are expected to reduce PM (four-stroke engines, pulse air, and direct fuel injection techniques for example). The organic emissions are a mixture of fuel and oil, and reductions in the organic emissions will likely yield both HC and PM reductions. HC measurements would capture the reduction from both the gas and particle (at ambient temperature) phases. For example, the HC emission factor for a typical two-stroke snowmobile is 111 g/hp-hr. The HC emission factor for a direct fuel injection engine is 21.8, and for a four-stroke is 7.8 g/hp-hr, representing a 80-percent and 99-percent reduction, respectively. Similarly, the PM emission factor for a typical two-stroke snowmobile is 2.7 g/hp-hr. The corresponding PM emission factor for a direct fuel injection engine is 0.57, and for a four-stroke is 0.15 g/hp-hr, representing a 75 percent and 93 percent reduction, respectively.

Thus, manufacturers will generally reduce PM emissions as a result of reducing HC emissions, making separate PM standards less necessary. Moreover, PM standards would cover only the PM directly emitted at the tailpipe. It would not measure the gaseous or semi-volatile organic emissions which would condense or be converted into PM in the atmosphere. The HC measurements would also include the gaseous HC which would condense or be converted into PM in the atmosphere. Consequently, the HC measurement would be a more comprehensive measurement. Also, HC standards actually will reduce secondary PM emissions that would not necessarily be reduced by PM standards.

Finally, from an implementation point of view, PM is not routinely measured in snowmobiles. There is no currently established protocol for measuring PM and substantial technical issues would need to be overcome to create a new method. Establishing additional PM test procedures would also entail additional costs for manufacturers. HC measurements are more routinely performed on these types of engines, and these measurements currently serve as a more reliable basis for setting a numeric standard. Thus, we believe that regulation of HC is the best way to reduce PM emissions and PM contributions from current snowmobile engines.

We included a NOx standard for snowmobiles. This standard will essentially cap NOx emissions from these engines to prevent backsliding. We are not promulgating standards that would require substantial reductions in

[32]Memo to Docket, Mike Samulski. “Hydrocarbon Measurements as an Indicator for Particulate Matter Emissions in Snowmobiles,” with attachments. September 6, 2002, Docket A-2000-01; Document No. IV-B-42.

NOx because we believe that standards which force substantial NOx reductions would likely not lead to reductions in PM and may in fact increase PM levels. NOx emissions from snowmobiles are very small, particularly compared to levels of HC. In fact, technologies that reduce HC and CO are likely to increase levels of NOx and vice versa, because technologies to reduce HC and CO emissions would result in leaner operation. A lean air and fuel mixture causes NOx emissions to increase. These increases are minor, however, compared to the reductions of HC (and therefore PM) that result from these techniques.

On the other hand, substantial control of NOx emissions may have the counter-effect of increasing HC emissions and the greater PM emissions associated with those HC emissions. The only way to reduce NOx emissions from four-stroke engines (at the same time as reducing HC and CO levels) would be to use a three-way catalytic converter. We do not have enough information at this time on the durability or safety implications of using a three-way catalyst with a four-stroke engine in snowmobile applications. Three-way catalyst technology is well beyond the technology reviewed for this rule and would need substantial additional review before being contemplated for snowmobiles. Thus, given the overwhelming level of HC compared to NOx, and the secondary PM expected to result from these levels, it would be premature and possibly counterproductive to promulgate NOx standards that require significant Nox reductions from snowmobiles at this time. We have therefore decided to structure our long term HC+NOx standard for 2012 and later model year snowmobiles to require only a cap on NOx emissions from the advanced technology engines which will be the dominant technology in the new snowmobiles certified at that time.

II. Nonroad: General Provisions

This section describes general provisions concerning the emission standards adopted in this final rule and the ways in which a manufacturer shows compliance with these standards. Clean Air Act section 213(a)(3) requires us to set standards that achieve the greatest degree of emission reduction achievable through the application of technology that will be available, giving appropriate consideration to cost, noise, energy, and safety factors. Section 202(a)(4) provides further authority to adopt standards for pollution beyond that regulated under section 202(a)(3). In addition to emission standards, this document describes a variety of other provisions necessary for implementing the proposed emission-control program in an effective way, such as applying for certification, labeling engines, and meeting warranty requirements.

The discussions in this section are general and are meant to cover all the nonroad engines and vehicles subject to the new standards. In this Section II, the term engine is sometimes used to include both nonroad engines and nonroad vehicles. Refer to the discussions of specific programs, contained in Sections III through VI, to determine whether the regulations are being applied to the entire vehicle or just the engine, as well as for more information about specific requirements for different categories of nonroad engines and vehicles.

This section describes general nonroad provisions related to certification prior to sale or introduction into commerce. Section VII describes several compliance provisions that apply generally to nonroad engines, and Section VIII similarly describes general testing provisions.

A. Scope of Application

This final rule covers recreational marine diesel engines, nonroad spark-ignition engines rated over 19 kW, and recreational spark-ignition vehicles introduced into commerce in the United States. The following sections describe generally when emission standards apply to these products. These provisions are generally consistent with prior nonroad and motor-vehicle rulemakings. Refer to the specific program discussion below for more information about the scope of application and timing of new standards.

1. What engines and vehicles are subject to the standards?

The scope of this rule is broadly set by Clean Air Act section 213(a), which instructs us to set emission standards for *new* nonroad engines and *new* nonroad vehicles. Generally speaking, this rule is intended to cover all new engines and vehicles in the categories listed above (including any associated equipment or vessels) for their entire useful lives, as defined in the regulations.[33] Once the emission standards apply to a group of engines or vehicles, manufacturers of a new engine must have an approved certificate of conformity from us before selling them

[33]For recreational vehicles, we are adopting vehicle-based standards. For these applications, the term "engine" in this document applies equally to the vehicles.

in the United States.[34] This also applies to importation by any person and any other means of introducing new engines and vehicles into commerce. We also require equipment manufacturers that install engines from other companies to install only certified engines into new equipment once emission standards apply. The information we require of manufacturers applying for certification (with the corresponding engine labels) provides assurance that manufacturers have met their obligation to make engines that meet emission standards over the useful life we specify in the regulations.

2. How do I know if my engine or equipment is new?

We are defining "new" consistent with previous rulemakings. We will consider a nonroad engine (or nonroad equipment) to be new until its title has been transferred to the ultimate purchaser or the engine has been placed into service. This definition applies to both engines and equipment, so the nonroad equipment using these engines, including all-terrain vehicles, snowmobiles, off-highway motorcycles, and other land-based nonroad equipment will be considered new until their title has been transferred to an ultimate buyer. In Section II.B.1 we describe how to determine the model year of individual engines and vehicles.

To further clarify the definition of new nonroad engine, we specify that a nonroad engine, vehicle, or equipment is placed into service when it is used for its intended purpose. An engine subject to emission standards is used for its functional purpose when it is installed in an all-terrain vehicle, snowmobile, off-highway motorcycle, marine vessel, or other piece of nonroad equipment. We need to make this clarification because some engines are made by modifying a highway or land-based nonroad engine that has already been installed on a vehicle or other piece of equipment. For example, someone can install an engine in a recreational marine vessel after it has been used for its functional purpose as a land-based highway or nonroad engine. We believe our approach is reasonable because the practice of adapting used highway or land-based nonroad engines may become more common if these engines are not subject to emission standards.

In summary, an engine may be subject to emission standards if it is:

- Freshly manufactured, whether domestic or imported; this may include engines produced from engine block cores
- Installed for the first time in nonroad equipment after having powered an automobile or a category of nonroad equipment subject to different emission standards
- Installed in new nonroad equipment, regardless of the age of the engine
- Imported (freshly manufactured or used) and was originally manufactured after the effective date of our standards

[34]The term "manufacturer" includes any individual or company that manufactures any new engine for sale or otherwise introduces a new engine into commerce in the United States. It also includes importers for resale.

3. When do imported engines need to meet emission standards?

The emission standards apply to all new engines sold in the United States. Consistent with Clean Air Act section 216, engines that are imported by any person, whether freshly manufactured or used are considered "new" engines.[35] Thus, we include engines that are imported for use in the United States, whether they are imported as loose engines or if they are already installed on a marine vessel, recreational vehicle, or other piece of nonroad equipment, built elsewhere. All imported engines manufactured after our standards begin to apply need an EPA-issued certificate of conformity to clear customs, with limited exemptions (as described below).

An engine or marine vessel, recreational vehicle, or other piece of nonroad equipment that was built after emission standards take effect cannot be imported without a currently valid certificate of conformity. We would consider it to be a new engine, vehicle, or vessel, which would trigger a requirement to comply with the applicable emission standards. Thus, for example, a marine vessel manufactured in a foreign country in 2007, then imported into the United States in 2010, would be considered "new." The engines on that vessel would have to comply with the requirements for the 2007 model year, assuming no other exemptions apply. This provision is important to prevent manufacturers from avoiding emission standards by building vessels or vehicles abroad, transferring their title, and then importing them as used vessels or vehicles.

Imported engines are generally subject to emission standards. However, we are not adopting a definition of "import" in this regulation. We will defer to the U.S. Customs Service for determinations of when an engine or vehicle is imported into the U.S.

4. Do the standards apply to exported engines or vehicles?

Engines or vehicles intended for export are generally not required to meet the emission standards or other requirements adopted in this rule. However, engines that will be exported and subsequently re-imported into the United States must be covered by a certificate of conformity. For example, this would occur when a foreign company purchases engines manufactured in the United States for installation on a marine vessel, recreational vehicle, or other nonroad equipment for export back to the United States. Those engines would be subject to the emission standards that apply on the date the engine was originally manufactured. If the engine is later modified and certified (or recertified), the engine is subject to emission standards that apply on the date the modification is complete. So, for example, foreign boat builders buying U.S.-made engines without recertifying the engines will need to make sure they purchase complying engines for the products they sell in the U.S. We also do not exempt engines exported to countries that share our emission standards.

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[35] The definition in Clean Air Act section 216 applies specifically to "new motor vehicles," but we have interpreted "new nonroad engine" consistently with the definition in section 216.

5. Are any new engines or vehicles in the applicable categories not subject to emission standards of this rule?

We are extending our basic nonroad exemptions to the engines and vehicles covered by this rulemaking. These include the testing exemption, the manufacturer-owned exemption, the display exemption, and the national-security exemption. These exemptions are described in more detail in Section VII.C.

In addition, the Clean Air Act does not consider stationary engines or engines used solely for competition to be nonroad engines, so the emission standards do not apply to them. Refer to the program discussions below for a description of how these exclusions or exemptions apply for different categories of engines.

B. Emission Standards and Testing

1. Which pollutants are covered by emission standards?

Engines subject to the exhaust emission standards must meet standards based on measured levels of specified pollutants, such as NOx, HC, or CO, though not all engines have standards for each pollutant. Diesel engines generally must also meet a PM emission standard. In addition, there may be standards or other requirements for crankcase, evaporative, or permeation emissions, as described below.

The emission standards are effective on a model-year basis. We define model year much like we do for passenger cars. It generally means either the calendar year or some other annual production period based on the manufacturer's production practices. A model year may include January 1 from only one year. For example, manufacturers could start selling 2006 model year engines as early as January 2, 2005, as long as the production period extends until at least January 1, 2006. All of a manufacturer's engines from a given model year must meet emission standards for that model year. For example, manufacturers producing new engines in the 2006 model year need to comply with the 2006 standards. The model year of a particular engine is determined based on the date that the engine is fully assembled. In the case of recreational vehicles, this generally applies to the final assembly of the whole vehicle, since the emission standards apply to the vehicle. Refer to the individual program discussions below or the regulations for additional information about model year periods, including how to define what model year means in less common scenarios, such as installing used engines in new equipment.

2. What standards apply to crankcase, evaporative, permeation, and other emissions?

Blow-by of combustion gases and the reciprocating action of the piston can cause exhaust emissions to accumulate in the crankcase of four-stroke engines. Uncontrolled engine designs route these vapors directly to the atmosphere, where they contribute to ambient levels of hydrocarbons. We have long required that automotive engines prevent emissions from the their crankcases. Manufacturers typically do this by routing crankcase vapors through a valve into the engine's air intake system. We generally require in this rulemaking that engines control crankcase emissions.

Vehicles with spark-ignition engines use fuel that is volatile and the unburned fuel can be released into the ambient air. We are adopting standards to limit evaporative emissions from the fuel. Evaporative emissions result from heating gasoline or other volatile fuels in a tank that is vented to the atmosphere or from permeation through plastic fuel tanks and rubber hoses. Section IV describes the permeation standards for recreational vehicles. Section V provides additional information on the evaporative emission standards for Large SI engines.

We are also adopting a general requirement that all engines subject to this final rule may not cause or contribute to an unreasonable risk to public health, welfare, or safety, especially with respect to noxious or toxic emissions that may increase as a result of emission-control technologies. The regulatory language has been modified consistent with the alternate language suggested in the proposal. This alternate language implements sections 202(a)(4) and 206(a)(3) of the Act and clarifies that the purpose of this requirement is to prevent control technologies that would cause unreasonable risks, rather than to prevent trace emissions of any noxious compounds. For example, this requirement would prevent the use of emission-control technologies that produce high levels of pollutants for which we have not set emission standards, but nevertheless pose a risk to the public. However, it should be noted that this would generally not apply to exhaust gas recirculation systems on gasoline- or diesel-fueled engines.

3. What duty cycles is EPA adopting for emission testing?

Testing an engine for exhaust emissions typically consists of exercising it over a prescribed duty cycle of speeds and loads, typically using an engine or chassis dynamometer. The duty cycle used to measure emissions for certification, which is generally derived from typical operation from the field, is critical in evaluating the likely emissions performance of engines designed to emission standards. Testing for recreational marine diesel engines and Large SI engines may also include additional operation not included in the specific duty cycles.

Steady-state testing consists of engine operation for an extended period at several speed-load combinations. Associated with these test points are weighting factors that allow calculation of a single weighted-average steady-state emission level in g/kW. Transient testing involves a continuous trace of specified engine or vehicle operation; emissions are collected over the whole testing period for a single mass measurement.

See Section VIII.C for a discussion of how we define maximum test speed and intermediate speed for engine testing. Refer to the program discussions below for more information about the type of duty cycle required for testing the various engines and vehicles. Those sections also include information regarding testing provisions that do not rely on specific operating cycles (i.e., field-testing, not-to exceed testing, and evaporative testing).

4. How do adjustable engine parameters affect emission testing?

Many engines are designed with components that can be adjusted for optimum performance under changing conditions, such as varying fuel quality, high altitude, or engine wear. Examples of adjustable parameters include spark timing, idle-speed setting, and fuel-injection timing. While we recognize the need for this practice, we are also concerned that engines maintain an appropriate level of emission control for the whole range of adjustability. Manufacturers must therefore show that their engines meet emission standards over the full adjustment range. Manufacturers must also provide a physical stop to prevent adjustment outside the established range. Operators are then prohibited by the anti-tampering provisions from adjusting engines outside this range.

5. What are voluntary low-emission engines and Blue Sky standards?

Several state and environmental groups and manufacturers of emission controls have supported our efforts to develop incentive programs to encourage engine technologies that go beyond federal emission standards. Some companies have already significantly developed these technologies. In the final rule for land-based nonroad diesel engines, we included a program of voluntary standards for low-emitting engines, referring to these as "Blue Sky Series" engines (63 FR 56967, October 23, 1998). We included similar programs for commercial marine diesel engines. The general purposes of such programs are to provide incentives to manufacturers to produce clean products, as well as to create market choices and opportunities for environmental information for consumers regarding such products.

We are adopting voluntary Blue Sky Series standards for some of the engines subject to this final rule. Creating a program of voluntary standards for low-emitting engines, including testing and durability provisions to help ensure adequate in-use performance, will be a step forward in advancing emission-control technologies. While these are voluntary standards, they become binding once a manufacturer chooses to participate. EPA certification will therefore provide protection against false claims of environmentally beneficial products.

C. Demonstrating Compliance

We are adopting a compliance program to accompany the final emission standards. This consists first of a process for demonstrating that new engine models comply with the emission standards. In addition to new-engine testing, several provisions ensure that emission-control systems will continue to function over long-term operation in the field. Most of these certification provisions are consistent with previous rulemakings for other nonroad engines. Refer to the discussion of the specific programs below for additional information about these requirements for each engine category.

1. How do I certify my engines?

We are adopting a certification process similar to that already established for other nonroad engines. Manufacturers generally test representative prototype engines and submit the emission data along with other information to EPA in an application for a Certificate of Conformity. If we approve the application, EPA issues a Certificate of Conformity which allows the manufacturer to produce and sell the engines described in the application in the U.S.

Manufacturers certify their engine models by grouping them into engine families that have similar emission characteristics. The engine family definition is fundamental to the certification process and to a large degree determines the amount of testing required for certification. The regulations include specific engine characteristics for grouping engine families for each category of engines. To address a manufacturer's unique product mix, we may approve using broader or narrower engine families.

Engine manufacturers are responsible to build engines that meet the emission standards over each engine's useful life. The useful life we adopt by regulation is intended to reflect the period during which engines are designed to properly function without being remanufactured or the average service life. Useful life values, which are expressed in terms of years or amount of operation (in hours or kilometers), vary by engine category, as described in the following sections. Consistent with other recent EPA programs, we generally consider this useful life value in amount of operation to be a minimum value, requiring manufacturers to comply for a longer period in those cases where their engines operate longer than the minimum useful life.

The emission-data engine is the engine from an engine family that will be used for certification testing. To ensure that all engines in the family meet the standards, manufacturers must select the engine most likely to exceed emission standards in a family for certification testing. In selecting this "worst-case" engine, the manufacturer uses good engineering judgment. Manufacturers consider, for example, all engine configurations and power ratings within the engine family and the range of installed options allowed. Requiring the worst-case engine to be tested helps the manufacturer be sure that all engines within the engine family are complying with emission standards. Manufacturers estimate the rate of deterioration for each engine family over its useful life and show that engines continue to meet standards after incorporating the estimated deterioration. We may also test the engines ourselves.

Manufacturers must include in their application for certification the results of emission tests showing that the engine family meets emission standards. In addition, we may ask the manufacturer to include any additional data from their emission-data engines, including any diagnostic-type measurements (such as ppm testing) and invalidated tests. This complete set of test data ensures that the valid tests forming the basis of the manufacturer's application are a robust indicator of emission-control performance, rather than a spurious or incidental test result.

We are adopting test-fuel specifications intended to represent in-use fuels. Engines must be able to meet the standards on fuels with properties anywhere in the specified ranges. The test fuel is generally to be used for all testing associated with the regulations, including certification, production-line testing, and in-use testing. Refer to the program discussions below related to test fuel specifications.

We require engine manufacturers to give engine buyers instructions for properly maintaining their engines. We are including limitations on the frequency of scheduled maintenance that a manufacturer may specify for emission-related components to help ensure that emission-control systems don't depend on an unreasonable expectation of maintenance in the field. These maintenance limits also apply during any service accumulation that a manufacturer may do to establish deterioration factors. This approach is common to all our engine programs. It is important to note, however, that these provisions don't limit the maintenance an operator may perform; it merely limits the maintenance that operators can be expected to perform on a regularly scheduled basis. Refer to the discussion of the specific programs below for additional information about the allowable maintenance intervals for each category of engines.

Once an engine family is certified, we require every engine a manufacturer produces from the engine family to have a label with basic identifying information. The design and content of engine labels is specified in the regulations.

2. What warranty requirements apply to certified engines?

Consistent with our current emission-control programs, manufacturers must provide a design and defect warranty covering emission-related components for a minimum period specified in the regulations. This minimum period is generally half of the useful life period. The regulations also provide that the manufacturer's emission warranty period could be adjusted to a value higher than the minimum period for those cases where the manufacturer provides a longer mechanical warranty for the engine or any of its components; this includes extended warranties that are available for an extra price. Any such adjustment would be dependent on the average service life of the vehicle as well. The manufacturer generally does not need to include scheduled maintenance or other routine maintenance under the emission warranty. See the regulation language for a detailed description of the components that are considered to be emission-related.

If an operator makes a valid warranty claim for an emission-related component during the warranty period, the engine manufacturer is generally obligated to replace the component at no charge to the operator. The engine manufacturer may deny warranty claims, however, if the operator caused the component failure by misusing the engine or failing to do necessary maintenance.

We are also adopting a defect reporting requirement that applies separate from the emission-related warranty (see Section VII.F). In general, defect reporting applies when a manufacturer discovers a pattern of component failures, whether that information comes from warranty claims, voluntary investigation of product quality, or other sources.

3. Can I use emission averaging to show that I meet emission standards?

Many of our mobile source emission-control programs include voluntary use of emission credits to facilitate implementation of emission controls. An emission-credit program is an important factor we take into consideration in setting emission standards that are appropriate under Clean Air Act section 213. An emission-credit program can improve the technological feasibility and reduce the cost of achieving standards, allowing us to consider a more stringent emission standard than might otherwise be appropriate, including a compliance date for the standards earlier than would otherwise be appropriate. Manufacturers gain flexibility in product planning and introduction of product lines meeting a new standard. Emission-credit programs also create an incentive for the early introduction of new technology, which allows certain engine families to act as trailblazers for new technology. This can help provide valuable information to manufacturers on the technology before they apply the technology throughout their product line. This early introduction of clean technology improves the feasibility of achieving the standards and can provide valuable information for use in other regulatory programs that may benefit from similar technologies.

Emission-credit programs may involve averaging, banking, or trading. Averaging allows a manufacturer to certify one or more engine families at emission levels above the applicable emission standards, as long as the increased emissions from that engine family are offset by one or more engine families certified below the applicable standards. The over-complying engine families generate credits that are used by the under-complying engine families. Compliance is determined taking into account differences in production volume, power and useful life among engine families. The average of all the engine families for a particular manufacturer's production must be at or below the level of the applicable emission standards. This calculation generally factors in sales-weighted average power, production volume, and useful life. Banking allows a manufacturer to generate emission credits and bank them for future use in its own averaging program in later years. Trading allows transfer of credits to another company.

In general, a manufacturer choosing to participate in an emission-credit program certifies each participating engine family to a Family Emission Limit. In its certification application, a manufacturer determines a separate Family Emission Limit for each pollutant included in the emission-credit program. The Family Emission Limit selected by the manufacturer becomes the emission standard for each engine in that engine family. Emission credits are based on the difference between the emission standard that applies to the family and the Family Emission Limit. Manufacturers must meet the Family Emission Limit for all emission testing of any engine in that family. At the end of the model year, manufacturers must show that the net effect of all their engine families participating in the emission-credit program is a zero balance or a net positive balance of credits. A manufacturer may generally choose to include only a single pollutant from an engine family in the emission-credit program or, alternatively, to establish a Family Emission Limit for each of the regulated pollutants. Refer to the program discussions below for more information about emission-credit provisions for individual engine categories.

4. What are the production-line testing requirements?

We are adopting production-line testing requirements for recreational marine diesel engines, recreational vehicles, and Large SI engines. Manufacturers must routinely test production-line engines to help ensure that newly assembled engines control emissions at least as well as the emission-data engines tested for certification. Production-line testing serves as a quality-control step, providing information to allow early detection of any problems with the design or assembly of freshly manufactured engines. This is different than selective enforcement auditing, in which we would give a test order for more rigorous testing for a small subset of production-line engines in a particular engine family (see Section VII.E). Production-line testing requirements are already common to several categories of nonroad engines as part of their emission-control program.

If an engine fails to meet an emission standard, the manufacturer must modify it to bring that specific engine into compliance. Manufacturers may adjust the engine family's Family Emission Limit to take into account the results from production-line testing (if applicable). If too many engines exceed emission standards, this indicates it is more of a family-wide problem and the manufacturer must correct the problem for all affected engines. The remedy may involve changes to assembly procedures or engine design, but the manufacturer must, in any case, do sufficient testing to show that the engine family complies with emission standards before producing more engines. The remedy may also need to address engines already produced since the last showing that production-line engines met emission standards.

The production-line testing programs for Large SI engines and for recreational vehicles depend on the Cumulative Sum (CumSum) statistical process for determining the number of engines a manufacturer needs to test (see the regulations for the specific calculation methodology). Each manufacturer generally selects engines randomly at the beginning of each new quarter.[36] If engines must be tested at a facility where final assembly is not yet completed, manufacturers must randomly select engine components and assemble the test engine according to their established assembly instructions. The Cumulative Sum program uses the emission results to calculate the number of tests required for the remainder of the year to reach a pass or fail determination for production-line testing. If tested engines have emissions close to the standard, the statistical sampling method calls for an increased number of tests to show whether to make a pass or fail determination for the engine family. The remaining number of tests is recalculated after the manufacturer tests each engine. Engines selected should cover the broadest range of production configurations possible. Tests should also be distributed evenly throughout the sampling period to the extent possible.

If an engine family fails the production-line testing criteria, we may suspend the Certificate of Conformity. Under the CumSum approach, individual engines can exceed the emission standards without causing the whole engine family to exceed the production-line testing criteria. The production-line testing criteria are designed to determine if there is a problem that applies broadly across the engine family. Whether or not the production-line testing criteria are met, manufacturers must adjust or repair every failing engine and retest it to show that it meets the emission standards. Note also that all production-line emission measurements must be included in the periodic reports to us. This includes any type of screening or surveillance tests (including ppm measurements), all data points for evaluating whether an engine controls emissions “off-cycle,” and any engine tests that exceed the minimum required level of testing.

The regulations allow us to reduce testing requirements for engine families that consistently pass the production-line testing criteria. For engine families that pass all of the production-line test requirements for two consecutive years, the manufacturer may request a reduced testing rate. The minimum testing rate is one test per engine family for one year. Our approval for a reduced testing rate may be limited to a single model year, but manufacturers may continue to request reduced testing rates.

[36]We consider an engine to be randomly selected if it undergoes normal assembly and manufacturing procedures. An engine is not randomly selected if it has been built with any kind of special components or procedures.

As we have concluded in other engine programs, some manufacturers may have unique circumstances that call for different methods to show that production engines comply with emission standards. A manufacturer may therefore suggest an alternate plan for testing production-line engines, as long as the alternate program is as effective at ensuring that the engines will comply. A manufacturer's petition to use an alternate plan should address the need for the alternative and should justify any changes from the regular testing program. The petition must also describe in detail the equivalent thresholds and failure rates for the alternate plan. If we approve the plan, we will use these criteria to determine when an engine family passes or fails the production-line testing criteria. It is important to note that this allowance is intended only as a flexibility, and is not intended to affect the stringency of the standards or the production-line testing program.

Refer to the specific program discussions below for additional information about production-line testing for different types of engines.

D. Other Concepts

1. What are emission-related installation instructions?

Manufacturers selling loose engines to equipment manufacturers must develop a set of emission-related installation instructions. These instructions include anything the installer needs to know to ensure that the engine operates within its certified design configuration. For example, the installation instructions could specify a total capacity needed from the engine cooling system, placement of catalysts after final assembly, or specification of parts needed to control evaporative or permeation emissions. We approve emission-related installation instructions as part of the certification process. If equipment manufacturers fail to follow the established emission-related installation instructions, we will consider this tampering, which may subject them to significant civil penalties. Refer to the program discussions below for more information about specific provisions related to installation instructions.

2. Are there special provisions for small manufacturers of these engines and vehicles?

The scope of this rule includes many engine and vehicle manufacturers that have previously not been subject to our mobile source regulations or certification process. Some of these manufacturers are small businesses, with unique concerns relating to the compliance burden from the general regulating program. The sections describing the emission-control program include discussion of special compliance provisions designed to address this for the different engine categories.

III. Recreational Vehicles and Engines

A. Overview

We are adopting new exhaust emission standards for snowmobiles, off-highway motorcycles, and all-terrain vehicles (ATVs). The engines used in these vehicles are a subset of nonroad SI engines.[37] In our program to set exhaust emission standards for nonroad spark-ignition engines below 19 kW (Small SI), we excluded recreational vehicles because they have different design characteristics and usage patterns than certain other engines in the Small SI category. For example, engines typically found in the Small SI category are used in lawn mowers, chainsaws, trimmers, and other lawn and garden applications. These engines tend to have low power outputs and operate at constant loads and speeds, whereas recreational vehicles can have high power outputs with highly variable engine loads and speeds. This suggests that these engines should be regulated differently than Small SI engines. In the same way, we treat snowmobiles, off-highway motorcycles, and ATVs separately from our Large SI engine program, which is described in Section V. Recreational vehicles that are not snowmobiles, off-highway motorcycles, or ATVs, will be subject to the standards that otherwise apply to small nonroad spark-ignition engines (see Section III.B.2).

We are adopting exhaust emission standards for HC and CO from all recreational vehicles. We are adopting an additional requirement to control NOx from off-highway motorcycles and ATVs. We believe that vehicle and engine manufacturers will be able to use technology already established for other types of engines, such as highway motorcycles, small spark-ignition engines, and marine engines, to meet these standards. We recognize that some small businesses manufacture recreational vehicles; we are therefore adopting several special compliance provisions to reduce the burden of emission regulations on small businesses.

1. What are recreational vehicles and who makes them?

We are adopting new exhaust emission standards for off-highway motorcycles, ATVs, and snowmobiles. Eight large manufacturers dominate the sales of these recreational vehicles. Of these eight manufacturers, seven of them manufacture two or more of the three main types of recreational vehicles. For example, there are four companies that manufacture both off-highway motorcycles and ATVs. There are three companies that manufacture ATVs and snowmobiles; one company manufactures all three. These eight companies represent approximately 95 percent of all domestic sales of recreational vehicles.

a. Off-highway motorcycles

Motorcycles are two-wheeled, self-powered vehicles that come in a variety of configurations and styles. Off-highway motorcycles are similar in appearance to highway motorcycles, but there are several important distinctions between the two types of machines. Off-highway motorcycles are not street-legal and are primarily operated on public and private lands over trails and open areas. A significant number are used in competition events. Off-highway motorcycles tend to be much smaller, lighter and more maneuverable than their larger highway counterparts. They are equipped with relatively small-displacement single- cylinder two- or four-stroke engines

[37] Almost all recreational vehicles are equipped with spark-ignition engines. Any diesel engines used in these applications must meet our emission standards for nonroad diesel engines.

ranging from 48 to 650 cubic centimeters (cc) in size. The exhaust systems for off-highway motorcycles are distinctively routed high on the frame to prevent damage from brush, rocks, and water. Off-highway motorcycles are designed to be operated over varying surfaces, such as dirt, sand, or mud, and are equipped with knobby tires to give better traction in off-road conditions. Unlike highway motorcycles, off-highway motorcycles have fenders mounted far from the wheels and closer to the rider to keep dirt and mud from spraying the rider and clogging between the fender and tire. Off-highway motorcycles are also equipped with more advanced suspension systems than those for highway motorcycles. This allows the operator to ride over obstacles and make jumps safely.

Five companies dominate sales of off-highway motorcycles. They are long-established, large corporations that manufacture several different products including highway and off-highway motorcycles. These five companies account for 90 to 95 percent of all domestic sales of off-highway motorcycles. There are also several relatively small companies that manufacture off-highway motorcycles, many of which specialize in competition machines.

b. All-terrain vehicles

The earliest ATVs were three-wheeled off-highway models with large balloon tires that existed in the early 1970's. Due to safety concerns, the three-wheeled ATVs were phased-out in the mid-1980s and replaced by the current and more popular four-wheeled vehicle known as “quad runners” or simply “quads.” Quads resemble the earlier three-wheeled ATVs except that the single front wheel was replaced with two wheels. The ATV steering system uses motorcycle handlebars, rather than a steering wheel. The operator sits on and rides the quad much like a motorcycle. The engines used in quads tend to be very similar to those used in off-highway motorcycles—relatively small, single-cylinder two- or four-stroke engines. Quads are typically divided into utility and sport models. The utility quads are designed for multi-function use and have the ability to perform many utility functions, such as plowing snow, tilling gardens, and mowing lawns in addition to use for recreational riding. They are typically heavier and equipped with relatively large four-stroke engines and automatic transmissions with a reverse gear. Sport quads are smaller and lighter and designed primarily for recreational purposes. They are equipped with two- or four-stroke engines and manual transmissions. Presently utility ATVs comprise about 75 percent of the market and sport models about 25 percent.

Of all of the types of recreational vehicles, ATVs have the largest number of major manufacturers. All but one of the companies noted above for off-highway motorcycles and below for snowmobiles are significant ATV producers. These seven companies represent over 95 percent of total domestic ATV sales. The remaining 5 percent of sales come from importers, which tend to import less expensive, youth-oriented ATVs.

As discussed below, we are requiring utility vehicles capable of speeds above 25 mph to comply the regulations for ATVs.

c. Snowmobiles

Snowmobiles, also referred to as "sleds," are tracked vehicles designed to operate over snow. Snowmobiles have some similarities to off-highway motorcycles and ATVs. A snowmobile rider sits on and rides a snowmobile similar to an ATV. Snowmobiles use high-powered two- and three-cylinder two-stroke engines that look similar to off-highway motorcycle engines. Rather than wheels, snowmobiles are propelled by a track system similar to what is used on a bulldozer. The snowmobile is steered by two skis at the front of the sled. Snowmobiles use handlebars similar to off-highway motorcycles and ATVs. The typical snowmobile seats two riders comfortably. Over the years, snowmobile performance has steadily increased to the point that many snowmobiles currently have engines over 100 horsepower and are capable of exceeding 100 miles per hour. The definition for snowmobiles includes a limit of 1.5-meter width to differentiate conventional snowmobiles from ice-grooming machines and snow coaches, which use very different engines.

There are four major snowmobile manufacturers, accounting for more than 99 percent of all domestic sales. The remaining sales come from very small manufacturers who tend to specialize in high-performance designs.

d. Other recreational vehicles

Currently, our Small SI nonroad engine regulations cover all recreational engines that are under 19 kW (25 hp) and have either an installed speed governor or a maximum engine speed less than 5,000 revolutions per minute (rpm). Recreational vehicles currently covered by the Small SI standards include go-carts, golf carts, and small mini-bikes. Although some off-highway motorcycles, ATVs and snowmobiles have engines with rated horsepower less than 19 kW, they all have maximum engine speeds greater than 5,000 rpm. Thus they have not been included in the Small SI regulations. The only other types of small recreational engines not covered by the Small SI rule are those engines under 19 kW that aren't governed and have maximum engine speed of at least 5,000 rpm. There are relatively few such vehicles with recreational engines not covered by the Small SI regulations. The best example of vehicles that fit in this category are stand-on scooters and skateboards that have been equipped with very small gasoline spark-ignition engines. The engines used on these vehicles are typically the same as those used in string trimmers or other lawn and garden equipment, which are covered under the Small SI regulations. Because these engines are generally already covered by the Small SI regulations and are the same as, or very similar to, engines as those used in lawn and garden applications, we are revising the Small SI rules to cover these engines under the Small SI regulations. To avoid any problems in transitioning to meet emission standards, we are applying these standards beginning in 2006. We did not receive any comments on this approach.

2. What is the regulatory history for recreational vehicles?

The California Air Resources Board (California ARB) established standards for off-highway motorcycles and ATVs, which took effect in January 1997 (1999 for vehicles with engines of 90 cc or less). California has not adopted standards for snowmobiles. The standards, shown in Table III.A-1, are based on the highway motorcycle chassis test procedures. Manufacturers may certify ATVs to optional standards, also shown in Table III.A-1, which are based on the utility engine test procedure.[38] This is the test procedure over which Small SI engines are tested. The stringency level of the standards was based on the emission performance of small four-stroke engines and advanced two-stroke engines with a catalytic converter. California ARB anticipated that the standards would be met initially by using high-performance four-stroke engines.

III.A-1
California Off-highway Motorcycle and ATV Standards for
Model Year 1997 and later (1999 and later for engines at or below 90 cc)

	HC	NOx	CO	PM
Off-highway motorcycle and ATV standards (g/km)	1.2[a]	—	15	—
	HC + NOx		CO	PM
Optional standards for ATV engines below 225 cc (g/bhp-hr)	12.0[a]		300	—
Optional standards for ATV engines at or above 225 cc (g/bhp-hr)	10.0[a]		300	—

[a] Corporate-average standard.

California revisited the program because a lack of certified off-highway motorcycles from manufacturers was reportedly creating economic hardship for dealerships. The number of certified off-highway motorcycle models was particularly inadequate.[39] In 1998, California revised the program, allowing the uncertified products in off-highway vehicle recreation areas with regional/seasonal use restrictions. Currently, noncomplying vehicles may be sold in California and used in attainment areas year-round and in nonattainment areas during months when exceedances of the state ozone standard are not expected. For enforcement purposes, certified and uncertified products are identified with green and red stickers, respectively. Only about one-third of off-highway motorcycles selling in California are certified. All certified products have four-stroke engines.

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[38] Notice to Off-Highway Recreational Vehicle Manufacturers and All Other Interested Parties Regarding Alternate Emission Standards for All-Terrain Vehicles, Mail Out #95-16, April 28, 1995, California ARB (Docket A-2000-01, document II-D-06).

[39] Initial Statement of Reasons, Public Hearing to Consider Amendments to the California Regulations for New 1997 and Later Off-highway Recreational Vehicles and Engines, California ARB, October 23, 1998 (Docket A-2000-01, document II-D-08).

B. Engines Covered by This Rule

We are adopting new emission standards for new off-highway motorcycles, ATVs, and snowmobiles. (We are also applying existing Small SI emission standards to other recreational equipment, as described above.) The engines used in recreational vehicles tend to be small, air- or liquid-cooled, reciprocating Otto-cycle engines that operate on gasoline.[40] Engines used in vehicle applications experience engine performance that is characterized by highly transient operation, with a wide range of engine speed and load capability. Maximum engine speed are typically well above 5,000 rpm. Also, with the exception of snowmobiles, the vehicles are typically equipped with transmissions rather than torque converters to ensure performance under a variety of operating conditions.[41]

1. Two-stroke vs. four-stroke engines

The engines used by recreational vehicles can be separated into two distinct designs: two-stroke and four-stroke. The distinction between two-stroke and four-stroke engines is important for emissions because two-stroke engines tend to emit much greater amounts of unburned HC and PM than four-stroke engines of similar size and power. Two-stroke engines have lower NOx emissions than do four-stroke engines because they experience a significant amount of internal exhaust gas recirculation resulting from exhaust gases being drawn back into the combustion chamber on the piston's downward stroke while the exhaust port is uncovered. Exhaust gas is inert and displaces fresh fuel and air that could otherwise be combusted, which creates lower in-cylinder temperatures and thus less NOx. Two-stroke engines also have greater fuel consumption than four-stroke engines, but they also tend to have higher power output per-unit displacement, lighter weight, and better cold-starting performance. These , and other characteristics, tend to make two-stroke engines popular as a power unit for recreational vehicles. With the exception of a few youth and touring models, almost all snowmobiles use two-stroke engines. Currently, about 63 percent of all off-highway motorcycles (predominantly in high-performance, youth, and entry-level bikes) and 20 percent of all ATVs sold in the United States use two-stroke engines.

The basis for the differences in engine performance and exhaust emissions between two-stroke and four-stroke engines can be found in the fundamental differences in how two-stroke and four-stroke engines operate. Four-stroke operation takes place in four distinct steps: intake, compression, power, and exhaust. Each step corresponds to one up or down stroke of the piston or 180° of crankshaft rotation. The first step of the cycle is for an intake valve in the combustion chamber to open during the intake stroke, allowing a mixture of air and fuel to be drawn into the cylinder while the piston moves down the cylinder. The intake valve then closes and the momentum of the crankshaft causes the piston to move back up the cylinder, compressing the air and fuel mixture. At the very end of the compression stroke, the air and fuel mixture is ignited by a spark from a spark plug and begins to burn. As the air and fuel mixture burns, increasing temperature and pressure cause the piston to move back down the cylinder. This is

[40] Otto-cycle is another name for a reciprocating, internal-combustion engine that uses a spark to ignite a homogeneous air and fuel mixture, in which air-fuel mixing may occur inside or outside the combustion chamber.

[41] Snowmobiles use continuously variable transmissions, which tend to operate like torque converters.

referred to as the "power" stroke. At the bottom of the power stroke, an exhaust valve opens in the combustion chamber and as the piston moves back up the cylinder, the burnt gases are pushed out through the exhaust valve to the exhaust manifold, and the cycle is complete.

In a four-stroke engine, combustion and the resulting power stroke occur only once every two revolutions of the crankshaft. In a two-stroke engine, combustion occurs every revolution of the crankshaft. Two-stroke engines eliminate the intake and exhaust strokes, leaving only compression and power strokes. This is due to the fact that two-stroke engines do not use intake and exhaust valves. Instead, they have intake and exhaust ports in the sides of the cylinder walls. With a two-stroke engine, as the piston approaches the bottom of the power stroke, it uncovers exhaust ports in the wall of the cylinder. The high pressure combustion gases blow into the exhaust manifold. As the piston gets closer to the bottom of the power stroke, the intake ports are uncovered, and fresh mixture of air and fuel are forced into the cylinder while the exhaust ports are still open. Exhaust gas is "scavenged" or forced into the exhaust by the pressure of the incoming charge of fresh air and fuel. In the process, however, some mixing between the exhaust gas and the fresh charge of air and fuel takes place, so that some of the fresh charge is also emitted in the exhaust. Losing part of the fuel out of the exhaust during scavenging causes very high hydrocarbon emission characteristics of two-stroke engines. The other major reason for high HC emissions from two-stroke engines is their tendency to misfire under low-load conditions due to greater combustion instability.

2. Applicability of Small SI regulations

In our regulations for Small SI engines, we established criteria, such as rated engine speed at or above 5,000 rpm and the use of a speed governor, that excluded engines used in certain types of recreational vehicles (see 40 CFR 90.1(b)(5)). Engines used in some other types of recreational vehicles may be covered by the Small SI standards, depending on the characteristics of the engines. For example, lawnmower-type engines used in go carts are typically covered by the Small SI standards because they don't operate above 5000 rpm. Similarly, engines used in golf carts are included in the Small SI program. As discussed above, we are revising the Small SI regulations to include all recreational engines except those in off-highway motorcycles, ATVs, snowmobiles, and hobby engines. Golf cart and go-cart engines will remain in the Small SI program because the vehicles are not designed for operation over rough terrain and do not meet the definition of ATV. We are accordingly removing the 5,000 rpm and speed governor criteria from the applicability provisions of the Small SI regulations.

3. Utility vehicles

We proposed to define ATV as a "nonroad vehicle with three or more wheels and a seat designed for operation over rough terrain and intended primarily for transportation.", and that it would include "both land-based and amphibious vehicles". We requested comment on the proposed definition and based on comments, we are modifying the definition to clearly exclude utility vehicles not capable of reaching 25 mph. Utility vehicles differ from ATVs in several ways. As stated earlier, an ATV is operated and ridden very similar to a motorcycle, with the rider straddling the seat and using handlebars to steer the vehicle. The throttle and brakes are located on the handle bars, similar to a motorcycle and snowmobile. Utility vehicles look and operate very similarly to golf carts. The operator sits on a bench seat with a back support that holds two or more passengers. Rather than handlebars, utility vehicles use a steering wheel and have throttle and brake pedals on the floor, similar to an automobile. Utility vehicles also typically have a cargo box or bed (similar to that found on a pick-up truck) used for hauling cargo. We define an off-highway utility vehicle as a "nonroad vehicle that has four or more wheels, seating for two or more persons, is designed for operation over rough terrain, and has either a rear payload of 350 pounds or more or seating for six or more passengers." We are requiring utility vehicles capable of high speed operation (speeds greater than 25 mph) to meet ATV standards. For utility vehicles that are permanently governed and not capable of reaching 25 mph, manufacturers must either continue to certify them to the Small SI standards (or Large SI standards, if applicable) or optionally certify them to the new ATV standards.

We received comments from the Outdoor Power Equipment Institute (OPEI) that the definition should be clarified to exclude utility vehicles. Most utility vehicles are equipped with engines that are currently required to meet EPA Small SI standards. OPEI commented that utility vehicles are designed specifically for work related tasks and are equipped with seating for passengers, a bed for cargo, and riding-mower-style controls.

The industry differentiates between utility vehicles based on vehicle speed. The vast majority of utility vehicles are considered "low-speed utility vehicles" (LUVs) and are vehicle speed governed with maximum speed of less than 25 mph. The engines used in such vehicles are generally below 25 hp and are typically used in other lawn and garden or utility applications such as generators or lawn tractors. The engines differ significantly from those used in recreational products which are designed for higher rpm operation with an emphasis on higher performance. OPEI also provided comment on a newer type of utility vehicle, which uses a more powerful (over 19kW) ATV-based engine and is capable of speeds of up to 40 mph.

We are finalizing the approach described. The engines used in low-speed utility vehicles are more similar in design and use to utility engines than ATVs. The engines used to power these vehicles are often used in other utility applications, such as lawn and garden tractors and generators and are typically produced by companies that specialize in utility and lawn equipment rather than power sport vehicles. These products are already certified to the Small SI standards.

However, we have some concerns with continuing to use the Small SI program test cycle for engines used in applications that operate at broad engine speeds. The cycle was developed primarily for push lawnmowers and other equipment that operates in a narrow band of engine speeds. The Small SI test cycle measures emissions only at a single high engine speed. We are concerned that the Small SI test cycle may not achieve the same emission reductions for off-highway utility vehicles in use as it would for lawnmowers, especially as more stringent standards go into effect. The concern also applies to other large ride-on equipment in the Small SI program, such as riding lawn mowers, where engine speed is inherently variable. While the ATV program may not be appropriate for these low-speed utility applications due to operating and design differences, the Small SI program as it is currently designed may not be completely appropriate either. Since we did not propose changes for the Small SI program which currently applies to utility vehicles and need to further study the issues, we are not finalizing such changes to the Small SI program in this Final Rule. We plan to continue to study the issue and, if necessary, address it through a future rulemaking for the Small SI program.

In addition to test cycle, there are other reasons we plan to continue to examine the appropriateness of the Small SI program for large ride-on equipment. With respect to useful life, we are concerned that off-highway utility vehicles may be designed to last significantly longer than the typical lawnmower. 40 CFR 90.105 specifies useful life values that vary by application with the longest useful life being 1000 hours. It is not clear that this maximum value is high enough to address the expected life of in-use off-highway utility vehicles, especially those that are used commercially. Finally, with respect to the level of the standards, we are concerned about the relative stringency of the Small SI standards relative to the long-term standards for ATVs and other nonroad vehicles. Nevertheless, given the low-speed operation of these vehicles, and other differences, we do not believe that they should be treated the same as higher speed ATVs. We did not propose changes for the Small SI program to address the above issues and need to study them further. However, these vehicles are unique in many ways, and should be addressed in a future rulemaking.

Given the utility nature of the low-speed vehicles, we believe that at least for now, it is appropriate to continue to certify them under 40 CFR part 90. For vehicles capable of higher speeds (e.g., greater than 25 mph), the engine designs and vehicle in-use operation is likely to be more like ATVs. The test procedures and standards for ATVs will better fit these high speed vehicles than those in the Small SI program. For regulatory purposes, we are defining an off-highway utility vehicle as a nonroad vehicle that has four or more wheels, seating for two or more persons, is designed for operation over rough terrain, and has either a rear payload capacity of 350 pounds or more or total seating for six or more passengers.

4. Hobby engines

The Small SI rule categorized spark-ignition engines used in model cars, boats, and airplanes as recreational engines and exempted them from the Small SI program.[42] We are continuing to exclude hobby engines from the Small SI program because of significant engine design and use differences. We also believe that hobby engines are substantially different than engines used in recreational vehicles and, as proposed, we are not including spark-ignition hobby engines in this final rule. We received no comment on our proposed treatment of hobby engines or any additional information on their design or use.

There are about 8,000 spark-ignition engines sold per year for use in scale-model aircraft, cars, and boats.[43] This is a very small subsection of the overall model engine market, most of which are glow-plug engines that run on

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[42] 80 FR 24292, April 25, 2000.

[43] Comments submitted by Hobbico on behalf of Great Plains Model Distributors and Radio Control Hobby Trade Association, February 5, 2001, Docket A-2000-01, document II-D-58.

a mix of castor oil, methyl alcohol, and nitro methane.[44] A typical spark-ignition hobby engine is approximately 25 cc with a horsepower rating of about 1-3 hp, though larger engines are available. These spark-ignition engines are specialty products sold in very low volumes, usually not more than a few hundred units per engine line annually. Many of the engines are used in model airplanes, but they are also used in other types of models such as cars and boats. These engines, especially the larger displacement models, are frequently used in competitive events by experienced operators. The racing engines sometimes run on methanol instead of gasoline. In addition, the engines are usually installed and adjusted by the hobbyist who selects an engine that best fits the particular model being constructed.

The average annual hours of operation has been estimated to be about 12.2 hours per year.[45] The usage rate is very low compared to other recreational or utility engine applications due to the nature of their use. Much of the hobby revolves around building the model and preparing the model for operation. The engine and model must be adjusted, maintained, and repaired between uses.

Spark-ignition model engines are highly specialized and differ significantly in design compared to engines used in other recreational or utility engine applications. While some of the basic components such as pistons may be similar, the materials, airflow, cooling, and fuel delivery systems are considerably different.[46, 47] Some spark-ignition model engines are scale replicas of multi-cylinder aircraft or automobile engines and are fundamentally different than spark-ignition engines used in other applications. Model-engine manufacturers often select lighter-weight materials and simplified designs to keep engine weight down, often at the expense of engine longevity. Hobby engines use special ignition systems designed specifically for the application to be lighter than those used in other applications. To save weight, hobby engines typically lack pull starters that are found on other engines. Hobby engines must be started by spinning the propeller. In addition, the models themselves vary significantly in their design, introducing packaging issues for engine manufacturers.

We are not including spark-ignition hobby engines in the recreational vehicles program. The engines differ significantly from other recreational engines in their design and use, as noted above. Emission-control strategies envisioned for other recreational vehicles may not be well suited for hobby engines because of their design, weight constraints, and packaging limitations. Approaches such as using a four-stroke engine, a catalyst, or fuel injection all would involve increases in weight, which would be particularly problematic for model airplanes. The feasibility of

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[44] Hobby engines with glow plugs are considered compression-ignition (diesel) engines because they lack a spark-ignition system and a throttle (see the definition of compression-ignition, 40 CFR 89.2). The nonroad diesel engine regulations 40 CFR part 89 generally do not apply to hobby engines, so these engines are unregulated.

[45] Comments submitted by Hobbico on behalf of Great Plains Model Distributors and Radio Control Hobby Trade Association, February 5, 2001, Docket A-2000-01, document II-D-58.

[46] E-mail from Carl Maroney of the Academy of Model Aeronautics to Christopher Lieske, of EPA, June 4, 2001, Docket A-2000-01, document II-G-144.

[47] Comments submitted by Hobbico on Behalf of Great Plains Model Distributors and Radio Control Hobby Trade Association, February 5, 2001, Docket A-2000-01, document II-D-58.

these approaches for these engines is questionable. Reducing emissions, even if feasible, would likely involve fundamental engine redesign and substantial R&D efforts. The costs of achieving emission reductions are likely to be much higher per engine than for other recreational applications because the R&D costs would be spread over very low sales volumes. The cost of fundamentally redesigning the engines could double the cost of some engines.

By contrast, because of their very low sales volumes, annual usage rates, and relatively short engine life cycle, spark-ignition hobby engine emission contributions are extremely small compared to recreational vehicles. The emission reductions possible from regulating such engines would be minuscule (we estimate that spark-ignition hobby engines as a whole account for less than 30 tons of HC nationally per year, much less than 0.01 percent of mobile source HC emissions).[48]

In addition, hobby engines differ significantly in their in-use operating characteristics compared to small utility engines and other recreational vehicle engines. It is unclear if the test procedures developed and used for other types of spark-ignition engine applications would be sufficiently representative or even technically practical for hobby engines. We are not aware of any efforts to develop an emission test cycle or conduct any emission testing of these engines. Also, because installing, optimizing, maintaining, and repairing the engines are as much a part of the hobby as operating the engine, emission standards could fundamentally alter the hobby itself. Engines with emission-control systems would be more complex and the operator would need to be careful not to make changes that would cause the engine to exceed emission standards. EPA will continue to review these issues, as necessary, in the future and reconsider adoption of regulations if appropriate.

5. Competition exemptions

a. Off-Highway motorcycles

Currently, a large portion of off-highway motorcycles are designed as competition/racing motorcycles. These models often represent a manufacturer’s high-performance offerings in the off-highway market. Most such motorcycles are of the motocross variety, although some high-performance enduro models are marketed for

[48] For further information on the feasibility, emission inventories, and costs, see “Analysis of Spark Ignition Hobby Engines”, Memorandum from Chris Lieske to Docket A-2000-01, document II-G-144.

competition use.[49,50] These high-performance motorcycles are largely powered by two-stroke engines, though some four-stroke models have been introduced in recent years.

Competition events for motocross motorcycles mostly involve closed-course or track racing. Other types of off-highway motorcycles, such as enduros and trials bikes, are usually marketed for trail or open-area use. When used for competition, these models are likely to be involved in point-to-point competition events over trails or stretches of open land. There are also specialized off-highway motorcycles that are designed for competitions such as ice racing, drag racing, and observed trials competition. A few races involve professional manufacturer-sponsored racing teams. Amateur competition events for off-highway motorcycles are also held frequently in many areas of the U.S.

Clean Air Act subsections 216 (10) and (11) exclude engines and vehicles "used solely for competition" from nonroad engine and nonroad vehicle regulations. In the proposal we stated that in previous nonroad engine emission-control programs, we have generally defined the term as follows:

> *Used solely for competition* means exhibiting features that are not easily removed and that would render its use other than in competition unsafe, impractical, or highly unlikely.

Most motorcycles marketed for competition do not appear to have obvious physical characteristics that constrain their use solely to competition. In fact, they are usually sold by dealers from the showroom floor. Upon closer inspection, however, there are several features and characteristics for many competition motorcycles that make recreational use unlikely. For example, motocross bikes are not equipped with lights or a spark arrester, which prohibits them from legally operating on public lands (such as roads, parks, state land, and federal land).[51] Vehicle performance of modern motocross bikes is so advanced (for example, with extremely high power-to-weight ratios and advanced suspension systems) that it is highly unlikely that these machines will be used for recreational purposes. In addition, motocross and other competition off-highway motorcycles typically do not come with a warranty, which

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[49] A motocross bike is typically a high-performance off-highway motorcycle that is designed to be operated in motocross competition. Motocross competition is defined as a circuit race around an off-highway closed-course. The course contains numerous jumps, hills, flat sections, and bermed or banked turns. The course surface usually consists of dirt, gravel, sand, and mud. Motocross bikes are designed to be very light for quick handling and easy maneuverability. They also come with large knobby tires for traction, high fenders to protect the rider from flying dirt and rocks, aggressive suspension systems that allow the bike to absorb large amounts of shock, and are powered by high-performance engines. They are not equipped with lights.

[50] An enduro bike is very similar in design and appearance to a motocross bike. The primary difference is that enduros are equipped with lights and have slightly different engine performance that is more geared towards a broader variety of operation than a motocross bike. An enduro bike needs to be able to cruise at high speeds as well as operate through tight woods or deep mud.

[51] A spark arrester is a device located in the end of the tailpipe that catches carbon sparks coming from the engine before they get out of the exhaust system. This is important when a bike is used off-highway, where hot carbon sparks falling in grassy or wooded areas could result in fires.

further deters purchasing and using competition bikes for recreational operation.[52] We believe these features are sufficient in distinguishing competition motorcycles from recreational motorcycles. Therefore, we are specifically adopting the following features as indicative of motorcycles used solely for competition: *absence of a headlight or other lights; the absence of a spark arrester; suspension travel greater than 10 inches; an engine displacement greater than 50 cc; absence of a manufacturer warranty; and the absence of a functional seat.*

Manufacturers must specifically request and receive an exemption from EPA to sell off-highway motorcycles without a certificate under the competition exemption. Vehicles not meeting the applicable criteria listed above will be exempted only in cases where the manufacturer has clear and convincing evidence that the vehicles for which the exemption is being sought will be used solely for competition. Examples of this type of evidence may be technical rationale explaining the differences between a competition and non-competition motorcycle, marketing and sales information indicating the intent of the motorcycle for competition purposes, and survey data from users indicating the competitive nature of the motorcycle.

Although there are several features that generally distinguish competition motorcycles from recreational motorcycles, several parties have commented that they believe motorcycles designed for competition use are also used for recreational purposes, rather than solely for competition. This is of particular concern because competition motorcycles represent about 29 percent of total off-highway motorcycle sales or approximately 43,000 units per year. However, a study on the characterization of off-highway motorcycle usage found that there are numerous—and increasingly popular—amateur off-highway motorcycle competitions across the country, especially motocross.[53] The estimated number of off-highway motorcycle competitors is as high as 80,000. Since it is very common for competitive riders to replace their machines every one to two years, the sale of 43,000 off-highway competition motorcycles appears to be a reasonable number, considering the number of competitive participants. We are therefore confident that, although we are excluding a high percentage of off-highway motorcycles as being competition machines, the criteria laid out above are indicative of motorcycles used solely for competition.

However, we do recognize that it is possible that some competition motorcycles will be used for recreational purposes. We are therefore adopting a provision within the regulations that allows the Agency to deny a manufacturer's claim for exemption from the standards for any models, including models that meet the six specified criteria, where other information is available that indicates these off-highway motorcycle models are not used solely for competition. This same provision allows the Agency to deny claims for exemptions in later years even if they had been granted previously. Examples of this type of information can be state registration data that indicate a significant number of competition exempt models being registered to operate on public lands. Off-highway competition motorcycles designed for motocross competition are not typically required to be registered with states, since most motocross competitions occur on closed-circuit courses on private, not public land, and motocross machines lack

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[52] Most manufacturers of motocross racing motorcycles do not offer a warranty. Some manufacturers do, however, offer very limited (1 to 3 months) warranties under special conditions.

[53] "Characterization of Off-Road Motorcycle Use," ICF Consulting, September 2001, A-2000-1 document II-A-81.

spark arresters which are required to operate on public land. We believe the possibility of losing an exemption for competition motorcycles will encourage manufacturers to take proper actions in promoting, marketing, and guaranteeing that competition machines are sold to those individuals who will use them solely for competition.

b. Snowmobiles and ATVs

Snowmobiles and ATVs are also used in competition events; however, the percentage of snowmobiles or ATVs used solely for competition is not nearly as large as that for off-highway motorcycles. Since snowmobile and ATV competition have typically not been as popular as off-highway motorcycle competitions, there has not been the demand for competition machines that exists with off-highway motorcycles. As a result, manufacturers have not manufactured and sold directly from their dealers competition snowmobiles and ATVs like they have off-highway motorcycles. Most snowmobiles and ATVs used in competition events are modified recreational vehicles, rather than stock racing machines bought directly from the dealer, as is the case with off-highway motorcycles. As a result, there isn't the same concern over potential misuse of competition snowmobiles and ATVs for recreational purposes.

Competition snowmobiles and ATVs aren't currently sold directly at the dealership. Therefore, manufacturers can receive a competition exemption from EPA for snowmobiles and ATVs meeting all of the following criteria: *the vehicle or engine may not be displayed for sale in any public dealership; sale of the vehicle must be limited to professional racers or other qualified racers; and the vehicle must have performance characteristics that are substantially superior to noncompetitive models.*

As with off-highway motorcycles, snowmobiles and ATVs not meeting the applicable criteria listed above will be exempted only in cases where the manufacturer has clear and convincing evidence that the vehicles for which the exemption is being sought will be used solely for competition. We are also adopting the same provision as for off-highway motorcycles within the regulations that allows the Agency to deny a manufacturer's claim for exemption from the standards for any models where other information is available that indicates these snowmobiles and ATVs models are not used solely for competition. As with off-highway motorcycles, this same provision allows the Agency to deny claims for exemptions in later years even if they had been granted previously.

C. Emission Standards

1. What are the emission standards and compliance dates?

a. Off-highway motorcycles

We are adopting HC plus NOx and CO standards for off-highway motorcycles. We expect the largest benefit to come from reducing HC emissions from two-stroke engines. Two-stroke engines have very high HC emission levels. Baseline NOx levels are relatively low for engines used in these applications and therefore including NOx in the standard serves only to cap NOx emissions for these engines. Comparable CO reductions can be expected from both two-stroke and four-stroke engines, as CO levels are similar for the two engine types. We are also adopting averaging, banking and trading provisions for off-highway motorcycles, as discussed below.

In the current off-highway motorcycle market, consumers can choose between two-stroke and four-stroke models in most sizes. Each engine type offers unique performance characteristics. Some manufacturers specialize in two-stroke or four-stroke models, while others offer a mix of models. The HC standard is likely to be a primary determining factor for what technology manufacturers choose to employ to meet emission standards overall. HC emissions can be reduced substantially by switching from two-stroke to four-stroke engines. Four-stroke engines are very common in off-highway motorcycle applications. Approximately 55 percent of non-competition off-highway motorcycles are four-stroke. Certification results from California ARB's emission-control program for off-highway motorcycles, combined with our own baseline emission testing, provides ample data on the emission-control capability of four-stroke engines in off-highway motorcycles. Off-highway motorcycles certified to California ARB standards for the 2000 model year have HC certification levels ranging from 0.4 to 1.0 g/km. These motorcycles have engines ranging in size from 48 to 650 cc; none of these use catalysts.

The emission standards for off-highway motorcycles take effect beginning in the 2006 model year. We will allow a phase-in of 50-percent implementation in the 2006 model year with full implementation in 2007. These standards apply to testing with the highway motorcycle Federal Test Procedure (FTP) test cycle. For HC+NOx emissions, the standard is 2.0 g/km (3.2 g/mi). For CO emissions, the standard is 25.0 g/km (40.5 g/mi). Both of these standards are based on averaging with a cap on the Family Emission Limit (FEL) of 20 g/km for HC+NOx and 50 g/km for CO. Banking and trading provisions are also included in the program, as described in Section III.C.2. These emission standards allow us to set near-term requirements to introduce the low-emission technologies for substantial emission reductions with minimal lead time. We expect manufacturers to meet these standards using four-stroke engines with some low-level modifications to fuel-system calibrations. These systems are similar to those used for many years in highway motorcycle applications, but with less overall sophistication for off-highway applications.

We received comments from several states and environmental groups encouraging us to harmonize our off-highway motorcycle standards with California. The comments focused on the perceived difference in stringency between the two programs. For California, the standard is an HC-only standard of 1.2 g/km. Our standard is a HC+NOx standard of 2.0 g/km. We believe it is prudent to set a HC+NOx standard in lieu of a HC-only standard since the main emission-control strategy is expected to be the use of four-stroke engines in lieu of two-stroke engines. Two-stroke engines emit extremely low levels of NOx. Four-stroke engines, on the other hand, have higher NOx emission levels, in the range of 0.3 g/km on average. This is part of the reason why we proposed a somewhat higher numeric standard compared to California.

The California standards, which were adopted in 1994, were stringent enough that manufacturers were unable to certify several models of off-highway motorcycles, even some with four-stroke engine technology. The result was a substantial shortage of products for dealers to sell in California. The shortage led California to change their program to allow manufacturers to sell noncompliant off-highway motorcycles under some circumstances. As a result, approximately a third of the off-highway motorcycles sold in California are compliant with the standards. The uncertified models being sold in California include both two-stroke and four-stroke machines.

EPA received comments from dealers and consumers concerned that a similar shortage could arise nationwide if EPA adopted the California standards. EPA shared this concern and proposed standards that were somewhat less stringent than that of California, based on test data from high-performance four-stroke machines. We are finalizing this approach to ensure the four-stroke technology can be implemented broadly across the product line in the 2006 time-frame. Although the approach we are finalizing contains somewhat less stringent standards than the California program, we believe it will achieve reductions beyond that of the California program because more products will be certified (even when the competition exemption is taken into account). The vast majority of the HC reductions achieved by the program come from shifting away from conventional two-stroke engines which have HC emissions levels in the range of 35 g/km. The 2.0 g/km standard represents about a 95-percent reduction in emissions for these vehicles.

If we were to go beyond this level of reduction, manufacturers would need to employ on a widespread basis additional technology that presents significant technical issues concerning their application to off-highway motorcycles given their extreme usage patterns and issues such as safety, packaging, and weight. For example, technologies such as electronic fuel injection and secondary air injection raise concerns about their durability and reliability in the harsh operating environments to which off-highway motorcycles are sometimes exposed. The use of catalytic converters poses concerns over packaging, durability and safety. Off-highway motorcycles are very light and narrow. These attributes are necessary for operating through tight forest trails and other harsh conditions. This leaves little room for packaging a catalyst so that it won't be damaged from engine vibration, shock resulting from jumps and hopping logs, and falling over and hitting objects, such as trees and rocks. These technologies may become compatible for off-highway motorcycles in the future, but we do not believe that it is appropriate to promulgate emission standards based on these technologies at this time, given the technical problems currently associated with their use. Four-stroke engine technology has advanced considerably since the California regulations went into effect. Manufacturers are now capable of offering four-stroke engines that provide excellent performance. This performance can be achieved only as long as manufacturers are allowed to operate four-stroke engines with a slightly rich air and fuel mixture, which can result in somewhat higher HC and CO emissions. Although the standards we are setting are higher than those in California, we believe they will require four-stroke engines that are well calibrated for emissions control without significantly sacrificing performance. For these reasons, we believe the standards we are establishing are appropriate.

As discussed above in Section III.B.5, the Clean Air Act requires us to exempt from emission standards off-highway motorcycles used for competition. We expect several competition two-stroke off-highway motorcycle models to continue to be available. We are concerned that setting standards as stringent as California's would result in a performance penalty for some four-stroke engines that would be unacceptable to the consumers. This could encourage consumers who want performance-oriented off-highway motorcycles to purchase competition vehicles (and use them recreationally) in lieu of purchasing compliant machines that don't provide the desired performance. We believe that our emission standards will allow the continued advancement of four-stroke technology and properly considers available emission-control technology while taking vehicle performance into consideration and avoiding significant adverse impacts on performance.

As proposed, we are also finalizing an option allowing off-highway motorcycles with an engine displacement of 50 cc or less to be certified using the Small SI emission standards for non-handheld Class I engines. These youth-oriented models may not be able to operate over the FTP due to the higher speeds of the test cycle. We did not receive comment on this provision.

Optional Standards

During the comment period, we received several comments expressing concern that our proposed standard of 2.0 g/km HC+NOx for off-highway motorcycles would effectively prohibit the use of two-stroke engines in non-competition applications. These engines currently have typical HC+NOx levels of about 35 g/km. The commenters argued that two-stroke engines possess several unique attributes, such as high power and light weight, that make two-stroke powered off-highway motorcycles more desirable to some operators, especially smaller, lighter riders, than heavier four-stroke powered off-highway motorcycles.

We also received comments from several states and environmental organizations expressing strong concern over the number of competition off-highway motorcycles that would be exempt from our regulations as a result of our competition exemption. They felt that people purchasing exempt competition motorcycles would use them for recreational purposes instead of solely for competition.

One manufacturer indicated that they were planning on building high-performance off-highway motorcycles equipped with direct fuel-injection two-stroke engines that would potentially be capable of meeting a HC+NOx standard of 4.0 g/km. To enable use of this technology, they suggested that we should adopt a standard of 4.0 g/km instead of the proposed standard of 2.0 g/km. The commenter believes that direct injection could be used to make clean competition machines and also argued that the technology is robust and not as susceptible to user modifications as other technologies such as catalysts. The commenter wanted an opportunity to develop and certify their product because it perceives a benefit to the purchaser not only in performance but also in the ability for the owner to resell the competition vehicle into the secondary market without concerns about potential misuse. In addition, the owner would be able to use the vehicle both for competition and recreation.

It is clear that if manufacturers were able to certify and bring to market clean competition machines as described by the commenter, significant reductions in emissions would be gained over conventional two-stroke technology. Some competition models we tested had baseline HC and CO emissions in excess of 50 g/km and 40 g/km, respectively. We believe it is appropriate to provide an avenue for the development and voluntary certification of clean competition motorcycles. Therefore, we are finalizing an optional set of standards for off-highway motorcycles of 4.0 g/km HC+NOx and 35.0 g/km CO. For manufacturers to utilize this option, however, they must certify all of their models, including their competition models, to the optional standards. To qualify for this option, a manufacturer must show that ten percent or more of their sales would otherwise meet the competition definition.

The optional standard was derived from the fact that non-competition four-stroke engines can meet a 2.0 g/km level and competition two-stroke machines with advanced direct fuel-injection technology could meet a 8.0 g/km level. Since approximately one-third of the total off-highway motorcycle fleet are competition machines and the other two-thirds would be non-competition four-stroke recreational machines, the weighting of the 2.0 g/km level by two-thirds and the 8.0 g/km level by one-third results in a weighted standard of 4.0 g/km. This presumes that emissions from four-stroke engines will not increase under this option and that non-competition engines will be almost exclusively four-stroke engines. These assumptions are discussed below. The significant reductions in otherwise unregulated competition engines means that this option should produce even greater overall reductions than the base 2.0 g/km standard. We recognize that for some manufacturers this program will increase opportunities to make a limited number of non-competition recreational two-stroke machines; however, we believe that the number of two-stroke non-competition engines developed under this program will be limited by the fact that the required technology (direct fuel-injection) would be too expensive and complex for the recreational motorcycle market. The majority of non-competition recreational off-highway motorcycles that use two-stroke engines are entry-level and youth motorcycles, where cost and simplicity are important factors. There is also the fact that for every two stroke non-competition engine manufactured under this program, a manufacturer must make one less competition engine or must make more four-stroke engines. Further, we believe that any increase in the number of non-competition two-stroke engines is justified given the fact that this program will overall bring levels from off-highway engines down considerably and the fact that the technology needed to reduce emissions from competition machines will only be made available and used if, under this optional approach, manufacturers have an incentive to use the technologies.

One major incentive in using this approach is the fact that once these machines are certified, a consumer will be able to use these machines legally for non-competition uses, which increases the value of the competition machines. This approach thus will also reduce the incentive for manufacturers to manufacturer all of their two-stroke machines as competition machines to avoid regulation, and thus reduce the incentive for users to circumvent the regulations. This may mean that any increase in two-stroke non-competition engines under this approach would not lead to an increase in total two-stroke sales, because manufacturers will not have an incentive to increase the number of two-stroke competition vehicles to avoid regulation.

We believe this approach is responsive to all of the above comments. It directly addresses the concerns of the manufacturer developing the new competition motorcycle and also helps address the concerns of users, states, and environmental groups. The successful development and certification of clean competition models increases the choices for consumers in the marketplace. Offered the option of a certified high-performance two-stroke off-highway motorcycle that can be used both for competition and recreation, consumers may not feel the need to purchase exempt competition motorcycles. This option has the potential to significantly decrease the number of conventional two-stroke competition machines sold under the competition exemption and is likely to decrease the potential for misuse of competition machines. Conventional competition two-stroke motorcycles generate extremely high levels of HC emissions, as noted above. For every conventional two-stroke competition machine replaced by a certified competition machine, HC emissions would be reduced by 80 percent, or more.

While the 4.0 g/km standard is higher than the 2.0 g/km standard contained in the base program, we do not expect any loss in emissions reductions from four-stroke models. We continue to believe most off-highway motorcycles will continue to be powered by four-stroke engines. Most non-competition off-highway motorcycles are already four-stroke motorcycles, and the trend towards four-stroke is continuing even in the absence of these regulations. We are convinced that there will be no backsliding of emissions control for motorcycles using four-stroke engines, because the dirtiest of the four-stroke models tend to be competition machines, and our emissions testing indicates that competition four-stroke off-highway motorcycles have HC+NOx emission levels below 2.0 g/km. Since these motorcycles are optimized for power and racing conditions, there is no incentive for manufacturers to increase HC+NOx emissions from their current levels. In fact, increasing the emission levels would mean increasing the air-to-fuel mixture, which would tend to reduce the engines performance.

As with the primary program, these optional standards would take effect in 2006 with 50-percent implementation and full implementation in 2007 and manufacturers could switch between the options from model year to model year. The HC+NOx standard can be met through averaging with some families certified above the standards and some below. If averaging is used, the FEL cap would be 8.0 g/km.

We are retaining the averaging approach for this option because it may be a critical flexibility for manufacturers pursuing clean competition products. The commenter based its recommendation for a 4.0 g/km standard on their projections for a single prototype model equipped with a medium sized engine. This engine is in the early stages of development and there is some uncertainty as to what emissions level the final product can achieve. Also, manufacturers may want to apply their approach to other engines that may not be able to achieve this same level of control. Manufacturers could find that they can produce competition products that are very clean relative to the baseline but with higher emissions than 4.0 g/km. For example, larger engine sizes could have emissions levels somewhat higher than the 4.0 g/km suggested by the commenter. We are not satisfied at this time that two-stroke off-highway motorcycles, particularly those used in competition could meet the 4.0 g/km standard, especially considering the special performance needs of competition motorcycles. Therefore, rather than keeping a 2.0 g/km standard for four-stroke engines and having a standard higher than 4.0 g/km for two-stroke engines (a standard as high as 8.0 g/km might be appropriate), we are using a 4.0 g/km standard that permits averaging. Averaging provides flexibility for manufacturers to bring cleaner two-stroke, particularly cleaner competition two-stroke, engines to market without creating a disincentive to building four-stroke engines. One way of taking advantage of the averaging program in this way would be for a manufacturer to maximize its sales of four-stroke models as part of its sales mix, and average the emissions from these engines against the higher emissions of the two-stroke competition engines which still would need to be much cleaner than if they were unregulated. This approach therefore requires the substantial use of cleaner four-stroke technologies while at the same time encouraging manufacturers to substantially reduce emissions from motorcycles that would otherwise be unregulated competition motorcycles. We have capped the emissions levels at 8.0 g/km HC+NOx because we want to ensure that products certified under this option provide large emissions reductions compared to baseline levels and that the option provides environmental benefits in all cases. Competition motorcycles certified to the 8.0 g/km level would continue to provide over a 75-percent reduction in HC emissions over baseline levels.

One of the challenges facing manufacturers selecting this option is the potentially high CO emissions from competition machines. We tested competition models and found CO emissions to be in the range 25 to 50 g/km. Although this option contains a somewhat higher CO standard (35 g/km compared to 25 g/km) than the base program, manufacturers are still expected to need to control CO emissions through tight engine calibrations. We are not including averaging for the less stringent CO standard. As noted by the manufacturer supporting the 4.0 g/km option, direct injection technology is likely to reduce CO from two-stroke engines. We believe that through proper calibration, the 35 g/km standard will be achievable and will not significantly impede manufacturers in selecting this option.

b. ATVs

We are adopting HC plus NOx and CO standards for ATVs. We expect the largest benefit to come from reducing HC emissions from two-stroke engines. Two-stroke engines have very high HC emission levels. Baseline NOx levels are relatively low for engines used in these applications and therefore including NOx in these standards serves only to cap NOx emissions for these engines. Comparable CO reductions can be expected from both two-stroke and four-stroke engines, as CO levels are similar for the two engine types. We are also adopting averaging, banking and trading provisions for ATVs, as discussed below.

In the current ATV market, consumers can choose between two-stroke and four-stroke models, although the majority, approximately eighty-percent of sales, are four-stroke. Each engine type offers unique performance characteristics. Some manufacturers specialize in two-stroke or four-stroke models, but most manufacturers offer a mix of models. The HC standard is likely to be a primary determining factor for which technology manufacturers choose to employ to meet emission standards overall. HC emissions can be reduced substantially by switching from two-stroke to four-stroke engines. Certification results from California ARB's emission-control program for ATVs, combined with our own baseline emission testing, provides ample data on the emission-control capability of four-stroke engines in ATVs.

In the proposal we included two phases of ATV standards. The first phase of standards, 2.0 g/km HC+NOx and 25 g/km CO, was proposed be phased in at 50 percent of production in 2006 with the remainder phased-in for 2007. We proposed a second set of standards that included a more stringent 1.0 g/km HC+NOx standard with no change to the CO standards. It was to be met in 2009/2010 using the same 50-percent and 100-percent phase-in scheme as Phase 1. We proposed that both phases of HC+NOx standards could be met through averaging.

We received comments from several environmental groups stating that we should harmonize our Phase 1 standards with the California FTP-based standards. Manufacturers did not comment on the level of our proposed Phase 1 HC+NOx standards. However, in a letter sent to the Agency in August 6, 2001, just before we published the proposal, the Motorcycle Industry Council stated that the most cost-effective approach to setting standards for ATVs would be to adopt the California HC standards of 1.2 g/km. They did comment on the fact that almost all of the CO nonattainment areas identified in the Draft Regulatory Support Document are now in compliance and that ATV activity is typically so far removed from congested urban areas, that we should delete the proposed CO standard.[54] Manufacturers stated generally that CO standards will make it more difficult to meet the HC+NOx standards but did not provide additional specific comments on the feasibility or costs of the CO level proposed. In subsequent meetings with manufacturers, they suggested

[54] We respond to these comments in Section II of the Summary and Analysis of Comments.

that if we were not going to delete the CO standard, it should be set sufficiently high so that it would not be an impediment to meeting the HC+NOx standard. They suggested a level of 50.0 g/km.

We have decided to finalize only one set of HC+NOx emission standards for the 2006 model year that are essentially equivalent to the California standard. The emission standards for ATVs take effect beginning in the 2006 model year. We will allow a phase-in of 50-percent implementation in the 2006 model year with full implementation in 2007. These standards apply to testing with the highway motorcycle Class I FTP test cycle. For HC+NOx emissions, the standard is 1.5 g/km (2.4 g/mi). The California program has a HC-only standard of 1.2 g/km. We have made the standard 1.5 g/km to account for NOx emissions. For CO emissions, we agree with manufacturers that CO standards can make it more difficult to meet the HC+NOx standard. Based on our emission test data, we feel that a standard of 35.0 g/km (56.4 g/mi) is more appropriate than the 25.0 g/km standard we proposed or the 50.0 g/km standard suggested by the manufacturers. A standard of 35.0 g/km will still result in an overall reduction in CO emissions from high emitting ATVs, but will also allow manufacturers to balance CO control with the need to meet stringent NOx levels. The HC+NOx standard may be met through averaging. Banking and trading provisions for HC+NOx are also being included in the program, as discussed in C.2., below.

Our decision to finalize a 1.5 g/km value rather than the 2.0 g/km value is consistent with the manufacturers technical capability in the 2006/2007 time-frame. The 1.5 g/km HC+NOx and 35 g/km CO standards require the use of engine technology changes and add-on devices such as secondary air systems, which are clearly available for ATV application in this time frame. We proposed a 1.0 g/km HC+NOx standard for a 2009/2010 phase-in which could require use of catalytic converter technology in many models of ATVs. As discussed below, we are not finalizing that proposal now, and thus find it appropriate to finalize more stringent Phase 1 standards which are technologically feasible and otherwise consistent with statutory criteria related to cost, safety, noise, and energy considerations.

Aligning our emission standards with those currently in place in California allows us to set requirements to introduce the low-emission technologies for substantial emission reductions with reasonable lead time and will for the most part allow manufacturers to sell one model in all fifty states. This “harmonization” between federal and California requirements is valued by industry because it allows the development and production of one emission-control technology per model/family. However, in a few cases, we expect emissions reductions under the EPA program that go beyond that of the California program because California allows the sale of uncertified ATVs, including two-stroke models, under their red sticker provisions. With the exception of competition exempt ATVs, all ATV models subject to the EPA program will need to be certified. We expect manufacturers to meet these standards using four-stroke engines with some modifications to fuel-system calibrations and some limited use of secondary air systems. These systems are similar to those used for many years in highway applications, but will likely require lesser sophistication than used in highway motorcycle applications.

In addition to being consistent with the California standards, we feel the 1.5 g/km HC+NOx standard is more appropriate than the proposed 2.0 g/km standard because our testing has shown that emission levels from four-stroke ATVs can vary considerably. We stated in the proposed rule that a standard of 2.0 g/km HC+NOx would be a four-stroke enforcing standard, which would most likely result in the elimination of any two-stroke engines, but not necessarily require any additional control from the four-stroke engines. As stated above, a standard of 1.5 g/km HC+NOx will require the use of engine technology changes and add-on devices such as secondary air systems, which are clearly available for ATV application in this time frame.

At this point, we do not believe it is appropriate to promulgate Phase 2 standards. In the proposal, we projected significant use of secondary air systems and catalysts for meeting the Phase 2 standards. Since that time, we have been conducting testing on ATVs with the type of catalysts and secondary air systems we envisioned for the Phase 2 standards to demonstrate feasibility. However, the testing we have done to date has not been sufficient to reach an affirmative conclusion on the feasibility of the Phase 2 standards. Testing with secondary air systems and catalysts have not shown consistent results and we have had only partial success in demonstrating the feasibility of the proposed Phase 2 standards using these technologies. In testing on a utility-type ATV, these technologies have provided only small emissions reductions.[55] The results of our preliminary testing are discussed further in Section III.F and in the Final Regulatory Support Document. It is unclear if the level of technology we projected in the proposal would be sufficient to meet the Phase 2 standards. We have not done enough research or testing on other potential technologies, such as electronic or direct fuel injection, to finalize a decision based on these technologies. We plan to continue to evaluate the technologies that would be needed to meet the Phase 2 levels and determine if those levels can be met with the level of technology we projected in the proposal or with other technology. We also received comments that we underestimated costs for Phase 2 and we will continue to evaluate costs as well.

In addition, we received comments that the emissions inventories we projected for ATVs were too large, and that if we adjusted them appropriately, we would see that Phase 2 was not needed. This is provided in detail in the public docket.[56] We have studied and evaluated in-depth the new and additional information provided by the commenters after we published the proposal. As is shown in our revised analysis, the emissions inventory projections for ATVs have been reduced by more than 75 percent in response to the significant new information we received after publishing the proposal. Our analysis of the appropriate standards for 2006/2007 described above was made using this new information, and future analysis of Phase 2 standards would also use these revised inventory numbers. However, it is important to note that the revised inventories still show that these vehicles contribute to nonattainment.

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[55] Utility-type ATVs, it should be noted, are not the same as utility vehicles. Utility vehicles are not considered ATVs due to fundamental differences in the vehicle characteristics. Most utility vehicles are currently regulated by the Small SI program, with a small subset of utility vehicles required by the Final Rule to meet ATV standards. See section III.B.3. above, for a complete discussion of utility vehicles. When we say utility-type ATV, we are referring to ATVs that have features that are work related such as cargo racks. These ATVs are often somewhat larger and bulkier than sport models and may have transmissions geared more for work related tasks rather than for high performance. However, they have ATV features such as four low pressure tires, a seat designed to be straddled by the operator, handlebars for steering controls, and are intended for use by a single operator. These vehicle must meet ATV requirements.

[56] Comments of the Motorcycle Industry Council, Inc., and the Specialty Vehicle Institute of America on the Notice of Proposed Rulemaking to Establish Mandatory Emission Standards for Nonroad Large Spark-Ignition Engines and Recreational Engines (Marine and Land-Based), Air Docket A-2000-01, IV-D-214.

Engine-based Standards

California allows ATVs to be optionally tested using the California ARB utility engine test cycle (SAE J1088) and procedures. In California, manufacturers using the J1088 engine test cycle option must meet the California Small Off-Road Engine emission standards. Some manufacturers do not have chassis testing facilities and at the time California finalized its program were concerned about the cost of doing FTP testing for California-only requirements. To use this option, manufacturers were required by California to submit some emission data from the various modes of the J1088 test cycles to show that emissions from these modes were comparable to FTP emissions. Although a good correlation was not found between the two test cycles, California allowed this option because the goal of their program was to encourage four-stroke engine technology in ATVs.

As described above, we are finalizing standards based on vehicle testing over the FTP that are essentially harmonized with the California FTP standards. We did not propose a permanent option of engine testing using J1088 due to strong concerns that the test cycle misses substantial portions of ATV operation because it contains test points at only one engine speed. We understand that vehicle testing would be a significant change for manufacturers who currently conduct emissions testing on the engine rather than the vehicle for California. Due to the costs and lead-time requirements associated with switching to vehicle-based testing, we proposed a transitional program to allow the J1088 option for models years 2006 through 2008. To facilitate the phase-in of ATV standards, we proposed to allow manufacturers to optionally certify ATVs using the California utility cycle and standards, shown in Table III.C-1, instead of the FTP standards.

Table III.C-1
California Utility Engine Emission Standards

Engine Displacement	HC+NOx	CO
less than 225 cc	12.0 g/hp-hr (16.1 g/kW-hr)	300 g/hp-hr (400 g/kW-hr)
greater than 225 cc	10.0 g/hp-hr (13.4 g/kW-hr)	300 g/hp-hr (400 g/kW-hr)

We are finalizing this approach, but will eliminate the J1088 option (including both the test cycle and the utility engine emission standards) for certification in model year 2009. The last model year to use the J1088 cycle and emission standards is 2008. We received comments that the FTP is also not representative of ATV operation and that the J1088 option should remain available until a new test cycle and accompanying standards can be developed and made available to manufacturers. Although it may not be completely representative of ATV operation, we believe the FTP to be greatly superior to the J1088 test cycle because the cycle is transient, emissions are measured at a variety of speeds and it is more likely to result in robust emission-control designs that reduce emissions in-use. We continue to be very concerned that the vast majority of ATV operation is missed with the J1088 test because the engine is tested at only one engine speed. ATV operation is inherently transient in nature because the user controls the throttle position to vary vehicle speed. We believe the J1088 test is not sufficient to ensure robust emissions control development and use for ATVs. Given the choice of available test procedures for the long-term, we could not justify retaining the J1088 option.

For small displacement ATVs of 70 cc or less, we proposed that they would have the permanent option to certify to the proposed FTP-based ATV standards discussed above or meet the Phase 1 Small SI emission standards for non-handheld Class 1 engines. These standards are 16.1 g/kW-hr HC+NOx and 610 g/kW-hr CO. Manufacturers argued that ATVs with engine displacements between 70 cc and 99 cc also should be allowed to certify to the Small SI standards, since the differences between a 70 cc and 99 cc engine is very small and the ATVs equipped with 99 cc engines face the same obstacles with the FTP test cycle as the 70 cc and below ATVs. They also argued that the Phase 1 Small SI standards are too stringent for these engines and recommended that EPA adopt the Phase 2 standards for Class 1B engines of 40 g/kW-hr for HC+NOx and 610 g/kW-hr for CO.

We recognize that the vast majority of engine families, including 4-stroke engines, below 100 cc are not certified to the California standards, which is an indication to us that the standards proposed may not be feasible for most engines in this size range given the lead time provided. However, manufacturers did not provide supporting data and we do not have data to confirm that the level recommended by the manufacturers would result in an appropriate level of control. We examined the 2002 model year certification data for non-handheld Small SI engines certified to the Phase 2 Class I-A and I-B engine standards (engines below 100 cc). We found that the five engine families certified to these standards had average emissions for HC+NOx of about 25 g/kW-hr. All of these engine families had CO emissions below 500 g/kW-hr and well below the 610 g/kW-hr level recommended by manufacturers. We believe these levels are more representative of the levels that can be achieved with the lead time provided through the use of 4-stroke engines than the standards recommended by the manufacturers. Therefore, we are finalizing a 25.0 g/kW-hr HC+NOx standard and a 500 g/kW-hr CO standard for ATVs with engine displacements of 99 cc or less. These standards will be optional to the FTP-based standards and, unlike the J-1088 standards option for larger displacement engines, the option will not expire. We are retaining averaging for the HC+NOx standard but do not believe averaging would be appropriate for the CO standard. This is consistent with the approach outlined above for J-1088 standards for engines above 100 cc.

The ATV standards are phased in at 50% of a manufacturer’s production in 2006 and 100% in 2007. This phase-in applies to a manufacturer’s overall ATV production regardless engine size or which option a manufacturer chooses for standards for particular models.

New Test Procedure for ATVs

We are comfortable with retaining the FTP as the basis of the long-term ATV program. However, EPA understands the manufacturers’ concerns regarding the additional facility costs associated with FTP testing for ATVs. We also recognize that this approach is a significant deviation from their current practice in the California program. Throughout the development of the final rule, we have met with manufacturers and the State of California and have discussed the possibility of developing a new test cycle for ATVs. We intend to work further with all interested parties to determine whether a new test cycle and accompanying standards is appropriate. The standards, if developed for the new test cycle, would be of equivalent stringency to the FTP standards discussed above. If we do propose a new test cycle and accompanying standards for ATVs, it is likely that we would do so in concert with a decision on whether a second phase of standards is appropriate for ATVs. We are now developing a Memorandum of Understanding with manufacturers which describes in detail the steps that will be taken in furtherance of this task.[57] Other interested parties including the state of California will also be invited to participate in this process.

By finalizing the temporary availability of J1088, we are providing time to develop, and if appropriate, finalize and implement an alternative to the FTP that meets both the needs of the Agency, manufacturers and other parties. This allows for our program to remain harmonized with California during the transition to the new test procedure. However, we do not support allowing the use of J1088 for a period any longer than necessary to make this transition. We expect that developing a new test cycle will be relatively straightforward and that the MOU process cited above will provide a road map of how we will proceed. We expect to initiate this effort next year and conclude the work on the new test cycle in enough time to promulgate it through rulemaking and to provide industry adequate lead time to implement it in an orderly manner (nominally three years lead time). If we encounter unforeseen and unavoidable delays or complications in this process, we will consider extending the J1088 temporarily as part of our process of adopting changes to the ATV test cycle through rulemaking. We would expect such an extension to be at most for one model year.

c. Snowmobiles

We are adopting CO and HC emission standards for snowmobiles, effective in three phases, as discussed below. As discussed below, we are also adopting an emissions averaging banking and trading program for snowmobiles which includes provisions for the early generation of credits prior to the effective date of the standards. We are not adopting PM standards for snowmobiles at this time, because limits on HC emissions will serve to simultaneously reduce PM and because there are significant complications in accurately measuring PM that make requiring PM standards difficult in this time frame. Finally, we are not adopting limits for NOx for the first two phases of standards, but manufacturers are required to measure NOx emissions and report them in the application for certification. However, we have included NOx in the Phase 3 standards to effectively cap NOx emissions from snowmobiles.

The three phases of standards we are adopting will require progressively broader application of advanced technologies such as direct injection two-stroke technology, and four stroke engines. Only about two percent of current snowmobile production utilizes these advanced technologies. We expect that about seven percent of new snowmobiles will have them by 2005. With the Phase 1 standards we expect that ten percent of snowmobiles will require advanced technologies (in addition to less advanced emissions controls on most other snowmobiles). We project that the Phase 2 and Phase 3 standards will require the application of advanced technology on 50 and 70 percent of new snowmobiles, respectively.

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[57] See item IV-G-114, docket A-2000-01.

Phase 1 Standards

We are adopting Phase 1 standards largely as proposed for snowmobiles to take effect for all models starting in the 2006 model year. However, given that the manufacturers will effectively have only three years to design and certify snowmobiles prior to the 2006 model year, as well as the fact that snowmobiles are currently unregulated, we believe that requiring 100 percent of models to certify in 2006 is not reasonable. Thus, we are including a phase in of the Phase 1 standards with 50 percent of sales required to comply with the 30 percent reduction standards in 2006 and 100 percent compliance required in 2007. The standards of 275 g/kW-hr (205 g/hp-hr) for CO and 100 g/kW-hr (75 g/hp-hr) for HC are to be met on average by each manufacturer. As described in the proposal, these standards represent a 30-percent reduction from the baseline CO and HC emission rates for uncontrolled snowmobiles. We expect manufacturers to meet these standards using a variety of technologies and strategies across their product lines. For the reasons described below, we believe these are the most stringent standards feasible beginning in the 2006 model year.

Snowmobiles pose some unique challenges for implementing emission-control technologies and strategies. Snowmobiles are very sensitive to weight, power, and packaging constraints. Current snowmobile designs have very high power-to-weight ratios, to address performance considerations. The desire for low weight has been stated to be a concern, since weight (and weight distribution) affects handling and operators occasionally have to drag their sleds out of deep snow. This has especially been mentioned as a concern in the context of four-stroke engines given that they are heavier than their two-stroke counterparts of similar power. However, four-stroke engines have significantly better fuel economy than two-stroke engines, and for identical fuel tank sizes, would have significantly greater range. This of course would be a positive attribute. The size of a fuel tank on a four-stroke powered snowmobile could be reduced to provide similar range to that of a similarly powered two-stroke snowmobile, resulting in offsetting weight savings from both the smaller fuel tank and less fuel on board. However, this could still represent a change in the distribution of weight compared to current sleds.

The approach used to control emissions in compliance with the Phase 1 standards will vary according to a given manufacturers product line, technological capability, long term plans, and other factors. However, we expect all manufacturers to pursue a mix of technologies. Some manufacturers may focus more on clean carburetion and associated engine modifications and apply those widely across their entire product line with more limited implementation of advanced technology such as four-stroke and semi direct injection engines. Others may choose to be more aggressive in applying advanced technologies in their more expensive, high-performance sleds and be less aggressive in pursuing emission reductions from their lower-priced offerings to optimize the fit of different technologies (and their associated costs) to the various product offerings in the near term. As can be seen on their websites[58], all large manufacturers now have limited product offerings of advanced emissions technology snowmobiles. Snowmobiles must, on average and according to the phase in schedule, meet the first phase of emission standards beginning with the 2006 model year. Given the relative inexperience this industry has with designing effective snowmobile engines with advanced emissions controls and in certifying to EPA requirements, it is unlikely that any manufacturer could market enough of these advanced snowmobiles for model year 2006 to enable it to meet significantly more stringent standards. Due to the unique performance

[58] http://www.arcticcat.com, http://www.polarisindustries.com, http://www.skidoo.com, and http://www.yamaha-motor.com.

requirements for snowmobiles and the relatively short lead time to modify current engines or design new products, we believe our 2006/2007 standards will be technologically challenging for manufacturers and will result in cleaner snowmobiles.

Phase 2 and Phase 3 Standards

We believe the two most viable advanced technologies for use in snowmobiles are two-stroke direct (or semi-direct) injection technology and four-stroke engines. All four major snowmobile manufacturers either currently offer or are planning to offer in the next year or two one or more of these technologies on a limited number of snowmobile models. With sufficient resources and lead time for manufacturers, we believe it would be technologically possible to eventually apply such advanced technology broadly across most or all of the snowmobile fleet.

Manufacturers have indicated that with enough investment and sufficient time to design and implement direct injection technology for snowmobile use, two-stroke engines equipped with direct fuel injection systems can reduce HC emissions by 70 to 75 percent and reduce CO emissions by 50 to 70 percent. These projections are based largely on laboratory prototypes and generally do not account for in-use deterioration or the need for production compliance margins in the ultimate certification levels. Certification results for 2002 model year outboard engines and personal water craft support these projections.[59]

In addition to the direct injection two-stroke, a few four-stroke models are currently available, and more are expected to be introduced in the next few years. Based on testing of prototypes and other low-hour engines it appears that advanced four-stroke snowmobiles are capable of HC reductions ranging from 70 to 95 percent relative to current technology two-stroke snowmobile engines. However, CO reductions from four stroke engines vary quite a bit. For four-stroke engines used in low-power applications, CO reductions of 50 to 80 percent from baseline levels have been reported. However, the majority of the snowmobile market is for higher-powered performance machines, and CO reductions from higher powered four stroke engines are lower than those from low powered four strokes, with expected reductions of 20 to 50 percent from baseline levels. As discussed further in the RSD and Summary and Analysis of Comments document, we expect that many of the four-stroke snowmobile models offered in the future will not be current two-stroke models which have been modified to utilize a four-stroke engine, but rather new models designed specifically to take advantage of the unique characteristics of four-stroke engines. Thus, we expect that the lead time associated with the conversion to four-stroke engines and optimized sleds is even longer than that needed for conversion to direct injection two-stroke technology.

It is not obvious to us that either of these advanced technologies is better than the other or more suited to broad application in the snowmobile market. Each has its strong points regarding emissions performance, power, noise, cost, etc. For example, two-stroke engines equipped with direct fuel injection have the potential to have greater CO emission reductions than a comparably powered four-stroke engine, although they would have less HC reductions. For those applications where a light, powerful, compact engine is desired, a direct injection two-stroke engine may be preferred. However, for applications where pure power and speed is desired, a high-performance four-stroke engine may be preferred.

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[59] See the snowmobile feasibility discussion in the Final Regulatory Support Document.

Given the broad range of snowmobile model designs and applications it is apparent that one of these technologies could be preferable to the other in some situations. Further, given the broad range of snowmobile types offered, a mix of advanced technologies would provide the best opportunity for substantial average emission reductions while still maintaining customer satisfaction across the entire range of snowmobile types. Thus, we believe it is most appropriate to set emission standards for snowmobiles that are not based entirely on the use of either direct injection two-stroke technology or four-stroke engines, but rather a mix of the two, along with some other technologies in certain applications.

It is our belief that with sufficient resources and lead time, manufacturers can successfully implement technologies such as two-stroke direct injection and four-stroke engines in many models in their respective snowmobile fleets. The question at hand is how broadly this technology can be practically applied across the snowmobile fleet in the near term, taking into account factors such as the number of engine and snowmobile models currently available, and the capacity of the industry to perform the research and development efforts required to optimally apply advanced technology to each of these models.

Currently there are only four major snowmobile manufacturers, and each has different technological capabilities. Of these four, only two currently manufacturer all of their own engines, one has limited in-house engine manufacturing operations, the other has none. Beyond this, there are only two advanced technologies (direct injection two-stroke, and four stroke) that at this time appear to be feasible to provide significant reductions in snowmobile emissions. Further, given the small volume of snowmobile sales compared to other vehicles and equipment which use similar sized engines, these manufacturers may have difficulty in working with their engine suppliers to develop and optimize four-stroke or direct injection two-stroke technology quickly. Clearly, the nature of the relationship between these snowmobile manufacturers and their suppliers would result in a less efficient use of available lead time as compared to the manufacturers that have both technology and engine manufacturing available in-house. Thus, there is varying capability within the snowmobile industry to develop and implement advanced technology in the next five to ten years.

The amount of engine redesign or development work is another factor. While one snowmobile manufacturer currently offers four different engine models, the other three, including the two that do not manufacture their own engines, currently offer eight to twelve engine models each. Additionally, each of these engine models typically goes into more than one type of snowmobile. There are a variety of basic snowmobile types specifically designed for a variety of riding styles and terrains including high-performance trail riding, high-performance off-trail riding (including designs specifically for deep snow), mountain riding, touring (two person snowmobiles designed for use on groomed trails), and entry level snowmobiles (lower-powered and lower priced snowmobiles which utilize simpler technology and are specifically designed to appeal to first time buyers). Some snowmobile manufacturers also offer snowmobile models specifically for youth, and utility models for work in cold climates or to facilitate winter sports such as hauling winter camping gear, or hunting and fishing equipment. It is not surprising that some of these snowmobile models are much more popular than others. Thus, there can be quite a difference in the production volumes of the different snowmobile types, with performance models typically having large sales volumes, and more unique models such as utility and youth models selling far fewer units.

Considering the number of snowmobile types, and the fact that each engine model is typically used in several different snowmobile models, each manufacturer has potentially dozens of different engine/snowmobile combinations that it offers. An analysis of the manufacturers current product offerings shows that while one manufacturer has only about twelve unique engine/snowmobile model combinations, the other three offer significantly more—from around 30 to over 50. Each of these different snowmobile models is designed with specific power needs in mind, with the engine and clutching specifically suited for the application style for which the snowmobile was intended. This means that a given engine model may require slightly different calibrations for each different snowmobile model in which it is used. While the advanced technologies are known, they are not "one size fits all" technologies. These technologies need to be optimized not only for the specific engine model, but in some cases for the snowmobile the engine will be used in as well, as just described.

For all of the reasons just discussed, we believe that it is necessary to allow two additional years of lead time for compliance with the proposed Phase 2 standards, and are therefore adopting the ultimate phase of snowmobile standards effective for the 2012 model year rather than the 2010 model year as proposed. However, we expect that between the 2006 and 2012 model years there can and will be substantial development and application of advanced technologies on snowmobiles beyond that required in compliance with the Phase 1 standards. We believe that it is important to capture the emission benefits that these advances present, and are therefore adopting a new set of Phase 2 standards, effective with the 2010 model year, which will require 50 percent HC reductions and 30 percent CO reductions from average baseline levels. The Phase 2 standards are 275 g/kW-hr (205 g/hp-hr) for CO and 75 g/kW-hr (56 g/hp-hr) for HC. These Phase 2 standards will be followed by Phase 3 standards in 2012 which will effectively require the equivalent of 50 percent reductions in both HC and CO as compared to average baseline levels.

We believe that the 2010 and 2012 model years are appropriate for the second and third phases of snowmobile standards because they allow an additional four to six years beyond the Phase 1 standards for the further development and application of advanced emissions control technology. We expect that the manufacturers will utilize some level of advanced technology in compliance with the Phase 1 standards, and this will give the manufacturers some time to evaluate how the advanced technology they have already applied works in the field as well as give them several years to work with the certification and compliance programs before more stringent Phase 2 standards take effect in 2010. We believe that by the 2010/2012 time frame manufacturers could, at least in theory, apply advanced technology across essentially their entire product lines. However, the manufacturers are resource constrained, and they will need to focus their efforts on compliance with the Phase 1 and Phase 2 standards prior to the 2010 model year. There is a need for significant technology development and manufacturing learning to occur, and there is concern that in this time frame such technology could not be performance, emissions, and safety optimized for each application given the number of engine and snowmobile model combinations that would require optimization. This would be especially challenging for those manufacturers who rely on outside suppliers for their engines. Rather, we expect that by the 2012 model year the manufacturers could both apply and optimize advanced technology to their larger volume families while applying clean carburetion and electronic fuel injection technology to the rest of their production. Under this scenario we expect that the manufacturers could apply optimized advanced technology on around 50 percent of their production by the 2010 model year, and an additional 20 percent of their production by the 2012 model year. We do not believe that having only two years lead time between the Phase 2 and Phase 3 standards presents any problems because compliance with the Phase 3 standards will be achieved through the broader application of technologies which will already be applied in compliance with the Phase 2 standards, rather than through the introduction of new technologies altogether.

As was previously discussed, four-stroke technology has the potential to significantly reduce HC emissions, even below levels expected from direct injection two-stroke technology. However, higher powered four-stroke engines are not currently capable of CO reductions on the order of those expected from direct injection two-stroke technology. This is significant given that a very large segment of the snowmobile market is in higher powered performance sleds. We are concerned that a straight 50 percent reduction in CO in the Phase 3 standards may deter technology development and constrain the use of four-stroke technology in this key portion of the snowmobile market. As the emissions standards become more stringent we believe that it is important to provide additional flexibility to assure compliance in a manner which minimizes costs and is consistent with the availability of technology and the realities of the snowmobile marketplace. Thus, to allow snowmobile manufacturers the flexibility to base their future product lines on higher percentages of four-stroke models, we are adopting a flexible Phase 3 standards scheme that will allow manufacturers to certify their production to levels which nominally represent 50 percent reductions in HC and CO. This overall reduction could be met by other combinations summing to 100 percent such as 70 percent reductions in HC and 30 percent reductions in CO, or any level between these two points (for example, 60 percent reductions in HC and 40 percent reductions in CO). However, in no case may a manufacturer's corporate average for the individual pollutants for Phase 3 be less than 50 percent on HC and 30 percent on CO (the Phase 2 standards).

Some manufacturers have raised safety concerns regarding the use of advanced technologies on snowmobiles, particularly four-stroke engines used in high-performance and mountain sleds. In particular, they raised issues regarding weight and the ability to start the snowmobile in cold weather. However, we believe these issues can be overcome with sufficient time and technology. For example, as noted above, smaller fuel tanks can significantly reduce the weight of four-stroke snowmobiles. The use of new light-weight materials can also reduce weight for four-stroke designs. Manufacturers have raised concerns over cold starting for four-stroke engines because the typical four-stroke design uses an oil distribution system where the pump and oil are located in the crankcase (referred to as a "wet" sump). During extremely cold temperatures, the oil becomes thick and provides an additional load the engine must overcome when starting. However, by using a "dry" sump, where the oil and pump are located in a separate tank (not in the crankcase), the concern over cold temperature starting loads due to thickened oil in the crankcase are gone. The new Yamaha RX-1 four-stroke snowmobile uses a smaller fuel tank and lighter materials to reduce weight and a dry sump to help cold starting, so clearly these issues can be addressed.

We believe that, given enough resources and lead time, it is ultimately feasible at some point beyond the 2012 model year to apply advanced technology successfully to all snowmobiles and perhaps to even resolve current design and operating issues with regard to the use of aftertreatment devices such as catalytic converters. However, it is difficult to predict at this point when this would be feasible, especially given the number of smaller volume snowmobile models that would need development effort once the larger volume models were optimized in compliance with the Phase 3 standards in 2012. We did consider standards based on the full application of optimized advanced technology to all snowmobiles, for example by setting the Phase 3 standards at a level that would require the full application of advanced technology to all snowmobiles. However, we believe that such standards are not feasible by 2012 and, we are not confident that we could choose the appropriate model year beyond 2012 for such standards given how far in the future such a requirement would be. Such an approach would also serve to eliminate the benefits associated with the Phase 3 standards in 2012. There are diverse capabilities and limiting factors within the industry, and time is needed for an orderly development and prove out of this advanced technology across the various models and applications before standards are set which require its use in all models. Additionally, as these engines have never previously been regulated or used advanced emission control technologies in large numbers, we believe it is appropriate to monitor the development and use of such technologies on snowmobiles before requiring these technologies for the entire fleet. Thus, we chose not to set standards at this time based on the optimized application of advanced technology to all snowmobiles. Nevertheless, we will monitor the development and application of the advanced technology as manufacturers work to comply with the Phase 3 standards in 2012 and will consider a fourth phase of snowmobile standards to take effect sometime after the 2012 model year.

We have not included a NOx standard for the first two phases of the snowmobile regulations because NOx emissions from snowmobiles, particularly two-stroke engines, are very small compared to levels of HC, CO and PM and we believe that stringent NOx standards may require the use of technologies that will lead to increases in HC, PM and CO levels. Technologies that reduce NOx are likely to increase levels of HC, PM and CO and vice versa, because technologies to reduce HC, PM and CO emissions would result in leaner operation. A lean air and fuel mixture causes NOx emissions to increase. These increases are minor, however, compared to the reductions of HC, CO and PM that result from these techniques. On the other hand, any attempt to control the NOx emissions may have the counter-effect of increasing HC, CO, and PM emissions, as well as causing the greater secondary PM concentrations associated with increased HC emissions. This is especially critical for HC and PM, because NOx would be regulated primarily for its effect on secondary PM levels.

We are promulgating a NOx standard (actually an HC plus NOx standard) as part of the third phase of the snowmobile standards. This standard will essentially cap NOx emissions from these engines. The reason we are including such standards in the final phase of the rule as that the third phase of the rule will result in increases in the use of four-stroke engines. While four-stroke engines greatly reduce HC and direct PM levels, they increase levels of NOx. While NOx levels remain substantially lower than HC and CO levels, they are higher than levels for two-stroke engines. Thus, it is appropriate to place a cap on such levels to ensure that levels do not become so high as to become a substantial concern.

While we are promulgating an effective cap on such emissions, the standard will not mandate substantial reductions in NOx. This is because the emissions effect on reducing NOx from four-stroke engines is the same as for two-stroke engines; that is, technologies that substantially reduce NOx will increase levels of other pollutants of concern. The only way to reduce NOx emissions from four-stroke engines (at the same time as reducing HC and CO levels) would be to use a three-way catalytic converter. We don’t have enough information at this time on the durability or safety implications of using a three-way catalyst with a four-stroke engine in snowmobile applications. Three-way catalyst technology is well beyond the technology reviewed for this rule and would need substantial additional review before being contemplated for snowmobiles. Thus, given the overwhelming level of HC and CO compared to NOx, and the secondary PM expected to result from these levels, it would be premature and possibly counterproductive to require substantial NOx reductions from snowmobiles at this time.

2. Are there opportunities for averaging, emission credits, or other flexibilities?

a. Averaging, banking and trading

Historically, voluntary emission-credit programs have allowed a manufacturer to certify one or more engine families at emission levels above the applicable emission standards, provided that the increased emissions are offset by one or more engine families certified below the applicable standards. With averaging alone, the average of all engine families for a particular manufacturer's production must be at or below that level of the applicable emission standards. We are adopting separate emission-credit programs for snowmobiles, off-highway motorcycles, and ATVs. We are adopting an emission-credit program for the optional ATV engine-based standards as well as the chassis-based standards.

In addition to the averaging program just described, the emission-credit program contains banking and trading provisions, which allow manufacturers to generate emission credits and bank them for future use in their own averaging program or sell them to another entity. We are not adopting a credit life limit or credit discounting for these credits. Unlimited credit life and no discounting increases the incentive to introduce the clean technologies needed to gain credits. To generate credits, the engine family's emissions level must be below the standard, so any credits will result from reducing emissions more than necessary to meet the standards.

ATVs and Off-highway Motorcycles

Emission credits from off-highway motorcycle and ATVs will be averaged separately because there are differing degrees of stringency in the standards for ATVs and off-highway motorcycles long-term and we do not want off-highway motorcycle credits to dilute the effectiveness of the ATV standards. This also avoids providing an advantage in the market to companies that offer both types of products over those that produce only one type. Also, ATVs certified to the chassis-based standards or engine-based standards are considered separate averaging groups with no credit exchanges between the two. We are not allowing credit exchanges between engine and chassis-based testing because there is little, if any, correlation between the two test cycles. Without a strong correlation, it is not possible to establish an exchange rate between the two programs. For the engine-based (J-1088) ATV standards, the standards vary by engine size (less than 100 cc, 100 cc up to 225 cc, and 225 cc and greater). We are allowing averaging, banking, and trading for each of the separate engine-based HC+NOx standards with no credit exchanges or averaging between the engine size categories.

We did not propose an averaging, banking, and trading program for CO for ATVs and off-highway motorcycles because it was not clear if such provisions would be needed to implement the expected technologies or if the need would warrant the additional complexity of an averaging program. We received comments that the 25 g/km CO standard could be technologically limiting in some instances. Manufacturers recommended that EPA drop CO the standard from the program and provided no comments regarding CO averaging. In addition, our recent testing indicates that the level of the standards may represent a significant technological challenge to the manufacturers in some cases.

We are retaining CO standards in the final program, and are establishing different CO standards for off-highway motorcycles and ATVs, as discussed in Section III.C.1. For ATVs, we are addressing the feasibility issues by finalizing a standard of 35 g/km. We are not including averaging or a credits program at this level. We are also adopting the 35 g/km CO standard for the optional off-highway motorcycle program with no averaging or credits program. At the 35 g/km level, we believe averaging is unnecessary and would greatly reduce the need to control CO, especially for larger manufacturers who have several engine families with which to average. The engine-based (J-1088) standards for CO also do not represent levels of stringency where we believe averaging would be appropriate or necessary. California certification test data shows that the engine-based (J-1088) CO standards can be achieved with reasonable compliance margins.

For the primary off-highway motorcycle program, we are retaining the proposed 25 g/km CO standard. We are providing the option of averaging for the 25 g/km CO standard, to help manufacturers balance the need to control CO while meeting stringent NOx requirements. We believe that the final program with averaging for CO will enable manufacturers to develop a unified emission-control strategy to control HC, NOx, and CO, rather than requiring them to develop unique control strategies driven by the need to meet the CO standards.

We are adopting FEL caps where we are allowing averaging standards. For ATVs certified to the 1.5 g/km FTP standard, there will be an FEL cap of 20 g/km HC+NOx. This cap will also apply to off-highway motorcycles certified to the 2.0 g/km NOx+HC standard. For off-highway motorcycles certified to the 25 g/km CO standard, the CO cap will be 50 g/km. For off-highway motorcycles, we are also finalizing an option that allows manufacturers to certify to an average HC+NOx standard of 4.0 g/km, if the manufacturer certifies all off-highway motorcycles including competition machines. Under this option, we are limiting FELs to 8.0 g/km. The goal of the option is to encourage the development and certification of clean competition products. Without a reasonable FEL limit, manufacturers could certify two-stroke machines at, or close to, baseline levels. This is a concern because the majority of manufacturers' product offerings are likely to be certified below the 4.0 g/km level and significant credits could be available. We believe the 8.0 g/km limit ensures significantly cleaner products compared to baseline levels for competition machines, while providing manufacturers with the incentive and flexibility to pursue innovative technologies for their competition products.

As noted above, we have also included engine-based J-1088 standards for ATVs. The HC+NOx portion of the J-1088 standards can be met through averaging and we have included reasonable emissions caps for these standards as well. For engines certified to the permanent optional J-1088 standards for ATV engines below 100 cc, the emissions cap is 40.0 g/kW-hr. The NOx+HC emissions cap is 32.2 g/kW-hr for engine certified to the temporary J-1088 standards which are available for all engine sizes.

Snowmobiles

For snowmobiles, we are adopting an emissions averaging and credit program for all three phases of standards. Averaging is available for each phase of standards. Once the program begins in 2006, manufacturers will make a demonstration of compliance with the applicable corporate average standards at the end of the model year. If a manufacturer has achieved a corporate average level below the corporate average standards, then the manufacturer may bank credits. Manufacturers may bank credits for use in a current phase of standards based on the difference between their corporate average and the standards. In order to bank credits for future use under a subsequent phase of standards, manufacturers may pull engines from their corporate average for the current phase of standards and certify them early to a future phase of standards. The credits must be generated based on the difference between the FEL for those engines and the phase of standards for which they are intended to be used. The credits may not be carried forward for use to meet a subsequent phase of standards.

For example, manufacturers may bank Phase 2 credits in 2007 by removing engines from their 2007 corporate average for one or both pollutants and certifying the engines to the Phase 2 standards early. These Phase 2 credits may then be saved for Phase 2, but may not be used for Phase 3. Manufacturers may also remove only part of an engine family for purposes of banking credits. Manufacturers may bank credits after the end of the model year when they have completed their demonstration of compliance for that year. The Final Rule includes provisions for banking credits for a single pollutant, with the other pollutant remaining in the averaging program for the current model year. For Phase 3, if a manufacturer chooses to bank credits for only one pollutant, the manufacturer must use an assigned value for the other pollutant in the Phase 3 standards formula. We are specifying a value of 90 g/kW-hr for HC+NOx and 275 g/kW-hr for CO. These levels ensure no windfall credits using the Phase 3 formula for the credit-generating engines.

Starting with Phase 3, Family Emission Limits may be set up to the current average baseline emission levels of 400 g/kW-hr (300 g/hp-hr) CO and 150 g/kW-hr (110 g/hp-hr) HC. These caps ensure a minimum level of control for each snowmobile certified under the long-term program. We believe this is appropriate due to the potential for personal exposure to very high levels of emissions as well as the potential for high levels of emissions in areas where several snowmobiles are operated in a group. We proposed that these limits would be effective beginning in 2006. We received comments from manufacturers recommending that we drop the FEL limits because they would create a tremendous near term workload burden. They commented that manufacturers would need to modify all product lines for 2006 just to meet the FEL limit. EPA recognizes that this could be a significant issue in the early years of the program and could detract from manufacturers' efforts to develop much cleaner technologies. Thus, we are finalizing the FEL limits only for Phase 3 and later, beginning in 2012. We believe this helps resolve the lead-time and workload issues while maintaining the integrity of the long-term program.

b. Early credits

We believe that allowing manufacturers to generate credits prior to 2006 has some merit in that it encourages them to produce cleaner snowmobiles earlier than they otherwise might and provides early environmental benefits. It would also allow for a smoother transition to new emission standards in a previously unregulated industry. However, in the proposal we expressed concern that an early-credit program could result in the generation of windfall credits, especially if the credits were generated relative to the average baseline emissions rates. A manufacturer could choose those engine families that already emit below the average baseline levels and certify those families for credit generation purposes without doing anything to actually reduce their emissions. Clearly this would undermine any environmental advantages of an early-credit program. However, we believe that it is possible to design an early-credit program which provides incentive for the early introduction of cleaner snowmobiles and also helps ease the transition into the first ever phase of snowmobile standards while preventing the generation of windfall credits. The early-credit program described in the following paragraphs will be available beginning with the 2003 model year. As with the standard snowmobile emissions averaging, banking and trading program, credits generated under the early-credit program will be calculated on a power-weighted basis.

A manufacturer can choose to certify one or more engine families early for purposes of credit generation. An engine family must at least meet the Phase 1 standards for both HC and CO to qualify for early credits, and the credits will be calculated based on the difference between the certification FEL and the Phase 1 standards. Credits generated under this option can be used only in compliance with the Phase 1 standards. Thus, such early credits will expire at the end of the 2009 model year.

The above discussion of early credits primarily addresses those snowmobiles that will meet the Phase 1 standards early. However, we also expect that there will be some engine families introduced prior to the 2006 model year which could meet Phase 2 standards. For such engines, a manufacturer may elect to split credits between Phase 1 and Phase 2. A manufacturer may save credits generated between the certification FELs and the actual Phase 2 standards for use in Phase 2. Credits generated between the Phase 1 and Phase 2 standards could be used for Phase 1 only. Credits generated prior to the start of the program in 2006 may not be used for Phase 3.

EPA did not receive comments on such programs for off-highway motorcycle or ATVs and we are not finalizing any additional provisions. The majority of products currently offered for sale are equipped with four-stroke engines which raises concerns over the potential for windfall credits. Due to this issue and the lack of suggestions or input on the part of commenters, we are not finalizing early credits or other types of flexibilities for these programs.

c. Nonconformance penalties for recreational vehicles

Section 206(g) of the Act, 42 U.S.C. 7525(g), authorizes EPA to establish nonconformance penalties (NCPs) for motorcycles and heavy-duty engines which exceed the applicable emission standard, provided that their emissions do not exceed an appropriate upper limit. NCPs allow manufacturers that are technological laggards to temporarily sell their vehicles by payment of a penalty, rather than being forced out of the marketplace. One manufacturer suggested that we consider establishing NCPs for recreational vehicles. Section 213(d) of the Act makes nonroad standards subject to the provisions of section 206, and directs EPA to enforce nonroad standards in the same manner as highway vehicles. We therefore believe that the Act authorizes us to establish NCPs in appropriate circumstances for nonroad engines and vehicles. Recreational vehicles are similar technologically to highway motorcycles, and NCPs might be appropriate for recreational vehicles under certain circumstances.

We will consider the need for NCPs two or three years before compliance with these standards is required. Manufacturers that determine in that time frame that they are likely to be unable to comply with the standards should notify us. If we determine that NCPs are appropriate for recreational vehicles, we would establish regulations that would specify how to calculate the penalties. While we have not determined the content of such regulations, it is likely that they would be similar to our existing NCP regulations for heavy-duty engines, which are set forth in 40 CFR part 86, subpart L.

3. Are there voluntary low-emission standards for these engines?

In the proposal we included a Voluntary Low-Emission Standards program for recreational vehicles. We did this for two reasons: to encourage new emission-control technology and to aid the consumer in choosing clean technologies.

We received numerous comments on this proposed program. The environmental community was supportive of voluntary standards and encouraged us to adopt permanent labels which identify the emission performance of the vehicle in a simplistic manner that would be easily understood by the initial purchaser and any purchases of used recreational vehicles. Manufacturers of recreational vehicles ATVs, off-highway motorcycles, and snowmobiles), on the other hand, did not support voluntary standards. They were supportive of providing initial purchasers with emission performance information via temporary consumer labeling, but were opposed to voluntary standards. Their concern was that voluntary standards or permanent labels could be used by federal, state, local or any other jurisdictions to limit the use of recreational vehicles from public lands by allowing access only to recreational vehicles that meet certain emission criteria. Manufacturers further argued that our proposed mandatory emission standards were stringent enough that they would encourage and result in the use of advanced emission-control technology and that the voluntary standards would provide no additional incentives.

As stated above, the general purpose of the Voluntary Low-Emission Standards program is to provide incentives to manufacturers to produce clean products and thus create market choices for consumers to purchase these products.[60] For all three recreational vehicle categories, but especially for snowmobiles, we are expecting a variety of emission-control technologies to be used to meet the standards. In all three categories we expect consumers to have a choice of which technologies to purchase and that they will base that purchase on an understanding of key attributes such as cost, performance, noise levels, safety, and emissions. Thus, an important factor for informing consumer decision is to provide them information on the relative emissions attributes of a given model. We believe this can be achieved through a temporary consumer labeling program without voluntary standards. Therefore, we are not finalizing a voluntary standard program for recreational vehicles at this time. We will consider this issue again in the future, once experience is gained under this program. In addition, given the manufacturer's opposition, it is not clear that voluntary standards by themselves would be an effective incentive for manufacturers.

Instead, we will be adopting a consumer labeling program. A label must be fixed securely to the product prior to arriving at the dealership but does not have to be permanent and may be removed by the consumer when placed into use. The label can be in the form of a removable sticker or decal, or a hang tag affixed to the handlebars or fuel cap. If a hang tag is used, it must be attached by a cable tie that cannot be easily removed, except by the ultimate retail consumer. The label, at a minimum, must include the following information: *U.S. EPA; Clean Air Index (appropriate pollutant, e.g., HC+NOx, etc.); manufacturer name; vehicle model with engine description (e.g., 500 cc two-stroke with direct fuel injection); emission performance rating scale; explanation of scale; and notice stating that label must be on vehicle prior to sale and can be removed only by the ultimate retail consumer*. In section 1051.135(g) of the regulations, titled "How must I label and identify the vehicles I produce?," we have developed several equations that determine what the emission performance rating scale will be for each category. The scale is based on a rating system of 1.0 through 10.0. A value of 1.0 would be assigned for the cleanest vehicle, while the dirtiest vehicle would get a rating of 10.0.

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[60] The snowmobile industry (see docket item II-G-221) and a group of public health and environmental organizations (see docket item II-G-139) have both expressed their general support for labeling programs that can provide information on the environmental performance of various products to consumers.

4. What durability provisions apply?

We are adopting several additional provisions to ensure that emission controls will be effective throughout the life of the vehicle. This section discusses these provisions for recreational vehicles. More general certification and compliance provisions, which apply across different vehicle categories, are discussed in Sections II and VII, respectively.

a. How long do my engines have to comply?

Manufacturers must produce off-highway motorcycle and ATV engines that comply over a useful life of 5 years or until the vehicle accumulates 10,000 kilometers, or for ATVs 1,000 hours, whichever occurs first. We consider the 10,000-kilometer and 1,000 hour values to be minimum values for useful life, with the requirement that manufacturers must comply for a longer period if the average life of their vehicles is longer than this minimum value.

The values being finalized will harmonize EPA's useful life intervals with those contained in the California program. We proposed a significantly longer useful life intervals of 30,000 kilometers based on our understanding of usage rates for the vehicles at the time of the proposal. We received comments from manufacturers that we overestimated vehicle usage and commenters recommended that we harmonize the useful life intervals with California's. We have lowered our estimate of usage rates based on available data, including new data provided during the comment period. Based on our current estimates of usage, we concur with manufacturers that harmonization with California is the best approach for establishing minimum useful life intervals. Generally, this will allow the same emission test data to be used for certification under both programs. However, this remains the minimum useful life and longer useful life intervals could be required in cases where the basic mechanical warranty of the engine or the advertised operating life is longer than the minimum interval. Average service life information will help in making such a determination. The manufacturer can alternatively base the longer useful life on the average service life of the vehicles where necessary data are available.

For snowmobiles, the minimum useful life is 5 years, 8,000 km, or 400 hours of operation, whichever occurs first. We based these values on discussions with manufacturers regarding typical snowmobile life, and on emission-modeling data regarding typical snowmobile usage rates.[61] As with ATVs and off-highway motorcycles, longer useful life intervals are required where the basic mechanical warranty of the engine or the advertised operating life is longer than the minimum interval and the manufacturer may alternatively base the longer useful life on the average service life of the vehicles where necessary data are available.

b. What are the minimum warranty periods for emission controls?

For off-highway motorcycle, ATVs, and snowmobiles, manufacturers must provide an emission-related warranty for at least half of the minimum useful life period. These periods could be longer if the manufacturer offers a longer

[61] EPA memorandum, "Emission Modeling for Recreational Vehicles," from Linc Wehrly to Docket A-2000-01, November 13, 2000 (document II-B-19).

mechanical warranty for the engine or any of its components; this includes extended warranties that are available for an extra price. See §1051.120 for a description of which components are emission-related.

We have included in our final rule an optional set of standards for off-highway motorcycles that would require the certification of competition motorcycles. However, for those individual vehicles actually used in organized competition events, it may be appropriate to exclude competition motorcycles from warranty coverage. Machines used in competition, even part of the time, may be subject to usage that can cause premature degradation of the engine and related components. Competition riders may place a premium on winning at the expense of engine durability or could otherwise damage the vehicle during the competition events. In fact, most manufacturers do not offer any mechanical warranty on vehicles used in competition. In addition, motorcycles used only for competition may be modified by the user in ways that alter the emissions characteristics of the vehicle.[62] We do not believe it is reasonable to hold manufacturers responsible for the emission warranty for such vehicles.

c. How do I demonstrate emission durability during certification?

Durability demonstration for off-highway motorcycles, ATVs, and snowmobiles includes a requirement to run the engines long enough to develop and justify the full life deterioration factor. This allows manufacturers to generate a deterioration factor that helps ensure that the engines will continue to control emissions over a lifetime of operation. Snowmobiles also must run out to the end of the useful life for purposes of durability demonstration and generating deterioration factors.

d. What maintenance is allowed during service accumulation?

For vehicles certified to the minimum useful life, emission-related maintenance is generally not allowed during service accumulation. The only maintenance that may be done must be (1) regularly scheduled, (2) unrelated to emissions, and (3) technologically necessary. This typically includes changing engine oil, oil filter, fuel filter, and air filter.

5. Do these standards apply to alternative-fueled engines?

These standards apply to all spark-ignited recreational vehicles, without regard to the type of fuel used. However, because we are not aware of any alternative-fueled recreational vehicles sold into the U.S. market, we are not adopting extensive special provisions to address them at this time.

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[62] While it is possible that the user could make modifications to their competition off-highway motorcycle that alter the emissions characteristics of the vehicle, we do not expect tampering to be a problem for those competition vehicles certifying to our voluntary standard of 4.0 g/km HC+NOx because the technologies required to meet this standard, four-stroke engines and direct fuel injection two-stroke engines, are inherent to the engine and will be optimized for maximum engine performance as well as emissions performance. Thus, any modifications would actually reduce rather than improve engine performance.

6. Is EPA controlling crankcase emissions?

We are requiring that new off-highway motorcycles and ATVs not emit crankcase vapors directly to the atmosphere. This requirement will phase in beginning in 2006 and be fully phased in by 2007. California's regulations for off-highway motorcycles and ATVs, which has been in effect since 1997, also prohibits the venting of crankcase vapors into the atmosphere. The major ATV manufacturers sell many of their California certified ATV models federally as 50-state applications. Thus, many ATVs sold federally already control crankcase emissions. The only exceptions could be some of the small youth ATV models that are imported from Asia.

The typical control strategy used to control crankcase emissions is to route the crankcase vapors back to the engine intake. This is consistent with our previous regulation of crankcase emissions from such diverse sources as highway motorcycles, outboard and personal water craft marine engines, locomotives, and passenger cars. We have data from California ARB showing that a performance-based four-stroke off-highway motorcycle experienced considerably higher tailpipe emission results when crankcase emissions were routed back into the intake of the engine, illustrating the potentially high levels of crankcase emissions that exist.[63]

New snowmobiles must also have closed crankcases, beginning in 2006. This requirement is relevant only for four-stroke snowmobiles, however, since two-stroke engines, by virtue of their operation, have closed crankcases. Information on the costs and benefits of this action can be found in the Final Regulatory Support Document.

D. Testing Requirements

1. What duty cycles are used to measure emissions?

Testing a vehicle or engine for emissions typically consists of exercising it over a prescribed duty cycle of speeds and loads, typically using a chassis or engine dynamometer. The nature of the duty cycle used for determining compliance with emission standards during the certification process is critical in evaluating the likely emission performance of engines designed to those standards. Duty cycles must be relatively comparable to the way equipment is actually used because if they are not, then compliance with emission standards would not assure that emissions from the equipment are actually being reduced in use as intended.

a. Off-highway Motorcycles and ATVs

For testing off-highway motorcycles and ATVs, we specify the current highway motorcycle test procedure be used for measuring emissions. The highway motorcycle test procedure is very similar to the test procedure as used for light-duty vehicles (i.e., passenger cars and trucks) and is referred to as the Federal Test Procedure (FTP). The FTP for a particular class of engine or equipment is actually the aggregate of all of the emission tests that the engine or equipment must meet to

[63] "Closed Crankcase Exhaust Emissions from Four-Stoke Competition Off-highway Motorcycle," EPA memo from L. Wehrly to Docket A-2000-01, September 10, 2001 (document II-B-25).

be certified. However, the term FTP has also been used traditionally to refer to the exhaust emission test based on the Urban Dynamometer Driving Schedule (UDDS), also referred to as the LA-4 (Los Angeles Driving Cycle #4). The UDDS is a chassis dynamometer driving cycle that consists of numerous "hills" which represent a driving event. Each hill includes accelerations, steady-state operation, and decelerations. There is an idle between each hill. The FTP consists of a cold start UDDS, a 10-minute soak, and a hot start. The emissions from these three separate events are collected into three unique bags. Each bag represents one of the events. Bag 1 represents cold transient operation, Bag 2 represents cold stabilized operation, and Bag 3 represents hot transient operation.

For highway motorcycles, we have three classes based on engine displacement, with Class I (50 to 169 cc) being the smallest and Class III (280 cc and over) being the largest. The highway motorcycle regulations allow Class I motorcycles to be tested on a less severe UDDS cycle than the Class II and III motorcycles. This is accomplished by reducing the acceleration and deceleration rates on some the more aggressive "hills." We proposed to use this same class/cycle distinction for off-highway motorcycles and ATVs. In other words, we proposed that off-highway motorcycles and ATVs with an engine displacement at or below 169 cc would be tested over the FTP test cycle for Class I highway motorcycles. We proposed that off-highway motorcycles and ATVs with engine displacements greater than 169 cc would be tested over the FTP test cycle for Class II and Class III highway motorcycles. We requested comment on the appropriateness of allowing the use of the Class I test cycle for all ATVs.

Manufacturers have expressed concerns over the appropriateness of testing ATVs using the FTP and the ability of some ATVs to be run on the test cycle. Manufacturers recommended for FTP testing, that all ATVs be tested over the Class I cycle. Manufacturers stated that the Class I cycle top speed of 36 mph would be "much more representative" of ATV operation than the 57 mph top speed of the Class III cycle. Manufacturers also noted that California FTP testing is based on the use of the Class I cycle for all ATVs and that the EPA program would need to be changed allow for harmonization. Manufacturers did not raise these same concern for off-highway motorcycles which are tested in accordance with the highway motorcycle classifications for California.

After considering this issue further, we concur with the manufacturer's comments and are finalizing the Class I cycle for all ATVs. One of the objectives of the final program is to allow harmonization with California and this change is fundamental in the manufacturers' ability to use the same FTP test data for both programs. Also, the average speeds of in-use ATVs appear to be significantly lower than we estimated in the analysis for the proposal (8-13 mph compared to 20 mph). The new data on ATV usage alleviates concerns that the lower speeds of the Class I test cycle might miss significant high-speed ATV operation. The change in the test procedure is directionally consistent with this new data. In addition, the change in test procedure will enable ATVs in general to be tested over the FTP with fewer issues concerning the ability of the vehicles to operate over the driving cycle. We are finalizing the test procedure requirements as proposed for off-highway motorcycles. We believe that the manufacturer's concerns regarding the FTP are also addressed by the option to test the smallest ATVs (up to 100 cc) to J-1088 standards permanently. These vehicles are typically governed to top speeds below the 36 mph contained in the Class I FTP cycle. Also, the small displacement ATVs may be most strenuously tested (i.e., more operation at high loads) on the FTP due to their lower horsepower output.

We acknowledge that chassis dynamometers for ATVs could be costly to purchase and difficult to put in place in the near term, especially for smaller manufacturers. As discussed in Section III.C.1.b, we are allowing the use of the J1088 engine test cycle as a transitional option through model year 2008. The J1088 option expires after 2008 and the FTP becomes the required test cycle in 2009. As noted above, EPA is currently in discussions with ATV manufacturers to determine whether a new test cycle is appropriate. The J1088 may be discontinued earlier than 2009 if another test procedure is implemented.

b. Snowmobiles

We are adopting the snowmobile duty cycle developed by Southwest Research Institute (SwRI) in cooperation with the International Snowmobile Manufacturers Association (ISMA) for all snowmobile emission testing.[64] The test procedure consists of two main parts; the duty cycle that the snowmobile engine operates over during testing and other testing protocols surrounding the measurement of emissions (sampling and analytical equipment, specification of test fuel, atmospheric conditions for testing, etc.). While the duty cycle was developed specifically to roughly approximate snowmobile operation, many of the testing protocols are well established in other EPA emission-control programs and have been simply adapted where appropriate for snowmobiles.

The snowmobile duty cycle was developed by instrumenting several snowmobiles and operating them in the field in a variety of typical riding styles, including aggressive (trail), moderate (trail), double (trail with operator and one passenger), freestyle (off-trail), and lake driving. A statistical analysis of the collected data produced the five mode steady-state test cycle is shown in Table III.D-1. This duty cycle is the one that was used to generate the baseline emissions levels for snowmobiles, and we believe it is the most appropriate for demonstrating compliance with the snowmobile emission standards at this time.

Table III.D-1
Snowmobile Engine Test Cycle

Engine Parameter	Mode				
	1	2	3	4	5
Normalized Speed	1.00	0.85	0.75	0.65	Idle
Normalized Torque	1.00	0.51	0.33	0.19	0.00
Relative Weighting	12%	27%	25%	31%	5%

The rest of the testing protocol is largely derived from our regulations for marine outboard and personal water craft engines, as recommended in the SwRI/ISMA test cycle development work (61 FR 52088, October 4, 1996). The

[64] "Development and Validation of a Snowmobile Engine Emission Test Procedure," Jeff J. White, Southwest Research Institute and Christopher W. Wright, Arctic Cat, Inc., Society of Automotive Engineers paper 982017, September, 1998. (Docket A-2000-1; document II-D-05).

testing equipment and procedures from that regulation are generally appropriate for snowmobiles, including the provisions for raw exhaust gas sampling which are being adopted here for snowmobiles.

Unlike marine engines, however, snowmobiles tend to operate in cold ambient temperatures. Thus, some provision needs to be made in the snowmobile test procedure to account for the colder ambient temperatures typical of snowmobile operation. Since snowmobile carburetors are jetted for specific ambient temperatures and pressures, appropriate accounting for typical operating temperatures is important to assure that anticipated emissions reductions actually occur in use. We proposed that snowmobile engine inlet air temperature be between -15° C and -5° C (5° F and 23° F), but that the ambient temperature in the test cell not be required to be refrigerated. We received comments stating that this approach would be expensive due to the need for refrigeration equipment, pointing out that the snowmobile manufacturers do not currently have the capacity for cold testing. Further, we received comments that accurate emissions results can be obtained using appropriate jetting determined by extrapolating from the manufacturer's jet chart, (if necessary).

We agree that emissions can be accurately measured at higher ambient temperatures provided that the proper compensation be made in the fueling system. For carbureted engines this means jetting the engine appropriately for the test temperature. For electronically controlled engines this doesn't tend to be an issue because such technology generally includes temperature compensation in its control algorithms. However, one manufacturer stated that for snowmobiles that have electronically controlled engines, it would be preferable and environmentally appropriate to test with colder inlet temperatures. Thus, we are adopting the option to allow snowmobile testing using either cold engine inlet air temperatures between -15° C and -5° C (5° F and 23° F) or warm engine inlet air temperatures between 20° C and 30° C (68° F and 86° F). However, depending on the location of the air box where inlet air enters the engine intake system, the inlet temperature could be considerably warmer than ambient conditions. For a snowmobile that does not have temperature compensating capabilities, it could be possible to get a moderate emission reduction due to the increase in air density that results at colder temperatures from the artificially induced test inlet air. These emission reductions would not occur in real operation since actual inlet air would be warmer. Therefore, to use the colder inlet temperature option, a manufacturer must demonstrate that for the given engine family, the temperature of the inlet air within the air box is consistent with the inlet-air temperature test conditions.

2. What fuels will be used during exhaust emission testing?

We are adopting fuel specifications as proposed for all recreational vehicles that we have specified for 2004 and later light-duty vehicles.

3. Are there production-line testing provisions for these engines?

Recreational vehicle or engine manufacturers must perform emission tests on a small percentage of their production as it leaves the assembly line to ensure that production vehicles operate at certified emission levels. The broad outline of this program is discussed in Section II.C.4 above. Production-line testing must be performed using the same test procedures as for certification testing.

E. Special Compliance Provisions

As described in Section XI.B, the report of the inter-agency Small Business Advocacy Review Panel addresses the concerns of small-volume manufacturers of recreational vehicles. We proposed to adopt the provisions recommended by the panel and received comments on the proposals. We are finalizing the provisions below as proposed, with the modifications as noted.

Off-highway Motorcycles and ATVs

To identify representatives of small businesses for this process, we used the definitions provided by the Small Business Administration for motorcycles, ATVs, and snowmobiles (fewer than 500 employees). Eleven small businesses agreed to serve as small-entity representatives. These companies represented a cross-section of off-highway motorcycle, ATV, and snowmobile manufacturers, as well as importers of off-highway motorcycles and ATVs

As discussed above, our emission standards for off-highway motorcycles and ATVs will likely necessitate the widespread use of four-stroke engines. Most small-volume off-highway motorcycle and ATV importers—and to a lesser degree, small-volume manufacturers—currently use two-stroke engines. While four-stroke engines are common in motorcycles and ATVs in general, their adoption by any manufacturer is still a significant business challenge. Small manufacturers of these engines may face additional challenges in certifying engines to emission standards, because the cost of certification would be spread over the relatively few engines they produce. These higher per-unit costs may place small manufacturers at a competitive disadvantage without specific provisions to address this burden.

We are applying the flexibilities described below to engines produced or imported by small entities with combined off-highway motorcycle and ATV annual sales of fewer than 5,000 units. The inter-agency panel recommended these provisions to address the potentially significant adverse effects on small entities of an emission standard that may require conversion to four-stroke engines. The 5,000-unit threshold is intended to focus these flexibilities on those segments of the market where the need is likely to be greatest and to ensure that the flexibilities do not result in significant adverse environmental effects during the period of additional lead-time recommended below.[65] In addition, we are limiting some or all of these flexibilities to companies that are in existence or have product sales at the time we proposed emission standards to avoid creating arbitrary opportunities in the import sector, and to guard against the possibility of corporate reorganization, entry into the market, or other action for the sole purpose of circumventing emission standards.

Snowmobiles

There are only a few small snowmobile manufacturers and they sell only a few hundred sleds a year, which represents less than 0.5 percent of total annual production. Therefore, the per-unit cost of regulation may be significantly higher for these small entities because they produce very low volumes. Additionally, these companies do not have the

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[65]For example, importers may have access to large supplies of vehicles from major overseas manufacturers and potentially could substantially increase their market share by selling less expensive noncomplying products.

design and engineering resources to tackle compliance with emission standard requirements at the same time as large manufacturers and tend to have limited ability to invest the capital necessary to conduct emission testing related to research, development, and certification. Finally, the requirements of the snowmobile program may be infeasible or highly impractical because some small-volume manufacturers may have typically produced engines with unique designs or calibrations to serve niche markets (such as mountain riding). The new snowmobile emission standards may impose significant economic hardship on these few manufacturers whose market presence is small. We therefore believe significant flexibility is necessary and appropriate for this category of small entities, as described below.

Flexibilities

1. Additional lead time

We are adopting a delay of two years beyond the date larger businesses must comply to ease the burden for small businesses. This will provide extra time to develop technology and, in the case of importers, extra time to resolve supplier issues that may arise. The two-year delay also applies to the timing of the Phase 2 standards for snowmobiles.

In addition, for small snowmobile manufacturers, the emission standards phase in over an additional two years at a rate of 50 percent, then 100 percent. Phase 1 phases in at 50/50/100 percent in 2008/2009/2010 and Phase 2 phases in at 50/50/100 percent in 2012/2013/2014.

2. Design-based certification

The process of certification is a business cost and lead time issue that may place a disproportionate burden on small entities, particularly importers. Certification is a fixed cost of doing business, which is potentially more burdensome on a unit-cost basis for small entities. It is potentially an even greater challenge, since some small entities will either contract emission testing to other parties or, in the case of importers, perhaps rely on off-shore manufacturers to develop and certify imported engines.

Small-volume manufacturers may use design-based certification, which allows us to issue a certificate to a small business for the emission-performance standard based on a demonstration that engines or vehicles of a similar design criteria meet the standards of the individual engine family. The small vehicle manufacturer must demonstrate that their engine uses a design similar to or superior to one that is being used by other manufacturers that has been shown through prior emission testing to meet the standards. The demonstration must be based in part on emission test data from engines of a similar design. Under a design-based certification program, a manufacturer provides evidence in the application for certification that an engine or vehicle meets the applicable standards for its useful life based on comparing its design (for example, the use a four-stroke engine, advanced fuel injection, or any other particular technology or calibration) to that of a previously tested engine. The design criteria might include specifications for engine type, calibrations (spark timing, air /fuel ratio, etc.), and other emission-critical features, including, if appropriate, catalysts (size, efficiency, precious metal loading). Manufacturers submit adequate engineering and other information about their individual designs showing that they will meet emission standards for the useful life.

3. Broaden engine families

Small businesses may define their engine families more broadly, putting all their models into one engine family (or more) for certification purposes. Manufacturers may then certify their engines using the "worst-case" configuration within the family.

A small manufacturer might need to conduct certification emission testing rather than pursuing design-based certification. Such a manufacturer would likely find broadened engine families useful.

4. Production-line testing waiver

As discussed above, manufacturers must test a small sampling of production engines to ensure that production engines meet emission standards. We are waiving production-line testing requirements for small manufacturers. This will eliminate or substantially reduce production-line testing requirements for small businesses.

5. Use of assigned deterioration factors for certification

Small manufacturers may use deterioration factors assigned by EPA. Rather than performing a durability demonstration for each family for certification, manufacturers may elect to use deterioration factors determined by us to demonstrate emission levels at the end of the useful life, thus reducing the development and testing burden. This might be a very useful and cost-beneficial option for a small manufacturer opting to perform certification emission testing instead of design-based certification.

6. Using emission standards and certification from other EPA programs

A wide array of engines certified to other EPA programs may be used in recreational vehicles. For example, there is a large variety of engines certified to EPA lawn and garden standards (Small SI). Manufacturers of recreational vehicles may use engines certified to any other EPA standards for five years. Under this approach, engines certified to the Small SI standards may be used in recreational vehicles. These engines would then meet the Small SI standards and related provisions rather than those adopted in this document for recreational vehicles. Small businesses using these engines will not have to recertify them, as long as they do not alter the engines in a way that might cause it to exceed the emission standards it was originally certified to meet. Also, the recreational vehicle application may not be the primary intended application for the engine.

Additionally, a certified snowmobile engine produced by a large snowmobile manufacturer may be used by a small snowmobile manufacturer, as long as the small manufacturer did not change the engine in a way that might cause it to exceed the snowmobile emission standards. This provides a reasonable degree of emission control. For example, if a manufacturer changed a certified engine only by replacing the stock exhaust pipes with pipes of similar configuration or the stock muffler and air intake box with a muffler and air box of similar air flow, the engine would still be eligible for this flexibility option, subject to our review. The manufacturer may also change the carburetor to have a leaner air-fuel ratio without losing eligibility. The manufacturer in such cases could establish a reasonable basis for knowing that emissions performance is not negatively affected be the changes. However, if the manufacturer changed the bore or stroke of the engine, it would no longer qualify, as emissions might increase beyond the level of the standard.

7. Averaging, banking, and trading

For the overall program, we are adopting corporate-average emission standards with opportunities for banking and trading of emission credits. We expect the averaging provisions to be most helpful to manufacturers with broad product lines. Small manufacturers and small importers with only a few models might not have as much opportunity to take advantage of these flexibilities. However, we received comment from one small manufacturer supporting these types of provisions as a critical component of the program. Therefore, we are adopting corporate-average emission standards with opportunities for banking and trading of emission credits for small manufacturers.

8. Hardship provisions

We are adopting provisions to address hardship circumstances, as described in Section VII.C.

9. Unique snowmobile engines

Even with the broad flexibilities described above, there may be a situation where a small snowmobile manufacturer cannot comply. Therefore, we are adopting an additional provision to allow a small snowmobile manufacturer to petition us for relaxed standards for one or more engine families. The manufacturer must justify that the engine has unique design, calibration, or operating characteristics that make it atypical and infeasible or highly impractical to meet the emission-reduction requirements, considering technology, cost, and other factors. At our discretion, we may then set an alternative standard at a level between the prescribed standard and the baseline level, which would likely apply until the engine family is retired or modified in a way that might alter emissions. These engines will be excluded from averaging calculations. We proposed that this provision be limited to 300 snowmobiles per year. However, we received comment that this limit is too restrictive to be of much assistance to small businesses. Based on this comment we are adopting a limit for this provision of 600 snowmobiles per year.

F. Technological Feasibility of the Standards

1. Off-highway motorcycles and ATVs

We believe the new emission standards are technologically feasible given the availability of emission-control technologies, as described below.

a. What are the baseline technologies and emission levels?

As discussed earlier, off-highway motorcycles and ATVs are equipped with relatively small (48 to 650 cc) high-performance two- or four-stroke single cylinder engines that are either air- or liquid-cooled.[66] Since these vehicles are unregulated outside of the state of California, the main emphasis of engine design is on performance, durability, and cost and thus they generally have no emission controls. The fuel systems used on these engines are almost exclusively carburetted. Two-stroke engines lubricate the piston and crankshaft by mixing oil with the air and fuel mixture. This is accomplished by most contemporary two-stroke engines with a pump that sends two-cycle oil from a separate oil reserve to the carburetor where it is mixed with the air and fuel mixture. Some less expensive two-stroke engines require that the oil be mixed with the gasoline in the fuel tank. Four-stroke engines inject oil via a pump throughout the engine as the means of lubrication. With the exception of those vehicles certified in California, most of these engines are unregulated and thus have no emission controls. For ATVs, approximately 80-percent use four-stroke engines while only 55 percent of off-highway motorcycles use four-stroke engines. The average HC emissions for two-stroke engines are about 35 g/km, while the average for four-stroke engines are 1.5 g/km. CO emissions levels are very similar between the types of engines with two-stroke levels of approximately 34 g/km and four-stroke levels of 30 g/km. For performance and durability reasons, off-highway motorcycle and ATV engines all tend to operate with a "rich" air and fuel mixture. That is, they operate with excess fuel, which enhances performance and allows engine cooling to promote longer engine life. However, rich operation results in high levels of HC, CO, and PM emissions. Also, two-stroke engines tend to have high scavenging losses, where up to a third of the unburned air and fuel mixture goes out of the exhaust resulting in high levels of HC emissions.

b. What technology approaches are available to control emissions?

Several approaches are available to control emissions from off-highway motorcycles and ATVs. The simplest approach consists of modifications to the base engine, fuel system, cooling system, and recalibration of the air and fuel mixture. These changes may include adjusting valve timing for four-stroke engines, changing from air- to liquid-cooling, and using advanced carburetion techniques or electronic fuel injection instead of traditional carburetion systems. Other approaches may include secondary air injected into the exhaust, an oxidation or three-way catalyst, or a combination of secondary air and a catalyst. The engine technology that may have the most potential for maximizing emission reductions from two-stroke engines is direct fuel injection. Direct fuel injection is able to reduce or even eliminate scavenging losses by pumping only air through the engine and then injecting fuel into the combustion chamber after the intake and exhaust ports have closed. Using oxidation catalysts with direct injection may reduce emissions even further. Finally, converting from two-stroke to four-stroke engine technology will significantly reduce HC emissions. All of these technologies have the capability to reduce HC and CO emissions.

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[66] The engines are small relative to automotive engines. For example, automotive engines typically range from one liter to well over five liters in displacement, whereas off-highway motorcycles range from 0.05 liters to 0.65 liters.

We expect none of these technologies to negatively affect noise, safety, or energy factors. Fuel injection can improve the combustion process which can result in lower engine noise. The vast majority of four-stroke engines used in off-highway motorcycles and ATVs are considerably quieter than their two-stroke counterparts. Fuel injection has no impact on safety and four-stroke engines often have a more “forgiving” power band which means the typical operator may find the performance of the machine to be more reasonable and safe. Fuel injection, the enleanment of the air and fuel mixture and four-stroke technology all can result in significant reductions in fuel consumption.

c. What technologies are most likely to be used to meet emission standards?

Four-Stroke Engines

Most manufacturers have experience with four-stroke engine technology and currently have several models powered by four-stroke engines. This is especially true in the ATV market where four-stroke engines account for 80 percent of sales. Because four-stroke engines have been so prevalent over the last 10 years in the off-highway motorcycle and ATV industry, manufacturers have developed a high level of confidence in four-stroke technology and its application.

Manufacturers of off-highway motorcycles and ATVs utilizing four-stroke engines will need to make some minor calibration changes and improvements to the carburetor to meet emission standards for the 2006 model year. Some of these modifications may have already been incorporated in response to California requirements. The calibration changes will most likely consist of reducing the amount of fuel in the air-fuel mixture. This is commonly referred to as leaning out the air-fuel ratio. Although four-stroke engines produce considerably lower levels of HC than two-stroke engines, the four-stroke engines used in off-highway motorcycles and ATVs all tend to be calibrated to operate with a rich air-fuel ratio for performance and durability benefits. This rich operation results in high levels of CO, since CO is formed in the engine when there is a lack of oxygen to complete combustion. We believe that many of these engines are calibrated to operate richer than needed, because they have either never had to consider emissions when optimizing air-fuel ratio or those that are certified to the California standards can operate richer because the California ATV CO standards are fairly lenient. Carburetors with tighter tolerances ensure more precise flow of fuel and air, resulting in better fuel atomization (i.e., smaller fuel droplets), better combustion, and lower emissions.

In addition to converting to four-stroke technology and making some minor calibration and carburetion improvements to meet the 2006 emission standards, manufacturers may need to use secondary air injection on some models. Secondary air has been used by passenger cars and highway motorcycles for many years as a means to help control HC and CO. The hot exhaust gases coming from the combustion chamber contain significant levels of unburned HC and CO. If sufficient oxygen is present, these gases will continue to react in the exhaust system, reducing the amount of pollution emitted into the atmosphere. To assure that sufficient oxygen is present in the exhaust, air is injected into the exhaust system. For off-highway motorcycles and ATVs, the additional air can be injected into the exhaust manifold using a series of check valves which use the normal pressure pulsations in the exhaust manifold to draw air from outside, commonly referred to as pulse air injection. We have tested several four-stroke ATVs with secondary air injected into the exhaust manifold and found that the HC and CO emission levels were below the standards (further details of our secondary air testing are described in the Final Regulatory Support Document).

A small number of models in California have been equipped with secondary air technology. It is likely that some manufacturers will opt to use secondary air systems to reduce emissions in addition to enleanment strategies to meet EPA standards. We believe this may be especially true for ATVs meeting the 1.5 g/km HC+NOx standard. Using these systems would also provide manufacturers with more flexibility within the averaging scheme and would allow them to avoid any negative affects on performance that could accompany excessive enleanment. Also, several models are not certified to California standards, including some four-stroke models. Manufacturers may use secondary air on a more widespread basis to bring all models into compliance.

Since the emission standards address HC + NOx, as well as CO, manufacturers will have to use an emission-control strategy or technology that doesn't cause NOx emissions to increase disproportionately. However, since all of these vehicles operate with rich air-fuel ratios, as discussed above, NOx levels from these engines are generally low and strategies designed to focus on HC reduction allow manufacturers to meet emission standards with no significant increase in NOx levels.

Two-Stroke Engines

Off-highway motorcycles and ATVs using two-stroke engines will present a greater challenge for compliance with emission standards. Since baseline HC and CO emission levels are so high for two-stroke engines, it would be very difficult for any two-stroke engine to meet our standards with current production technologies. Although catalysts have been used for two-stroke powered mopeds, scooters, and small displacement highway motorcycles in Europe and Asia, the standards and test cycles are significantly different from ours and there is no way to make reasonable comparisons. We have not performed any testing, nor are we aware of any emission test data on the use of catalysts on ATV and off-highway motorcycle two-stroke engines. Therefore, we do not believe that catalysts would be available for two-stroke engines that would meet our standards in the time frame necessary to comply with our program. Direct fuel injection has been successfully applied to two-stroke engines used in marine personal water craft, outboard engines, and small mopeds and scooters and is just now being looked at for off-highway motorcycle applications. However, as discussed below, even this advanced technology cannot meet our standards alone.

As described in Section III.C.1.a, we are including an optional standard for off-highway motorcycles of 4.0 g/km HC+NOx, for manufacturers willing to certify competition motorcycles that would otherwise be exempt from emission standards. We received comment from REV! Motorcycles in support of this level. Rev! plans to manufacture two-stroke off-highway motorcycles equipped with direct injection. Based on an early analysis of the technology, REV! requested that EPA consider establishing a 4.0 g/km standard to allow them to pursue the technology and have a realistic opportunity to meet emission standards. According to their comments, they believe that their engines will be capable of meeting the 4.0 g/km standard without the use of a catalyst. Perhaps most importantly, REV! believes that this is a viable technology approach for competition models, which have very high baseline emissions.

REV! shared their plans and emissions projections for a single prototype model of competition motorcycle. Production units, additional models, or motorcycles produced by other manufacturers using similar technologies may not be able to achieve the 4.0 g/km level. The 4.0 g/km level represents an HC reduction of 90 percent or more from baseline levels for some competition motorcycles, which is likely to be very challenging. This is one reason EPA is also allowing averaging, banking, and trading for this option. Averaging will provide flexibility to manufacturers who have some models that, while very clean relative to baseline levels, are above the 4.0 g/km standard. Manufacturers will be able to use credits, for example, from the sale of four-stroke machines with emissions below 4.0 g/km to achieve the 4.0 g/km standard on average.

2. Snowmobiles

a. What are the baseline technologies and emission levels?

As discussed earlier, snowmobiles are equipped with relatively small high-performance two-stroke two and three cylinder engines that are either air- or liquid-cooled. Since these vehicles are currently unregulated, the main emphasis of engine design is on performance, durability, and cost and thus they have no emission controls. The fuel system used on these engines are almost exclusively carburetors, although some have electronic fuel injection. Two-stroke engines lubricate the piston and crankshaft by mixing oil with the air and fuel mixture. This is accomplished by most contemporary two-stroke engines with a pump that sends two-cycle oil from a separate oil reserve to the carburetor where it is mixed with the air and fuel mixture. Some less expensive two-stroke engines require that the oil be mixed with the gasoline in the fuel tank. Snowmobiles currently operate with a “rich” air and fuel mixture. That is, they operate with excess fuel, which enhances performance and allows engine cooling which promotes longer lasting engine life. However, rich operation results in high levels of HC, CO, and PM emissions. Also, two-stroke engines tend to have high scavenging losses, where up to a third of the unburned air and fuel mixture goes out of the exhaust resulting in high levels of raw HC. Current average snowmobile emission rates are 400 g/kW-hr (296 g/hp-hr) CO and 150 g/kW-hr (111 g/hp-hr) HC. There are however, at least two snowmobile models that use four-stroke engines. Two companies currently have a moderate-powered four-stroke touring model that has very low emissions. One sled uses a small advanced automotive engine, while the other uses a modified ATV engine. Both engines are very sophisticated, using electronic fuel injection and computer-based closed-loop control. The other snowmobile manufacturers are planning to release four-stroke models for the 2003 model year, but are focusing on higher performing models that, according to the manufacturers, may not have as good of emissions control as the production four-stroke touring models.

b. What technology approaches are available to control emissions?

We believe the new emission standards are technologically feasible. A variety of technologies are currently available or in stages of development to be available for use on two-stroke snowmobiles. These include improvements to carburetion (improved fuel control and atomization, as well as improved production tolerances), enleanment strategies for both carbureted and fuel injected engines, and semi-direct and direct fuel injection. In addition to these two-stroke technologies, converting to four-stroke engines is also feasible. Each of these is discussed in the following paragraphs.

There are several ways to improve carburetion in snowmobile engines. First, strategies to improve fuel atomization promote more complete combustion of the fuel/air mixture. Additionally, improved production tolerances enable more consistent fuel metering. Both of these changes allow more accurate control of air-fuel ratios. Snowmobile engines are currently calibrated with rich air-fuel ratios for durability reasons. Leaner calibrations to CO and HC emissions pose a challenge for maintaining engine durability, but many engine improvements are available to prevent problems. These include changes to the cylinder head, pistons, ports and pipes to reduce knock. In addition critical engine components can be made more robust to improve durability.

The same calibration changes to the air-fuel ratio just discussed for carbureted engines can also be employed, possibly with more accuracy, by using fuel injection. At least one major snowmobile manufacturer currently employs electronic fuel injection on several of its snowmobile models.

In addition to rich air-fuel ratios, one of the main reasons that two-stroke engines have such high HC emission levels is that they release a substantial amount of unburned fuel into the atmosphere as a result from scavenging losses, as described above. One way to reduce or eliminate such losses is to inject the fuel into the cylinder after the exhaust port has closed. This can be done by injecting the fuel into the cylinder through the transfer port (semi-direct injection) or directly into the cylinder (direct injection). Both of these approaches are currently being used successfully in two-stroke personal water craft engines. We believe these technologies hold promise for application to snowmobiles. In fact, one company is offering a snowmobile with a semi-direct injection two-stroke engine for the 2003 model year. Manufacturers must address a variety of technical design issues for adapting the technology to snowmobile operation, such as operating in colder ambient temperatures and at variable altitude. The averaging approach and the several years of lead time give manufacturers time to incorporate these development efforts into their overall research plan as they apply these technologies to snowmobiles.

In addition to the two-stroke technologies just discussed, using four-stroke engines in snowmobiles is another feasible approach to reduce emissions. Since they do not scavenge the exhaust gases with the incoming air-fuel mixture, four-stroke engines have inherently lower HC emissions compared to two-stroke engines. Four-stroke engines have a lower power-to-displacement ratio than two-stroke engines and are heavier. Thus, initially they may be more appropriate for snowmobile models where extreme power and acceleration are not the primary selling points. Such models include touring and sport trail sleds. However, one company has developed a four-stroke engine based off one of their sport highway motorcycle engines that produces 150 horsepower and will be used in their high-performance snowmobiles in the 2003 model year.

c. What technologies are most likely to be used to meet emission standards?

2006 Standards

We expect that, in the context of an emissions averaging program, manufacturers might choose to take different paths to meet the 2006 emission standards. We expect manufacturers to use a mix of technologies that will include improved carburetion and enleanment strategies, combined with engine modifications, the use of direct injection, and the use of four-stroke engine technology. For example, depending on their emission rates, one scenario for meeting our standards could be a mixture of 60 percent using improved carburetion, enleanment strategies, and engine modifications, 15 percent using direct injection, and another 15 percent using four-stroke engines. Manufacturers can expect moderate emission reductions from engine modifications and enleanment strategies. Most two-stroke snowmobile engines are designed to operate with a rich air and fuel mixture, which result in high levels of HC, CO, and PM. By reducing the amount of fuel in the air and fuel mixture (i.e., enleanment), these emissions can be reduced. Because manufacturers use the extra fuel in the air and fuel mixture to help cool the engine, some modifications such as the use of more robust materials, may be necessary. Manufacturers have indicated to us that direct injection strategies can result in emission reductions of 70 to 75 percent for HC and 50 to 70 percent for CO. Certification results from 2000 model year outboard engines and personal water craft (PWC) support such reductions. We believe that as manufacturers learn to apply direct injection strategies they may choose to implement those technologies on some of their more expensive sleds and use less aggressive technologies, such as improved carburetion and enleanment on their lower performance models.

It appears that the use of four-stroke engines in snowmobiles will be more prevalent than we initially anticipated. For the 2003 model year, all four of the major snowmobile manufacturers will offer a four-stroke engine. Two manufacturers have already sold limited quantities of their four-stroke snowmobiles in 2002. All of these engines will be appearing in at least two different models and in some cases up to three or four models. The size and design of these engines is quite varied. All of the engines range in size from 650 cc to 1000 cc. There are two cylinder and four cylinder engines, fuel injected and carbureted, moderate horsepower and high horsepower. Manufacturers have indicated that depending on their success, four-stroke engines will play a large role in meeting our standards.

2010 Standards

As with the 2006 standards, we expect that manufacturers will use a mix of technologies to meet our 2010 standards. To meet the 2010 standards, manufacturers will need to employ the use of advanced technologies such as direct fuel-injection and four-stroke engines on a larger portion of their production. As noted above, manufacturers are beginning to introduce these technologies and will be gaining experience with them over the next several years. Because we are offering manufacturers the option to choose between two sets of standards in 2010, the mixture of technologies will be very manufacturer and engine family specific. For example, direct injection typically reduces CO significantly but does not reduce HC to the same extent as four-stroke engines. Engine families that manufacturers believe will be most compatible with direct injection technology would likely meet the 75 g/kW-hr HC and 200 g/kW-hr CO standards. A potential scenario for meeting these standards could be a mixture of 50 percent direct injection, 20 percent four-stroke engines, and 30 percent with engine modifications. Engine families that manufacturers believe will be more compatible with four-stroke technology, which typically has superior HC emissions levels but do not necessarily have exceptionally good CO performance, will likely meet the 45 g/kW-hr HC and 275 g/kw-hr CO standards. Under either option, it is possible that manufacturers will continue to sell two-stroke models with lesser levels of technology. Manufacturers are likely to reduce emissions where possible from at least a portion of the remaining two-stroke engines through the use of engine modifications, calibration optimization, and secondary air systems. In some cases this will be necessary just to meet the FEL cap. A potential scenario for meeting these standards could be a mixture of 70 percent four-stroke engines, 10 percent direct fuel injection, and 20 percent with engine modifications.

IV. Permeation Emission Control

A. Overview

In the proposal we specified only exhaust emission controls for recreational vehicles. However, several commenters raised the issue of control of evaporative emissions related to permeation from fuel tanks and fuel hoses. The commenters stated that work done by California ARB on permeation emissions from plastic fuel tanks and rubber fuel line hoses for various types of nonroad equipment as well as portable plastic fuel containers raised a new emissions concern. Our own investigation into the hydrocarbon emissions related to permeation of fuel tanks and fuel hoses from recreational land-based and marine applications supports the concerns raised by the commenters. Therefore, on May 1, 2002, we reopened the comment period and requested comment on possible approaches to regulating permeation emissions from recreational vehicles. As a result of our investigations and the comments received, we have determined that it is appropriate to promulgate standards regulating permeation emissions from these vehicles.

This section describes the provisions for 40 CFR part 1051, which would apply only to recreational vehicle manufacturers. This section also discusses test equipment and procedures (for anyone who tests fuel tanks and hoses to show they meet emission standards) and general compliance provisions.

We are adopting performance standards intended to reduce permeation emissions from recreational vehicles. The standards, which apply to new vehicles starting in 2008, are nominally based on manufacturers reducing these permeation emissions from new vehicles by about 90 percent overall.[67] We also recognize that there are many small businesses that manufacture recreational vehicles. We are therefore adopting several special compliance provisions to reduce the burden of permeation emission regulations on small businesses. These special provisions are the same as for the exhaust emission standards, as applicable, and are discussed in Section III.E.

B. Vehicles Covered by This Provision

We are adopting new permeation emission standards for new off-highway motorcycles, all-terrain vehicles, and snowmobiles. These provisions apply even if the recreational vehicle manufacturer exercises the option to use an engine certified under another program such as the small spark ignition requirements in 40 CFR part 90. These standards would require these vehicle manufacturers to use low permeability fuel tanks and hoses. We include vehicles and fuel systems that are used in the United States, whether they are made domestically or imported.

Even though snowmobiles do not usually experience year around use, as is the case with ATVs and off-highway motorcycles, we are including snowmobiles in this standard because it is common practice among snowmobile owners to store their snowmobiles in the off-season with fuel in the tank (typically half full to full tank). A fuel stabilizer is typically added to the fuel to prevent gum, varnish, and rust from occurring in the engine as a result of the fuel sitting in the fuel tank

[67] Estimated reductions in permeation are 95 percent when not considering competition vehicles, which are exempt from the standard.

and fuel system for an extended period of time; however, this does not reduce permeation. Thus, snowmobiles experience fuel permeation losses just like off-highway motorcycles and ATVs.

We are extending our basic nonroad exemptions to the engines and vehicles covered by this rule. These include the testing exemption, the manufacturer-owned exemption, the display exemption, and the national security exemption. These exemptions are described in more detail under Section VII.C. In addition, vehicles used solely for competition are not considered to be nonroad vehicles, so they are exempt from meeting the emission standards (but see discussion in Section III.C.1.a regarding the voluntary program for certification of all off-highway motorcycles).

C. Permeation Emission Standards

1. What are the emission standards and compliance dates?

We are finalizing new standards that will require an 85-percent reduction in plastic fuel tank permeation and a 95-percent reduction in fuel system hose permeation from new recreational vehicles beginning in 2008. These standards and their implementation dates are presented in Table IV.C-1. Section IV.D presents the test procedures associated with these standards. Test temperatures are presented in Table IV.C-1 because they represent an important parameter in defining the emission levels.

We will base the permeation standards on the inside surface areas of the hoses and fuel tanks. We sought comment on whether the potential permeation standards for fuel tanks should be expressed as grams per gallon of fuel tank capacity per day or as grams per square meter of inside surface area per day. Although volume is generally used to characterize fuel tank emission rates, we base the standard on inside surface area because permeation is a function of surface area. In addition, the surface to volume ratio of a fuel tank changes with capacity and geometry of the tank. Two similar shaped tanks of different volumes or two different shaped tanks of the same volume could have different g/gallon/day permeation rates even if they were made of the same material and used the same emission-control technology. Therefore, we believe that using a $g/m^2/day$ form of the standard more accurately represents the emissions characteristics of a fuel tank and minimizes complexity. This approach was supported by the commenters.

Table IV.C-1
Permeation Standards for Recreational Vehicles

Emission Component	Implementation Date	Standard	Test Temperature
Fuel Tank Permeation	2008	1.5 $g/m^2/day$	28°C (82°F)
Hose Permeation	2008	15 $g/m^2/day$	23°C (73°F)

These standards are revised compared to the values we sought comment on in the notice. In the reopening of the comment period, we identified the need to accommodate variability and deterioration in setting the fuel tank permeation standard. Since the notice, we have received test information that suggests that a tank permeation standard representing an 85 rather than a 95-percent reduction would fully accommodate these factors. Nonetheless, we continue to believe that manufacturers will target control technologies and strategies focused on achieving reductions of 95 percent in production tanks. With regard to the permeation standard for hoses, we have adjusted the standard slightly to give the manufacturers more freedom in selecting their hose material and to accommodate the fact that we selected a certification test fuel based on a 10-percent ethanol blend, which would be prone to greater permeation than straight gasoline.

Cost-effective technologies exist to significantly reduce permeation emissions. Because essentially all of these vehicles use high density polyethylene (HDPE) fuel tanks, manufacturers would be able to choose from several technologies for providing a permeation barrier in HDPE tanks. The use of metal fuel tanks would also meet the standards, because metal tanks do not experience any permeation losses. The hose permeation standard can be met using barrier hose technology or through using low permeation automotive-type tubing. These technologies are discussed in Section IV.F. The implementation dates give manufacturers three to four years to comply. This will allow manufacturers time to implement controls in their tanks and hoses in an orderly business manner.

2. Will I be able to average, bank, or trade emissions credits?

Averaging, banking, and trading (ABT) refers to the generation and use of emission credits based on certified emission levels relative to the standard. The general ABT concept is discussed in detail in Section II.C.3. In many cases, an ABT program can improve technological feasibility, provide manufacturers with additional product planning flexibility, and reduce costs which allows us to consider emission standards with the most appropriate level of stringency and lead time, as well as providing an incentive for the early introduction of new technology.

We are finalizing ABT for fuel tanks to facilitate the implementation of the standard across a variety of tank designs which include differences in wall thickness, tank geometry, material quality, and pigment in plastic fuel tanks. To meet the standard on average, manufacturers would be able to divide their fuel tanks into different emission families and certify each of their emission families to a different Family Emissions Level (FEL). The emission families would include fuel tanks with similar characteristics, including wall thickness, material used (including additives such as pigments, plasticizers, and UV inhibitors), and the emission-control strategy applied. The FELs would then be weighted by sales volume and fuel tank inside surface area to determine the average level across a manufacturer’s total production. An additional benefit of a corporate-average approach is that it provides an incentive for developing new technology that can be used to achieve even larger emission reductions or perhaps to achieve the same reduction at lower costs or to achieve some reductions early.

Any manufacturer could choose to certify each of its evaporative emission control families at levels which would meet the standard. Some manufacturers may choose this approach as the could see it as less complicated to implement.

We are also finalizing a voluntary program intended to give an opportunity for manufacturers to prove out technologies earlier than 2008. Manufacturers will be able to use permeation control strategies early, and even if they do not meet the standard, they can earn credit through partial emission reduction that will give them more lead time to meet the standard. This program will allow a manufacturer to certify fuel tanks early to a less stringent standard and thereby delay the fuel tank permeation standard. Therefore, a manufacturer can earn more time to meet the 1.5 g/m^2/day standard if they have an alternative approach that will reduce permeation by a lesser amount earlier than 2008. Specifically, if a manufacturer certifies fuel tanks early to a standard of 3.0 g/m^2/day, they can delay the 1.5 g/m^2/day standard for these fuel tanks by 1 tank-year for every tank-year of early certification. As an alternative, this delay could be applied to other fuel tanks provided that these tanks have an equal or smaller inside surface area and meet a level of 3.0 g/m^2/day. As an example, suppose a manufacturer were to sell 50 vehicles in 2006 and 75 vehicles in 2007 with fuel tanks that meet a level of 3.0 g/m^2/day. This manufacturer would then be able to sell 125 vehicles with fuel tanks that meet a level of 3.0 g/m^2/day in 2008 and later years. No uncontrolled tanks could be sold after 2007. In addition to providing implementation flexibility to manufacturers, this option, if used, would result in additional and earlier emission reductions.

For hoses, we do not believe that ABT provisions would result in a significant technological benefit to manufacturers. We believe that all fuel hoses can meet the permeation standards using straight forward technology as discussed in Section IV.F. From EPA's perspective, including an ABT program in the rule creates a long-term administrative burden that is not worth taking on since it does not provide the industry with useful flexibility.

3. How do I certify my products?

We are finalizing a certification process similar to our existing program for other mobile sources. Manufacturers test representative prototype designs and submit the emission data along with other information to EPA in an application for a Certificate of Conformity. As discussed in Section IV.D.3, we will allow manufacturers to certify based on either design (for which there is already data) or by conducting its own emissions testing. If we approve the application, then the manufacturer's Certificate of Conformity allows the manufacturer to produce and sell the vehicles described in the application in the U.S.

Manufacturers certify their fuel systems by grouping them into emission families that have similar emission characteristics. The emission family definition is fundamental to the certification process and to a large degree determines the amount of testing required for certification. The regulations include specific characteristics for grouping emission families for each category of tanks and hoses. For fuel tanks, key parameters include wall thickness, material used (including additives such as pigments, plasticizers, and UV inhibitors), and the emission-control strategy applied. For hoses, key parameters include material, wall thickness, and emission-control strategy applied. To address a manufacturer's unique product mix, we may approve using broader or narrower engine families. The certification process for vehicle permeation is similar as for the process for certifying engines (see Section II.C.1).

4. What durability provisions apply?

We are adopting several additional provisions to ensure that emission controls will be effective throughout the life of the vehicle. This section discusses these provisions for permeation from recreational vehicles. More general certification and compliance provisions, which apply across different vehicle categories, are discussed in Sections II and VII, respectively.

a. How long do my vehicles have to comply?

Manufacturers would be required to build fuel systems that meet the emission standards over each vehicle's useful life. For the permeation standards, we use the same useful life as discussed in Section III.C.4.a for exhaust emissions from recreational vehicle engines based on the belief that fuel system components and engines are intended to have the same design life. Further, we are applying the same warranty period for permeation emission related components of the fuel system as for exhaust emission-related components of the vehicle (See Section III.C.4.b).

b. How do I demonstrate emission durability?

We are adopting several additional provisions to ensure that emission controls will be effective throughout the life of the vehicle. Vehicle manufacturers must demonstrate that the permeation emission-control strategies will last for the useful life of the vehicle. Any deterioration in performance would have to be included in the family emissions limit. This section discusses durability provisions for fuel tanks and hoses.

For plastic fuel tanks, we are specifying a preconditioning and four durability steps that must be performed in conjunction with the permeation testing for certification to the standard. These steps, which include fuel soaking, slosh, pressure-vacuum cycling, temperature cycling, and ultra-violet light exposure, are described in more detail in Section IV.D.1. The purpose of these preconditioning steps is to help demonstrate the durability of the fuel tank permeation control under conditions that may occur in use. For fuel hoses, the only preconditioning step that we are requiring is a fuel soak to ensure that the permeation rate is stabilized prior to testing. Data from before and after the durability tests would be used to determine deterioration factors for the certified fuel tanks. The durability factors would be applied to permeation test results to determine the certification emission level of the fuel tank at full useful life. The manufacturer would still be responsible for ensuring that the fuel tank and hose meet the permeation standards throughout the useful life of the vehicle.

We recognize that vehicle manufacturers will likely depend on suppliers/vendors for treated tanks and fuel hoses. We believe that, in addition to normal business practices, our testing requirements will help assure that suppliers/vendors consistently meet the performance specifications laid out in the certificate.

D. Testing Requirements

To obtain a certificate allowing sale of products meeting EPA emission standards, manufacturers generally must show compliance with such standards through emission testing. The test procedures for determining permeation emissions from fuel tanks and hoses on recreational vehicles are described below. This section also discusses design-based certification as an alternative to performing specific testing.

1. What are the test procedures for measuring permeation emissions from fuel tanks?

Prior to testing the fuel tanks for permeation emissions, the fuel tank must be preconditioned by allowing the tank to sit with fuel in it until the hydrocarbon permeation rate has stabilized. Under this step, the fuel tank must be filled with a 10-percent ethanol blend in gasoline (E10), sealed, and soaked for 20 weeks at a temperature of 28 ± 5°C. Once the soak period has ended, the fuel tank is drained, refilled with fresh fuel, and sealed. The permeation rate from fuel tanks is measured at a temperature of 28 ± 2°C over a period of at least 2 weeks. Consistent with good engineering judgment, a longer period may be necessary for an accurate measurement for fuel tanks with low permeation rates. Permeation loss is determined by measuring the weight of the fuel tank before and after testing and taking the difference. Once the mass change is determined it is divided by the manufacturer provided tank surface area and the number of days of soak to get the emission rate. As an option, permeation may be measured using alternative methods that will provide equivalent or better accuracy. Such methods include enclosure testing as described in 40 CFR part 86. The fuel used for this testing will be a blend of 90-percent gasoline and 10-percent ethanol. This fuel is consistent with the test fuel used for highway evaporative emission testing.

To determine permeation emission deterioration factor, we are specifying three durability tests: slosh testing, pressure-vacuum cycling, and ultra-violet exposure. The purpose of these deterioration tests is to help ensure that the technology is durable and the measured emissions are representative of in-use permeation rates. For slosh testing, the fuel tank is filled to 40-percent capacity with E10 fuel and rocked for 1 million cycles. The pressure-vacuum testing contains 10,000 cycles from -0.5 to 2.0 psi. These two durability tests are based on draft recommended SAE practice.[68] The third durability test is intended to assess potential impacts of UV sunlight (0.2 µm - 0.4 µm) on the durability of the surface treatment. In this test, the tank must be exposed to a UV light of at least 0.40 W-hr/m^2 /min on the tank surface for 15 hours per day for 30 days. Alternatively, it can be exposed to direct natural sunlight for an equivalent period of time.

We originally sought comment on applying the procedures in 49 CFR part 173, appendix B, but upon further evaluation and receipt of additional information found these inadequate for our purposes. The 49 CFR part 173 test procedure is designed for testing plastic receptacles for transporting hazardous chemicals. This test focus on temperatures and durability procedures that do not represent recreational vehicle use.

2. What are the test procedures for measuring permeation emissions from fuel system hoses?

The permeation rate of fuel from hoses would be measured at a temperature of 23 ± 2°C using SAE method J30[69] with E10. The hose must be preconditioned with a fuel soak to ensure that the permeation rate has stabilized. The fuel to be used for this testing would be a blend of 90-percent gasoline and 10-percent ethanol. This fuel is consistent with the test fuel used for highway evaporative emission testing. Alternatively, for purposes of submission of data at certification, permeation could be measured using alternative equipment and procedures that provide equivalent results. To use these

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[68] Draft SAE Information Report J1769, "Test Protocol for Evaluation of Long Term Permeation Barrier Durability on Non-Metallic Fuel Tanks," (Docket A-2000-01, document IV-A-24).

[69] SAE Recommended Practice J30, "Fuel and Oil Hoses," June 1998, (Docket A-2000-01, document IV-A-92).

alternative methods, manufacturers would have to apply to us and demonstrate equivalence. Examples of alternative approaches that we anticipate manufacturers may use are the recirculation technique described in SAE J1737,[70] enclosure-type testing such as in 40 CFR part 86, or weight loss testing such as described in SAE J1527.[71]

3. Can I certify based on engineering design rather than through testing?

In general, test data would be required to certify fuel tanks and hoses to the permeation standards. Test data could be carried over from year to year for a given emission-control design. We do not believe the cost of testing tanks and hose designs for permeation would be burdensome especially given that the data could be carried over from year to year, and that there is a good possibility that the broad emission family concepts would lead to minimum testing. However, there are some specific cases where we would allow certification based on design. These special cases are discussed below.

We would consider a metal fuel tank to meet the design criteria for a low permeation fuel tank because fuel does not permeate through metal. However, we would not consider this design to be any more effective than any other low permeation fuel tank for the purposes of any sort of credit program. Although metal is impermeable, seals and gaskets used on the fuel tank may not be. The design criteria for the seals and gaskets would be that either they would not have a total exposed surface area exceeding 1000 mm^2, or the seals and gaskets would have to be made of a material with a permeation rate of 10 g/m^2/day or less at 23°C as measured under ASTM D814.[72] A metal fuel tank with seals that meet this design criteria would readily pass the standard.

Fuel hoses can be certified by design as being manufactured in compliance with certain accepted SAE specifications. Specifically, a fuel hose meeting the SAE J30 R11-A or R12 requirements could be design-certified to the standard. In addition, fuel line meeting the SAE J2260[73] Category 1 requirements could be design-certified to the standard. These fuel hoses and fuel line specifications are based on 15-percent methanol fuel and higher temperatures. We believe that fuel hoses and lines that are tested and meet these requirements would also meet our hose permeation standards because both are generally acknowledged as representing more stringent test parameters. In the future, if new SAE specifications are developed which are consistent with our hose permeation standards, we would consider including hoses meeting the new SAE requirements as being able to certify by design.

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[70] SAE Recommended Practice J1737, “Test Procedure to Determine the Hydrocarbon Losses from Fuel Tubes, Hoses, Fittings, and Fuel Line Assemblies by Recirculation,”1997, (Docket A-2000-01, document, IV-A-34).

[71] SAE Recommended Practice J1527, “Marine Fuel Hoses,”1993, (Docket A-2000-01, document IV-A-19).

[72] ASTM Standard Test Method D 814 - 95 (Reapproved 2000), “Rubber Property–Vapor Transmission of Volatile Liquids,” (Docket A-2000-01, document IV-A-95).

[73] SAE Recommended Practice J2260, “Nonmetallic Fuel System Tubing with One or More Layers,”1996, (Docket A-2000-01, document IV-A-18).

At certification, manufacturers will have to submit an engineering analysis showing that the tank or hose designs will meet the standards throughout their full useful life. The tanks and hoses will remain subject to the emission standards throughout their useful lives. The design criteria relate only to the issuance of a certificate.

E. Special Compliance Provisions

We believe that the permeation control requirements will be relatively easy for small businesses to meet, given the relatively low cost of the requirements and the availability of materials and treatment support by outside vendors. Low permeation fuel hoses are available from vendors today, and we would expect that surface treatment would be applied through an outside company. However, to minimize any additional burden these requirements may impose on small manufacturers, we are implementing, where they are applicable to permeation, the same options we proposed for the exhaust emission standards. These options for small recreational vehicle manufacturers are described in detail in Section III.E.

F. Technological Feasibility

We believe there are several strategies that manufacturers can use to meet our permeation emission standards. This section gives an overview of this technology. See Chapters 3 and 4 of the Final Regulatory Support Document for more detail on the technology discussed here.

1. Implementation schedule

The permeation emission standards for fuel tanks become effective in the 2008 model year. Several technologies are available that could be used to meet this standard. Surface treatments to reduce tank permeation are widely used today in other container applications, and the technology and production facilities needed to conduct this process exist. Selar is used by at least one portable fuel tank manufacturer and has also been used in automotive applications. Plastic tanks with coextruded barriers have been used in automotive applications for years. However, fuel tanks used in recreational vehicles are primarily (but not exclusively) high-density polyethylene tanks with no permeation control. We received comments from manufacturers that they would not be able to comply with permeation standards until 2008 or 2009. They stated that, especially for fuel tanks, they would need this extra lead time to ensure that the useful life requirement can be met on their products. At the same time, others commented that the technology is already available and that the permeation standards should apply in 2004. We believe it is appropriate to give manufacturers until the 2008 model year for the fuel tank permeation standards. Manufacturers will need lead time to allow for durability testing and other development work associated with applying this technology to recreational vehicles. This is especially true for manufacturers or vendors who choose to set up their own sulfonation or fluorination facilities in-house.

We believe that the low permeation hose technology can also be applied in the 2008 time frame. A lower permeation fuel hose exists today known as the SAE R9 hose that is as flexible as the SAE R7 hose used in most recreational applications today. These SAE hose specifications are contained in SAE J30 cited above. This hose would meet our permeation standard on gasoline, but probably not on a 10-percent ethanol blend. As noted in Chapter 4 of the Final Regulatory Support Document, barrier materials typically used in R9 hose today may have permeation rates 3 to 5 times higher on a 10-percent ethanol blend than on straight gasoline. However, there are several lower permeability barrier materials that can be used in rubber hose that will comply with the hose permeation requirement on a 10-percent ethanol blend and still be flexible enough for use in recreational vehicles. This hose is available for automotive applications at this time, but some lead time may be required to apply these hoses to recreational vehicles if hose connection fitting changes were required. For these reasons, we are implementing the hose permeation standard on the same schedule as the tank permeation standards.

2. Standard levels

We have identified several strategies for reducing permeation emissions from fuel tanks and hoses. We recognize that some of these technologies may be more desirable than others for some manufacturers, and we recognize that different strategies for equal emission reductions may be better for different applications. A specific example of technology that could be used to meet the fuel tank permeations would be surface barrier treatments such as sulfonation or fluorination. With these surface treatments, more than a 95-percent reduction in permeation emissions from new fuel tanks is feasible. However, variation in material tolerances and in-use deterioration can reduce this effectiveness. Given the lead time for the standards, manufacturers will be able to provide fuel tanks with consistent material quality, and the surface treatment processes can be optimized for a wide range of material qualities and additives such as pigments, plasticizers, and UV inhibitors. We do not expect a large deterioration in use; however, data on slosh testing suggest that some deterioration may occur. To accommodate variability and deterioration, we are finalizing a standard that represents about an 85-percent reduction in permeation emissions from plastic fuel tanks. It is our expectation that manufacturers will aim for a surface treatment effectiveness rate as near to 100 percent a practical for new tanks. Therefore, even with variability and deterioration in use, control rates are likely to exceed 85 percent. Several materials are available today that could be used as a low permeation barrier in rubber hoses. We present more detail on these and other technological approaches below.

3. Technological approaches

a. fuel tanks

Blow molding is widely used for the manufacture of small fuel tanks of recreational vehicles. Typically, blow molding is performed by creating a hollow tube, known as a parison, by pushing high-density polyethylene (HDPE) through an extruder with a screw. The parison is then pinched in a mold and inflated with an inert gas. In highway applications, non-permeable plastic fuel tanks are produced by blow molding a layer of ethylene vinyl alcohol (EVOH) or nylon between two layers of polyethylene. This process is called coextrusion and requires at least five layers: the barrier layer, adhesive layers on either side of the barrier layer, and HDPE as the outside layers which make up most of the thickness of the fuel tank walls. However, multi-layer construction requires two additional extruder screws which significantly increases the cost of the blow molding process. Multi-layer fuel tanks can also be formed using injection molding. In this method, a low viscosity polymer is forced into a thin mold to create each side of the fuel tank. The two sides are then welded together. To add a barrier layer, a thin sheet of the barrier material is placed inside the mold prior to injection of the poleythylene. The polyethylene, which generally has a much lower melting point than the barrier material, bonds with the barrier material to create a shell with an inner liner.

A less expensive alternative to coextrusion is to blend a low permeable resin in with the HDPE and extrude it with a single screw. The trade name typically used for this permeation control strategy is Selar. The low permeability resin, typically EVOH or nylon, creates non-continuous platelets in the HDPE fuel tank which reduce permeation by creating long, tortuous pathways that the hydrocarbon molecules must navigate to pass through the fuel tank walls. Although the barrier is not continuous, this strategy can still achieve greater than a 90-percent reduction in permeation of gasoline. EVOH has much higher permeation resistance to alcohol than nylon; therefore, it would be the preferred material to use for meeting our standard which is based on testing with a 10-percent ethanol fuel.

Another type of low permeation technology for fuel tanks would be to treat the surfaces of a plastic fuel tanks with a barrier layer. Two ways of achieving this are known as fluorination and sulfonation. The fluorination process causes a chemical reaction where exposed hydrogen atoms are replaced by larger fluorine atoms which creates a barrier on the surface of the fuel tank. In this process, a batch of fuel tanks are generally processed post production by stacking them in a steel container. The container is then voided of air and flooded with fluorine gas. By pulling a vacuum in the container, the fluorine gas is forced into every crevice in the fuel tanks. As a result of this process, both the inside and outside surfaces of the fuel tank would be treated. As an alternative, fuel tanks can be fluorinated on-line by exposing the inside surface of the fuel tank to fluorine during the blow molding process. However, this method may not prove as effective as off-line fluorination which treats the inside and outside surfaces.

Sulfonation is another surface treatment technology where sulfur trioxide is used to create the barrier by reacting with the exposed polyethylene to form sulfonic acid groups on the surface. Current practices for sulfonation are to place fuel tanks on a small assembly line and expose the inner surfaces to sulfur trioxide, then rinse with a neutralizing agent. However, sulfonation can also be performed using a batch method. Either of these processes can be used to reduce gasoline permeation by more than 95 percent.

Over the first month or so of use, polyethylene fuel tanks can expand by as much as three percent due to saturation of the plastic with fuel. Manufacturers have raised the concern that this hydrocarbon expansion could affect the effectiveness of surface treatments like fluorination or sulfonation. We believe this will not have a significant effect on the effectiveness of these surface treatments. California ARB has performed extensive permeation testing on portable fuel containers with and without these surface treatments. Prior to the permeation testing, the tanks were prepared by first performing a durability procedure where the fuel container is cycled a minimum of 1000 times between -1 psi and 5 psi. In addition, the fuel containers are soaked with fuel for a minimum of four weeks prior to testing. Their test data, presented in Chapter 4 of the Final Regulatory Support Document show that fluorination and sulfonation are still effective after this durability testing.

Manufacturers have also commented that fuel sloshing in the fuel tank, under normal in-use operation, could wear off the surface treatments. However, we do not believe that this is likely. These surface treatments actually result in an atomic change in the structure of the outside surface of the fuel tank. To wear off the treatment, the plastic would need to be worn away on the outside surface. In addition, testing by California ARB shows that the fuel tank permeation standard can be met by fuel tanks that have been sloshed for 1.2 million cycles. Test data on an sulfonated automotive HDPE fuel tank after five years of use showed no deterioration in the permeation barrier. This data are presented in Chapter 4 of the Final Regulatory Support Document.

Permeation can also be reduced from fuel tanks by constructing them out of a lower permeation material than HDPE. For instance, metal fuel tanks would not permeate. In addition, there are grades of plastics other than HDPE that could be molded into fuel tanks. One commenter suggested nylon; however, although nylon has excellent permeation resistance on gasoline, it has poor chemical resistance to alcohol-blended fuels. Other materials, which have excellent permeation even with alcohol-blended fuels are acetal copolymers and thermoplastic polyesters. At this time, these materials are generally much more expensive than HDPE.

b. hoses

Fuel hoses produced for use in recreational vehicles are generally extruded nitrile rubber with a cover for abrasion resistance. Lower permeability fuel hoses produced today for other applications are generally constructed in one of two ways: either with a low permeability layer or by using a low permeability rubber blend. By using hose with a low permeation thermoplastic layer, permeation emissions can be reduced by more than 95 percent. Because the thermoplastic layer is very thin, on the order of 0.1 to 0.2 mm, the rubber hose retains its flexibility. Two thermoplastics which have excellent permeation resistance, even with an alcohol-blend fuel, are ETFE and THV.[74]

In automotive applications, multilayer plastic tubing, made of fluoropolymers is generally used. An added benefit of these low permeability lines is that some fluoropolymers can be made to conduct electricity and therefore can prevent the buildup of static charges. Although this technology can achieve more than an order of magnitude lower permeation than barrier hoses, it is relatively inflexible and may need to be molded in specific shapes for each recreational vehicle design. Manufacturers have commented that they would need flexible hose to fit their many designs, resist vibration, and to simplify the hose connections and fittings.

An alternative approach to reducing the permeability of fuel hoses would be to apply a surface treatment such as fluorination or sulfonation. This process would be performed in a manner similar to discussed above for fuel tanks.

4. Conclusions

The standards for permeation emissions from recreational vehicles reasonably reflect what manufacturers can achieve through the application of available technology. Manufacturers will have several years of lead time to select, design, and produce permeation emission-control strategies that will work best for their product lines. We expect that meeting these requirements will pose a challenge, but one that is feasible taking into consideration the availability and cost

[74] ethylene-tetrafluoro-ethylene (ETFE), tetra-fluoro-ethylene, hexa-fluoro-propylene, and vinyledene fluoride (THV)

of technology, lead time, noise, energy, and safety. The role of these factors is presented in detail in Chapters 3 and 4 of the Final Regulatory Support Document.

The permeation standards are based on the effective application of low permeable materials or surface treatments. This is a step change in technology; therefore, we believe that even if we set a less stringent permeation standard, these technology options would likely still be used. In addition, this technology is relatively inexpensive and can achieve meaningful emission reductions. The standards are expected to achieve more than an 85-percent reduction in permeation emissions from fuel tanks and more than 95 percent from hoses. We believe that more stringent standards could result in significantly more expensive materials without corresponding additional emission reduction. In addition, the control technology would generally pay for itself over time by conserving fuel that would otherwise evaporate. The projected costs and fuel savings are discussed in Chapter 5 of the Final Regulatory Support Document.

V. Large SI Engines

A. Overview

This section applies to most nonroad spark-ignition engines rated over 19 kW ("Large SI engines"). The emission standards will lead to emission reductions of about 90 percent for CO, NOx, and HC. Since the emission standards are based on engine testing with broadly representative duty cycles, these estimated reductions apply to all types of equipment using these engines. Reducing Large SI engine emissions will help reduce ozone and CO concentrations and will also be valuable to individuals operating these engines in areas with limited fresh air circulation. The cost of applying the anticipated emission-control technology to these engines is offset by much greater cost savings from reduced fuel consumption over the engines' operating lifetime, as described in the Final Regulatory Support Document.

This section describes the requirements that apply to engine manufacturers. See Section II for a description of our general approach to regulating nonroad engines and how manufacturers show that they meet emission standards. See Section VII for additional requirements for engine manufacturers, equipment manufacturers, and others. See Section VIII for general provisions related to testing equipment and procedures.

B. Large SI Engines Covered by This Rule

Large SI engines covered in this section power nonroad equipment such as forklifts, sweepers, pumps, and generators. This includes marine auxiliary engines, but does not include marine propulsion engines or engines used in recreational vehicles (snowmobiles, off-highway motorcycles, and all-terrain vehicles). These other nonroad applications are addressed elsewhere in this document.

This final rule applies only to spark-ignition engines. Our most recent rulemaking for nonroad diesel engines adopted a definition of "compression-ignition" that addressed the status of alternative-fuel engines (63 FR 56968, October 23, 1998). We are adopting updated definitions consistent with those already established in previous rulemakings to clarify that all reciprocating internal combustion engines are either spark-ignition or compression-ignition.[75] These new definitions apply to 40 CFR parts 89 and 1048. Spark-ignitions include gasoline-fueled engines and any others that control power with a throttle and follow the theoretical Otto cycle. Compression-ignition engines are any reciprocating internal-combustion engines that are not spark-ignition engines. Under these definitions, it is possible for a diesel-derived engine to fall under the spark-ignition program. We believe the requirements adopted in this rule are feasible and appropriate for these engines. However, we will allow such engines over 250 kW to instead meet the requirements that apply to nonroad diesel engines. We believe this is appropriate for several reasons. First, the technology requirements are comparable between programs. The nonroad diesel emission standards, which apply over the longer useful life characteristic of diesel engines, are slightly more stringent for CO and slightly less stringent for HC+NOx. The calibration changes needed to adjust these emission levels are not fundamental to the overall design of the emission-control system. Second, the diesel engine manufacturers producing these engines are already set up to do testing based on test procedures that apply to diesel

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[75]Gas turbines are non-reciprocating internal combustion engines.

engines. To the extent that they would incur costs to be able to run test procedures specified for Large SI engines, these costs would likely not correspond with improving emission-controls. Third, these engines share important technical characteristics with diesel engines and are likely to experience in-use operation that is more like that of nonroad diesel engines. In addition, they are installed in applications that also use diesel engines, not Large SI engines.

Several types of engines are excluded or exempted from these new regulations. The following sections describe the types of special provisions that apply uniquely to nonrecreational spark-ignition engines rated over 19 kW. Section VII.C covers several additional exemptions that apply generally across programs.

1. Stationary engine exclusion

Consistent with the Clean Air Act, stationary-source engines are not nonroad engines, so the emission standards don’t apply to engines used in stationary applications. In general, an engine that would otherwise be considered a Large SI engine is not considered a nonroad engine if it will be either installed in a fixed position or if it will be a portable (or transportable) engine operating for at least one-year periods without moving throughout its lifetime. We are adopting the same definitions for these engines that have already been established for other programs. These stationary engines (that would otherwise qualify as Large SI engines) must have an engine label identifying their excluded status. This is especially valuable for importing excluded engines without complication from U.S. Customs officials. It also helps us ensure that such engines are legitimately excluded from emission standards.

2. Exclusion for engines used solely for competition

For Large SI engines we proposed the existing regulatory definition for nonroad engines, with excludes engines used solely for competition. As described in the proposed rule, we are not aware of any manufacturers producing new engines that are intended only for competition. As a result, we are not adopting any specific provisions addressing a competition exclusion for manufacturers. Part 1068 of the regulations includes provisions addressing the practice of modifying certified engines for competition (see Section VII.C).

3. Motor vehicle engine exemption

In some cases an engine manufacturer may want to modify a certified automotive engine for nonroad use to sell the engine without recertifying it as a Large SI engine. We are therefore adopting an exemption from the Large SI standards in 40 CFR part 1048 for engines that are already certified to the emission standards in 40 CFR part 86 for highway applications. To qualify for this exemption from separately certifying to nonroad standards, the manufacturer must makes no changes to the engine that might affect its exhaust or evaporative emissions. Companies using this exemption must report annually to us, including a list of its exempted engine models. For engines included under this provision, manufacturers of the vehicle or engine must generally meet all the requirements from 40 CFR part 86 that would apply if the engine were used in a motor vehicle. Section 1048.605 of the regulations describes the qualifying criteria and responsibilities in greater detail.

We generally prohibit equipment or vehicle manufacturers from producing new nonroad equipment that does not have engines certified to nonroad emission standards. However, in some cases a manufacturer may want to produce vehicles certified to highway emission standards for nonroad use. We are providing an exemption for these manufacturers, as long as there is no change in the vehicle's exhaust or evaporative emission-control systems. For example, a mining company may want to use a pickup truck for dedicated work at a mine site, but special-order the trucks from the manufacturer with modifications that cause the truck to no longer qualify as a motor vehicle. Manufacturers may produce such a modified version of a truck that has been certified to the motor-vehicle standards, as long as the modifications don't affect its emissions.

4. Lawn and garden engine exemption

Most Large SI engines, rated over 19 kW, have a total displacement greater than one liter. The design and application of the few Large SI engines currently being produced with displacement less than one liter are very similar to those of engines rated below 19 kW, which are typically used for lawn and garden applications. As described in the most recent rulemaking for these smaller engines, manufacturers may certify engines between 19 and 30 kW with total displacement of one liter or less to the requirements we have already adopted in 40 CFR part 90 for engines below 19 kW (see 65 FR 24268, April 25, 2000). We are not changing this provision, and engines so certified would not be subject to the requirements that apply to Large SI engines. This approach allows manufacturers of small air-cooled engines to certify their engines rated between 19 and 30 kW with the program adopted for the comparable engines with slightly lower power ratings. This is also consistent with the provisions adopted by California ARB, except for the addition of the 30-kW cap to prevent treating high-power engines under the program that applies to lawn and garden engines.

Technological, economic, and environmental issues associated with the few engine models with rated power over 19 kW, but with displacement at or below 1 liter, were previously analyzed in the rulemaking for nonroad spark-ignition engines below 19 kW. This rule therefore does not specifically address the provisions applying to them or repeat the estimated impacts of adopting emission standards.

Conversely, we are aware that some engines rated below 19 kW may be part of a larger family of engine models that includes engines rated above 19 kW. This may include, for example, three- and four-cylinder engine models that are otherwise identical. To avoid the need to separate these engines into separate engine families (certified under completely different control programs), manufacturers may certify any engine rated under 19 kW to the more stringent Large SI emission standards. Such an engine is then exempt from the requirements of 40 CFR part 90.

C. Emission Standards

In October 1998, California ARB adopted emission standards for Large SI engines. We are extending these requirements to the rest of the U.S. in the near term. We are also revising the emission standards and adding various provisions in the long term, as described below. The near-term and the long-term emission standards are based on three-way catalytic converters with electronic fueling systems to control emissions, and differ primarily in terms of how well the controls are optimized. In addition to the anticipated emission reductions, we project that these technologies will provide large savings to operators as a result of reduced fuel consumption and other performance improvements.

An important element of the control program is the attempted harmonization with the requirements adopted by California ARB. We are aware that inconsistent or conflicting requirements may lead to additional costs. Cooperation between agencies has allowed a great degree of harmonization. In addition to the common structure of the programs, the specific provisions that make up the certification requirements and compliance programs are consistent with very few exceptions. In most of the cases where individual provisions differ, the EPA language is more general than that adopted by California, rather than being incompatible. The following sections describe the requirements in greater detail.

1. What are the emission standards and compliance dates?

a. Exhaust emissions

We are adopting standards starting in the 2004 model year consistent with those adopted by California ARB. These standards, which apply to testing only with the applicable steady-state duty cycles, are 4.0 g/kW-hr (3.0 g/hp-hr) for HC+NOx emissions and 50 g/kW-hr (37 g/hp-hr) for CO emissions. See Section V.D for further discussion of the steady-state duty cycles. We expect manufacturers to meet these standards using three-way catalytic converters and electronically controlled fuel systems. These systems are similar to those used for many years in highway applications, but not necessarily with the same degree of sophistication.

Adopting emission standards for these engines starting in 2004 allows a relatively short lead time. However, manufacturers will be able to achieve this by expanding their production of the same engines they will be selling in California at that time. We have designed our 2004 standards to require no additional development, design, or testing beyond what California ARB already requires. Adopting these near-term emission standards allows us to set early requirements to introduce the low-emission technologies for substantial emission reductions with minimal lead time. The final requirements includes two principal adjustments to align with the California ARB standards. First, we specify that manufacturers' deterioration factors for 2004 through 2006 model years should be based on emission measurements over 3500 hours of engine operation, rather than the full useful life of 5000 hours. Second, for those same model years, we are applying an emission standard of 5.4 g/kW-hr (4.0 g/hp-hr) HC+NOx for any in-use testing to account for the potential for additional deterioration beyond 3500 hours. This allowance for higher in-use emissions is a temporary provision to ensure the feasibility of compliance in the early years of the program. Testing has shown that with additional design time, manufacturers can incorporate emission-control technologies with sufficient durability that the long-term standards do not require a separate in-use standard. This is separate from the field-testing standards described below.

Testing has shown that additional time to optimize designs to better control emissions will allow manufacturers to meet significantly more stringent emission standards that are based on more robust measurement procedures. We are therefore adopting a second tier of standards to require additional emission reductions. These later standards require manufacturers to control emissions under both steady-state and transient engine operation, as described in Section V.D below). Setting the emission standards to require additional control involves separate consideration of the achievable level of control for HC+NOx and CO emissions. While HC+NOx emissions contribute to nonattainment of ozone air quality standards, CO emissions contribute to nonattainment of CO air quality standards and potentially harmful exposures of individuals where engines are operating in areas where fresh airflow may be restricted. Emission-control technology is able to simultaneously control these three pollutants, but a tradeoff between NOx and CO emissions persists for any given system. This relationship is determined by an engine's precise control of air-fuel ratios—shifting to air-fuel ratios slightly lean of stoichiometric increases NOx emissions but decreases CO emissions and vice versa. Engines using different fuels face this same situation, though gasoline engines operating under heavy load generally need to shift to richer air-fuel ratios to prevent accelerated engines wear from very high combustion temperatures.

Our primary focus in setting the level of the emission standards is reductions in emissions that contribute to ambient air-pollution problems. At the same time, we recognize that these engines are used in many applications where there are concerns about personal exposure to the engine exhaust, including workplace exposure, focusing primarily on CO exposure. It is appropriate to take such concerns into consideration in setting the level of the standards. In this case, where the equipment using these engines can vary substantially and where the emission-control technology means there is a trade-off between HC+NOx control and CO control, it is difficult to set a single, optimal standard for all three pollutants. In such a situation it is reasonable to have more than one set of standards to allow an engine to use technologies focused on controlling the pollutants of most concern for a specific application.

We are not in a position, however, to readily identity the specific levels of alternative standards that are appropriate for each application or to pick specific applications that should go with different standards. We also want to ensure that engines significantly reduce emissions of all three pollutants.

To address this, we are setting a combination of standards requiring more effective emission controls starting with the 2007 model year. First, we are setting benchmark emission standards of 2.7 g/kW-hr (2.0 g/hp-hr) for HC+NOx emissions and 4.4 g/kW-hr (3.3 g/hp-hr) for CO emissions. The emission standards apply to measurements during duty-cycle testing under both steady-state and transient operation, including certification, production-line testing, and in-use testing.[76] These emission levels provide for substantial control of HC+NOx emissions (in fact, these standards are more stringent than those proposed), but also contain substantial control of CO emissions to protect against individual exposure as well as CO nonattainment.

We are also including an option for manufacturers to certify their engines to different emission levels to allow manufacturers to build engines whose emission controls are more weighted toward controlling NOx emissions to reflect the inherent tradeoff of NOx and CO emissions. Generally this involves meeting a less stringent CO standard if a manufacturer certifies an engine with lower HC+NOx emissions. Table V.C-1 shows several examples of possible combinations of HC+NOx and CO emission standards. The highest allowable CO standard is 20.6 g/kW-hr (15.4 g/hp-hr), which corresponds with HC+NOx emissions below 0.8 g/kW-hr (0.6 g/hp-hr). Manufacturers certify to any HC+NOx level between and including 0.8 and 2.7 g/kW-hr, rounding to the nearest 0.1 g/kW-hr. They will certify also to the corresponding CO level, as calculated using the formula below, again rounding to the nearest 0.1 g/kW-hr.

[76] See Section V.D for a discussion of duty cycles.

Table V.C-1
Samples of Possible Alternative Duty-Cycle
Emission Standards for Large SI Engines(g/kW-hr)*

HC+NOx	CO
2.7	4.4
2.2	5.6
1.7	7.9
1.3	11.1
1.0	15.5
0.8	20.6

*As described in the Final Regulatory Support Document and the regulations, the values in the table are related by the following formula: $(HC+NOx) \times CO^{0.784} = 8.57$. These values follow directly from the logarithmic relationship presented with the proposal in the Draft Regulatory Support Document.

We believe this flexible approach to setting standards is the most appropriate and efficient way to allocate the different design strategies to achieve effective reductions of HC+NOx emissions while providing for the best control of CO emissions where it is most needed. Testing has shown that emission controls are more likely to experience degradation with respect to controlling CO emissions than HC or NOx emissions. Manufacturers therefore have a natural incentive to certify engine families with an HC+NOx emission level as low as possible to increase the compliance margin for meeting the CO standard. In addition, many of these engines will be used in applications where ozone is of more concern. As a result, we expect manufacturers to design most of their engines to operate substantially below the 2.7 g/kW-hr standard for HC+NOx emissions. This approach also encourages manufacturers to continually improve their control of HC+NOx emissions over time. At the same time, to the extent that purchasers want engines with low CO emission levels, particularly for exposure-related concerns, manufacturers will be able to produce compliant engines that will provide appropriate protection. Note that engines operating at the highest allowable CO emission levels under the 2007 standards will still be substantially reducing CO emissions compared with baseline levels. The emission standards in this final rule will achieve substantial reductions, but are not designed to guarantee workplace safety or to set a safety standard. Rather, we intend to facilitate the use of engine-based control technologies so that owners and operators can purchase equipment to help them address these concerns.

We are not adopting any controls or limits to restrict the sale of engines meeting certain requirements into certain applications. We believe that the manufacturers and customers for these products will together make educated choices regarding the appropriate mix of emission controls for each application and that market forces will properly balance emission controls for the different pollutants in specific applications. We believe that customers for these applications, some of whom are subject to occupational air-quality standards for related pollutant concentrations, will be well placed to make informed choices regarding air-pollution control, especially given their ability to make choices based on the specific environmental circumstances of each particular customer.[77]

We are adopting field-testing standards of 3.8 g/kW-hr (2.8 g/hp-hr) for HC+NOx and 6.5 g/kW-hr (4.9 g/hp-hr) for CO. As described above for duty-cycle testing, field-testing allows for the same pattern of optional emission standards to reflect the tradeoff of CO and NOx emissions. See Section V.D.5 for more information about field testing.

As described in Chapter 4 of the Final Regulatory Support Document, we believe manufacturers can achieve these emission standards by optimizing currently available three-way catalysts and electronically controlled fuel systems.

Two additional provisions apply to specific situations. First, some engines need to operate with rich air-fuel ratios at high loads to protect the engine from overheating. This is especially true for gasoline-fueled engines, which typically experience higher combustion temperatures. When operating at such air-fuel ratios, the engines may be unable to meet the CO emission standard during steady-state testing because the steady-state duty cycle involves sustained operation under high-load conditions, unlike the transient duty cycle. If a manufacturer shows us that this type of engine operation keeps it from meeting the CO emission standard shown above for specific models, we will approve a separate CO emission standard of 31.0 g/kW-hr that would apply only to steady-state testing. This standard reflects the adjustment needed at high-load operation and would apply to any steady-state tests for certification, production-line testing, or in-use testing. To prevent high in-use emission levels, we are adopting several additional provisions related to this separate CO standard. Manufacturers must show that enrichment is necessary to protect the engine from damage and that enrichment will be limited to operating modes that require additional cooling to protect the engine from damage. In addition, manufacturers must show in their application for certification that enrichment will rarely occur in the equipment in which your engines are installed (for example, an engine that is expected to operate 5 percent of the time in use with enrichment would clearly not qualify). Finally, manufacturers must include in the emission-related installation instructions any steps necessary for someone installing the engines to prevent enrichment during normal operation. This option does not apply to transient or field testing, so these engines would need to meet the same formula for HC+NOx and CO standards that apply to other engines for transient testing and for field testing. By tying the CO standard for these engines to the highest allowable CO emission level for field testing, we are effectively requiring that manufacturers ensure that in-use engines employ engine-protection strategies no more frequently than is reflected in the steady-state duty cycles for certification.

Second, equipment manufacturers have made it clear that some nonroad applications involve operation in severe environments that require the use of air-cooled engines. These engines rely on air movement instead of an automotive-style water-cooled radiator to maintain acceptable engine temperatures. Since air cooling is less effective, these engines rely substantially on enrichment to provide additional cooling relative to water-cooled engines. At these richer air-fuel

[77]While the emission standards in this final rule require substantial emission reductions of CO and other harmful pollutants from nonroad engines, this does not replace the need for ongoing regulation of air quality to protect occupational safety and health. More specifically, in accordance with the limitations provided in Section 310(a) of the Clean Air Act (42 U.S.C. section 7610(a)), nothing in this rule affects the Occupational Safety and Health Administration's authority to enforce standards and other requirements under the Occupational Safety and Health Act of 1970 (29 U.S.C. sections 651 et seq.).

ratios, catalysts are able to reduce NOx emissions but oxidation of CO emissions is much less effective. As a result, we are adopting emission standards for these "severe-duty" engines of 2.7 g/kW-hr for HC+NOx and 130 g/kW-hr for CO. These standards apply to duty-cycle emission testing for both steady-state and transient measurements (for certification, production-line, and in-use testing). The corresponding field-testing standards are 3.8 g/kW-hr for HC+NOx and 200 g/kW-hr for CO. Severe-duty applications include concrete saws and concrete pumps. These types of equipment are exposed to high levels of concrete dust, which tends to form a thick insulating coat around any heat-exchanger surfaces and exposes engines to highly abrasive dust particles. Manufacturers may request approval in identifying additional severe-duty applications subject to these less stringent standards if they can provide clear evidence that the majority of installations need air-cooled engines as a result of operation in a severe-duty environment. This arrangement generally prevents these higher-emitting engines from gaining a competitive advantage in markets that don't already use air-cooled engines.

We believe three years between phases of emission standards allows manufacturers enough lead time to meet the more stringent emission standards. The projected emission-control technologies for the 2004 emission standards should be capable of meeting the 2007 emission levels with additional optimization and testing. In fact, manufacturers may be able to apply their optimization efforts before 2004, leaving only the additional testing demonstration for complying with the 2007 standards. The biggest part of the optimization effort may be related to gaining assurance that engines will meet field-testing emission standards described in Section V.D.5, since engines will not be following a prescribed duty cycle.

For engines fueled by gasoline and liquefied petroleum gas (LPG), we specify emission standards based on total hydrocarbon measurements, while California ARB standards are based on nonmethane hydrocarbons. We believe that switching to measurement based on total hydrocarbons simplifies testing, especially for field testing of in-use engines with portable devices (See Section V.D.5). To maintain consistency with California ARB standards in the near term, we will allow manufacturers to base their certification through 2006 on either nonmethane or total hydrocarbons (see 40 CFR 1048.145). Methane emissions from controlled engines operating on gasoline or LPG are about 0.1 g/kW-hr.

Operation of natural gas engines is very similar to that of LPG engines, with one noteworthy exception. Since natural gas consists primarily of methane, these engines have a much higher level of methane in the exhaust. Methane generally does not contribute to ozone formation, so it is often excluded from emission measurements. We have therefore specified nonmethane hydrocarbon emissions for comparison with the standard for natural gas engines. However, the emission standards based on measuring emissions in the field depend on total hydrocarbons. We are therefore adopting a NOx-only field-testing standard for natural gas engines instead of a HC+NOx standard. Since control of NOx emissions for natural gas engines poses a significantly greater challenge than controlling nonmethane hydrocarbons, duty-cycle testing provides adequate assurance that these engines have sufficiently low hydrocarbon emission levels. Manufacturers must show that they meet these duty-cycle standards for certification and the engines remain subject to the nonmethane hydrocarbon standard in-use when tested over the same duty-cycles.

b. Evaporative emissions

We are adopting requirements related to evaporative and permeation emissions from gasoline-fueled Large SI engines. For controlling diurnal emissions, we are adopting an emission standard of 0.2 grams of hydrocarbon per gallon of fuel tank capacity during a 24-hour period. In addition, we specify that manufacturers use fuel lines meeting an industry standard for permeation-resistance. Finally, we require that manufacturers take steps to prevent fuel from boiling. We expect certification of manufacturers' equipment to be design-based, as compared with conducting a full emission-measurement program during certification. As such, meeting these evaporative requirements is much more like meeting the requirements related to controlling crankcase emissions and is therefore discussed in detail in Section V.C.4 below.

2. May I average, bank, or trade emission credits?

We are not including an averaging, banking, and trading program for certifying engines. As described in Chapter 4 of the Final Regulatory Support Document, we believe that manufacturers will generally be able to rely on a relatively uniform application of emission-control technology to meet emission standards. The standards were selected based on the capabilities of all manufacturers to comply with all their models without an emission-credit program. Moreover, overlaying an emission-credit program on the flexible standards described above would be highly impractical. If such a program could be devised it would need to be very complex and would achieve little, if any, advantage to manufacturers beyond the advantages already embodied in the flexible approach we are adopting.

However, as an alternative to a program of calculating emission credits for averaging, banking, and trading, we are adopting a simpler approach of "family banking" to help manufacturers transition to new emission standards (see 40 CFR 1048.145 of the regulations). Manufacturers may certify an engine family early, which would allow them to delay certification of smaller engine families. This would be based on the actual sales of each engine family; this requires no calculation or accounting of emission credits. The manufacturer would have actual sales figures for the early family at the end of the production year, which would yield a total number of allowable sales for the engine family with delayed compliance. Manufacturers may certify engines to the 2004 standards early, but this would provide benefits only for complying with the 2004 standards. These "credits" would not apply to engines for meeting the 2007 standards.

3. Is EPA adopting voluntary Blue Sky standards for these engines?

We are adopting voluntary Blue Sky standards for Large SI engines. We are setting a target of 0.8 g/kW-hr (0.6 g/hp-hr) HC+NOx and 4.4 g/kW-hr (3.3 g/hp-hr) CO as a qualifying level for Blue Sky Series engines. The corresponding field-testing standards for Blue Sky Series engines are 1.1 g/kW-hr (0.8 g/hp-hr) HC+NOx and 6.6 g/kW-hr (4.9 g/hp-hr) CO. These voluntary standards are based on achieving the maximum control of both HC+NOx and CO emissions, as described in Section V.C.1. To achieve these emission levels, manufacturers will need to apply significantly additional technology beyond that required for the mandatory standards.

Manufacturers may start producing engines to these voluntary standards immediately after this final rule becomes effective. In addition, we are adopting interim voluntary standards corresponding with the introduction of new emission standards. Since manufacturers will not be complying early to bank emission credits, voluntary emission standards are an appropriate way to encourage manufacturers to meet emission standards before the regulatory deadline. If manufacturers certify engines to these voluntary standards, they are not eligible for participation in the family-banking program described above. In the 2003 model year, manufacturers may certify their engines to the requirements that apply starting in 2004 to qualify for the Blue Sky designation. Since manufacturers are producing engines with emission-control technologies starting in 2001, these engines are available to customers outside of California desiring emission reductions or fuel-economy improvements. Similarly, for 2003 through 2006 model years, manufacturers may certify their engines to the requirements that start to apply in 2007.

4. Are there other requirements for Large SI engines?

a. Crankcase emissions

Due to blowby of combustion gases and the reciprocating action of the piston, exhaust emissions (mostly hydrocarbons) can accumulate in the crankcase. These crankcase emissions are significant, representing about 33 percent of total exhaust hydrocarbon. Uncontrolled engines route these vapors directly to the atmosphere. We have long required that automotive engines prevent crankcase emissions. Manufacturers typically do this by routing crankcase vapors through a valve into the engine's air intake system where they are burned in the combustion process.

Manufacturers may choose one of two methods for controlling crankcase emissions. First, adding positive-crankcase ventilation prevents crankcase emissions. Since automotive engine blocks are already tooled for closed crankcases, the cost of adding a valve for positive-crankcase ventilation for most engines is very small. An alternative method addresses specific concerns related to turbocharged engines or engines operating in severe-duty environments. Where closed crankcases are impractical, manufacturers may therefore measure crankcase emissions during any emission testing to add crankcase emissions to measured exhaust emissions for comparing with the standards.

b. Diagnosing malfunctions

Manufacturers must design their Large SI engines to diagnose malfunctioning emission-control systems starting with the 2007 model year (see §1048.110). Three-way catalyst systems with closed-loop fueling control work well only when the air-fuel ratios are controlled to stay within a narrow range around stoichiometry.[78] Worn or broken components or drifting calibrations over time can prevent an engine from operating within the specified range. This increases emissions and can significantly increase fuel consumption and engine wear. The operator may or may not notice the change in the way the engine operates. We are not requiring similar diagnostic controls for recreational vehicles or recreational marine diesel engines, because the anticipated emission-control technologies for these other applications are generally less susceptible to drift and gradual deterioration.

This diagnostic requirement focuses solely on maintaining stoichiometric control of air-fuel ratios. This kind of design detects problems such as broken oxygen sensors, leaking exhaust pipes, fuel deposits, and other things that require maintenance to keep the engine at the proper air-fuel ratio.

[78]Stoichiometry is the proportion of a mixture of air and fuel such that the fuel is fully oxidized with no remaining oxygen. For example, stoichiometric combustion in gasoline engines typically occurs at an air-fuel mass ratio of about 14.7.

Some companies are already producing engines with diagnostic systems that check for consistent air-fuel ratios. Their initiative supports the idea that diagnostic monitoring provides a mechanism to help keep engines tuned to operate properly, with benefits for both controlling emissions and maintaining optimal performance. There are currently no inspection and maintenance programs for nonroad engines, so the most important variable in making the emission control and diagnostic systems effective is in getting operators to repair the engine when the diagnostic light comes on. This calls for a relatively simple design to avoid the signaling of false failures as much as possible. The diagnostic requirements in this rule therefore focus on detecting inappropriate air-fuel ratios, which is the most likely failure mode for three-way catalyst systems. The malfunction-indicator light must go on when an engine runs for a full minute under closed-loop operation without reaching a stoichiometric air-fuel ratio.

Some natural gas engines may meet standards with lean-burn designs that never approach stoichiometric combustion. While manufacturers may design these engines to operate at specific air-fuel ratios, catalyst conversion (with two-way catalysts) would not be as sensitive to air-fuel ratio as with stoichiometric designs. For these or other engines that rely on emission-control technologies incompatible with the diagnostic system described above, manufacturers must devise an alternate system that alerts the operator to engine malfunctions that would prevent the emission-control system from functioning properly.

The automotive industry has developed a standardized protocol for diagnostic systems, including hardware specifications, and uniform trouble codes. In the regulations we reference standards adopted by the International Organization for Standardization (ISO) for automotive systems. If manufacturers find that these standards are not applicable to the simpler diagnostic design specified for Large SI engines, we encourage engine manufacturers to cooperate with each other and with other interested companies to develop new standards specific to nonroad engines. Manufacturers may request approval to use systems that don’t meet the automotive specifications if those specifications are not practical or appropriate for their engines.

c. Evaporative emissions

Evaporative emissions occur when fuel evaporates and is vented into the atmosphere. They can occur while an engine or vehicle is operating and even while it is not being operated. Among the factors that affect evaporative emissions are:

- fuel metering (fuel injectors or carburetor)
- the degree to which fuel permeates fuel lines and fuel tanks
- proximity of the fuel tank to the exhaust system or other heat sources
- whether the fuel system is sealed and the pressure at which fuel vapors are ventilated.

In addition, some gasoline fuel tanks may be exposed to heat from the engine compartment and high-temperature surfaces such as the exhaust pipe. In extreme cases, fuel can start boiling, producing very large amounts of gasoline vapors vented directly to the atmosphere.

Evaporative emissions from Large SI engines and the associated equipment represent a significant part of their overall hydrocarbon emissions. The magnitude of evaporative emissions varies widely depending on the engine design and application. LPG-fueled equipment generally has very low evaporative emissions because of the tightly sealed fuel system. At the other extreme, carbureted gasoline-fueled equipment can have high rates of evaporation. In 1998, Southwest Research Institute measured emissions from several gasoline-fueled Large SI engines and found them to vary from about 12 g/day up to almost 100 g/day.[79] This study did not take into account the possibility of unusually high fuel temperatures during engine operation, as described further below.

We are adopting basic measures to reduce evaporative emissions from gasoline-fueled Large SI engines. First, we are adopting an evaporative emission standard of 0.2 grams per gallon of fuel tank capacity for 24-hour day when temperatures cycle between 72° and 96° F. For purposes of certification, manufacturers may choose, however, to rely on a specific design for certification instead of measuring emissions. We have identified a technology that adequately prevents evaporative emissions such that the design itself would be enough to show compliance with the evaporative emission standard for purposes of certification. Specifically, pressurized fuel tanks control evaporative emissions by suppressing vapor generation. In its standards for industrial trucks operating in certain environments, Underwriters Laboratories requires that trucks use self-closing fuel caps with tanks that stay sealed to prevent evaporative losses; venting is allowed for positive pressures above 3.5 psi or for vacuum pressures of at least 1.5 psi.[80] We know that any Large SI engines or vehicles operating with these pressures would meet the standard because test data confirm the basic chemistry principles related to phase-change pressure relationships showing that fuel tanks will remain sealed at all times during the prescribed test procedure. Also, similar to the Underwriters Laboratories' requirement, we specify that manufacturers must use self-closing or tethered fuel caps to ensure that fuel tanks designed to hold pressure are not inadvertently left exposed to the atmosphere.

In some applications, manufacturers may want to avoid high fuel-tank pressures. Manufacturers may be able to meet the standard using an air bladder inside the fuel tank that changes in volume to keep the system in equilibrium at atmospheric pressure.[81] We have data showing that these systems also would remain sealed at all times during the prescribed test procedure. However, the permeation levels related to the air bladder and the long-term durability of this type of system are still unknown. Once these parameters are established with test data, perhaps with some additional product development, this technology may then qualify as an option for design-based certification. Similarly, collapsible bladder tanks, which change in volume to prevent generation of a vapor space or vapor emissions, may eventually be available as a technology for design-based certification once permeation data are available to confirm that systems with these tanks would meet the standard. Finally, an automotive-type system that stores fuel tank vapors for burning in the

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[79]"Measurement of Evaporative Emissions from Off-Road Equipment," by James N. Carroll and Jeff J. White, Southwest Research Institute (SwRI 08-1076), November 1998, Docket A-2000-01, document II-A-10.

[80]"Industrial Trucks, Internal Combustion Engine-Powered," UL558, ninth edition, June 28, 1996, paragraphs 26.1 through 26.4, Docket A-2000-01, document II-A-28. See Section XI.I for our consideration of incorporating the UL requirements into our regulations by reference.

[81]"New Evaporative Control System for Gasoline Tanks," EPA Memorandum from Charles Moulis to Glenn Passavant, March 1, 2001, Docket A-2000-01, document II-B-16.

engine would be another alternative technology, though it is unlikely that such a system can be simply characterized and included as an option for design-based certification.

In addition, engine manufacturers must use (or specify that equipment manufacturers installing their engines use) fuel lines meeting the industry performance standard for permeation-resistant fuel lines developed for motor vehicles.[82] While metal fuel lines do not have problems with permeation, manufacturers should use discretion in selecting materials for grommets and valves connecting metal components to avoid high-permeation materials. Evaporative emission standards for motor vehicles have led to the development of a wide variety of permeation-resistant polymer components. These permeation requirements are based on manufacturers using a more effective emission controls than that specified for recreational vehicles. This is appropriate because Large SI manufacturers are able to use automotive-grade materials across their product line, while recreational vehicle manufacturers have pointed out various limitations in incorporating automotive-grade materials. Conversely, Large SI manufacturers are not subject to permeation requirements related to fuel tanks, since almost all of these tanks are made of metal.

Finally, based on available technologies, manufacturers must take steps to prevent fuel boiling. The Underwriters Laboratories specification for forklifts attempts to address this concern through a specified maximum fuel temperature, but the current limit does not prevent fuel boiling.[83] We are adopting a standard that prohibits fuel boiling during continuous operation at 30˚ C (86˚ F). Engine manufacturers must incorporate designs that reduce the heat load to the fuel tank to prevent boiling. For companies that sell loose engines, this may involve instructions to equipment manufacturers to help ensure, for example, that fuel tank surfaces are exposed to ambient air rather than to exhaust pipes or direct engine heat. Engine manufacturers may specify a maximum fuel temperature for the final installation. Such a temperature limit should be well below 53˚ C (128˚ F), the temperature at which summer-grade gasoline (9 RVP) typically starts boiling.

An additional source of evaporative emissions is from carburetors. Carburetors often have high hot soak emissions (immediately after engine shutdown). We expect manufacturers to convert carbureted designs to fuel injection as a result of the exhaust emission standards. While we do not mandate this technology, we believe the need to reduce exhaust emissions will cause engine manufacturers to use fuel injection on all gasoline engines. This change alone will eliminate most hot soak emissions.

Engine manufacturers using design-based certification need to describe in the application for certification the selected design measures and specifications to address evaporative losses from gasoline-fueled engines. For loose-engine sales, this includes emission-related installation instructions that the engine manufacturer gives to equipment manufacturers. While equipment manufacturers must follow these installation instruction, the engine manufacturer has the responsibility to certify a system that meets the evaporative-related requirements described in this section. This should work in practice, because engine manufacturers already provide equipment manufacturers a variety of specifications and other instructions to

[82]SAE J2260 "Nonmetallic Fuel System Tubing with One or More Layers," November 1996 (Docket A-2000-01, document II-A-03).

[83]UL558, paragraph 19.1.1, Docket A-2000-01, document II-A-28.

ensure that engines operate properly in-use after installation in the equipment. The alternative approach of requiring equipment manufacturers to certify is impractical because of the very large number of companies involved.

5. What durability provisions apply?

a. Useful life

We are adopting a useful life period of seven years or until the engine accumulates at least 5,000 operating hours, whichever comes first. This figure represents a minimum value and may increase as a result of data showing that an engine model is designed to last longer. This figure, which California ARB has already adopted, represents an operating period that is common for Large SI engines before they undergo rebuild. This also reflects a comparable degree of operation relative to the useful life values of 100,000 to 150,000 miles that apply to automotive engines (assuming an average driving speed of 20 to 30 miles per hour).

Some engines are designed for operation in severe-duty applications with a shorter expected lifetime. Concrete saws in particular undergo accelerated wear as a result of operating in an environment with high concentrations of highly abrasive, airborne concrete dust particles. We are allowing manufacturers to request a shorter useful life for an engine family based on information showing that engines in the family rarely operate beyond the alternative useful-life period. For example, if engines powering concrete saws are typically scrapped after 2000 hours of operation, this would form the basis for establishing a shorter useful-life period for those engines.

Manufacturers relying on design-based certification to meet the evaporative requirements must use good engineering judgment to show that emission controls will work for at least seven years. This may, for example, be based on warranty or product-performance history from component suppliers. This also applies for systems designed to address crankcase emissions.

b. Warranty

Manufacturers must provide an emission-related warranty for at least the first half of an engine's useful life (in operating hours) or three years, whichever comes first. These periods must be longer if the manufacturer offers a longer mechanical warranty for the engine or any of its components; this includes extended warranties that are available for an extra price. The emission-related warranty includes components related to controlling evaporative and crankcase emissions. In addition, we are adopting the warranty provisions adopted by California ARB for high-cost parts. For emission-related components whose replacement cost is more than about $400, we specify a minimum warranty period of at least 70 percent of the engine's useful life (in operating hours) or 5 years, whichever comes first. See §1048.120 for a description of which components are emission-related.

c. *Maintenance instructions*

We are specifying minimum maintenance intervals much like those established by California ARB for Large SI engines. The minimum intervals define how much maintenance a manufacturer may specify to ensure that engines are properly maintained for staying within emission standards. Manufacturers may schedule maintenance on catalysts, fuel injectors, electronic control units and turbochargers after 5,000 hours. For oxygen sensors and cleaning of fuel-system components, the minimum maintenance interval is 2,500 hours. This fuel-system cleaning must be limited to steps that can be taken without disassembling components. We have relaxed this from the proposed interval of 4,500 hours to take into account comments emphasizing that these maintenance steps will be necessary more frequently than the proposed interval; this shorter interval also reflects the comparable provisions that apply to automotive systems.

We are also proposing a diagnostic requirement to ensure that prematurely failing oxygen sensors or other components are detected and replaced on an as-needed basis. If operators fail to address faulty components after a fault signal, we would not consider that engine to be properly maintained. This could the engine ineligible for manufacturer in-use testing.

d. *Deterioration factors*

We are adopting an approach that gives manufacturers wide discretion in how to establish deterioration factors for Large SI engines. The general expectation is that manufacturers will rely on emission measurements from engines that have operated for an extended period, either in field service or in the laboratory. The manufacturer should do testing as needed to be confident that their engines will meet emission standards under the in-use testing program. In deciding to certify an engine family, we can review deterioration factors to ensure that the projected deterioration accurately predicts in-use deterioration. We will use results under the in-use testing program to verify the appropriateness of deterioration factors.

In the first two or three years of certification, manufacturers will not yet have data from the in-use testing program. Moreover, manufacturers may choose to rely on technologies and calibrations for meeting the long-term standards well before 2007 to simplify their product-development efforts. We are therefore allowing manufacturers to rely on an assigned deterioration factor to meet the 2004 standards, while continuing to require manufacturers to meet the applicable emission standards throughout the useful life for these engines. The assigned deterioration factor may be derived from any available data that would help predict the way these systems would perform in the field, using good engineering judgment.

Manufacturers may develop deterioration factors for crankcase and evaporative controls. However, we do not expect these control technologies to experience degradation that would cause a deterioration factor to be appropriate.

e. *In-use fuel quality*

Gasoline used in industrial applications is generally the same as that used for automotive applications. Improvements that have been made to highway-grade gasoline therefore carry over directly to nonroad markets. This helps manufacturers be sure that fuel quality will not degrade an engine's emission-control performance after several years of sustained operation.

In contrast, there are no enforceable industry or government standards for LPG fuel quality. Testing data indicate that varying fuel quality has a small direct effect on emissions from a closed-loop engine with a catalyst. The greater concern is that fuel impurities and heavy-end hydrocarbons may cause an accumulation of deposits that can prevent an emission-control system from functioning properly. While an engine's feedback controls can compensate for some restriction in air- and fuel-flow, deposits may eventually prevent the engine from accurately controlling air-fuel ratios at stoichiometry. As described in the Final Regulatory Support Document, test data show that emission-control systems can tolerate substantial fuel-related deposits before there is any measurable effect on emissions. Moreover, the engine diagnostic systems described in the next section will notify the operator when fuel-related deposits prevent an engine from operating at stoichiometry. In any case, a routine cleaning step should remove deposits and restore the engine to proper functioning.

Data from in-use testing will provide additional information related to the effects of varying fuel quality on emission levels. This information will be helpful in making sure that the deterioration factors for certifying engines accurately reflect the whole range of in-use operating variables, including varying fuel quality. Our testing shows that fuel properties of conventional commercial LPG fuel allow for durable, long-term control of emissions. However, to the extent that engines operating in specific areas have inferior fuel quality that prevents them from meeting emission standards, we will be pursuing nationwide requirements to set minimum quality standards for in-use LPG fuel.

D. Testing Requirements and Supplemental Emission Standards

1. What duty cycles are used to measure emissions?

For 2004 through 2006 model years, we specify the same steady-state duty cycles adopted by California ARB. For variable-speed engines, this involves the testing based on the ISO C2 duty cycle, which has five modes at various intermediate speed points, plus one mode at rated speed and one idle mode. The combined intermediate-speed points at 10, 25, and 50 percent account for over 70 percent of the total modal weighting. A separate duty cycle for the large number of Large SI engine providing power for constant-speed applications, such as generators, welders, compressors, pumps, sweepers, and aerial lifts. Constant-speed testing is based on the ISO D2 duty cycle, which specifies engine operation at rated speed with five different load points. This same steady-state duty cycle applies to constant-speed, nonroad diesel engines. Emission values measured on the D2 duty cycle are treated the same as values from the C2 duty cycle; the same numerical standards apply to both cycles.

Manufacturers must generally test engines on both the C2 and D2 duty cycles. Since the C2 cycle includes very little operation at rated speed, it is not effective in ensuring control of emissions for constant-speed engines. The D2 cycle is even less capable of predicting emission performance from variable-speed engines. Manufacturers may, however, choose to certify their engines on only one of these two steady-state duty cycles. In this case, they would need to take steps to make sure C2-certified engines are installed only in variable-speed applications and D2-certified engines are installed only in constant-speed applications. Engine manufacturers would do this by labeling their engines appropriately and providing installation instructions to make sure equipment manufacturers and others are aware of the restricted certification. Equipment manufacturers are required under the regulations to follow the engine manufacturer's emission-related installation instructions.

Starting in 2007, we specify an expanded set of duty cycles, again with separate treatment for variable-speed and constant-speed applications. The test procedure is comprised of three segments: (1) a warm-up segment, (2) a transient segment, and (3) a steady-state segment. Each of these segments, described briefly in this section, include specifications for the speed and load of the engine as a function of time. Measured emissions during the transient and steady-state segments must meet the same emission standards that apply to all duty cycles. In general, the duty cycles are intended to represent operation from the wide variety of in-use applications. This includes highly transient low-speed forklift operation, constant-speed operation of portable equipment, and intermediate-speed vehicle operation.

Ambient temperatures in the laboratory must be between 20˚ and 30˚ C (68˚ and 86˚ F) during duty-cycle testing. This improves the repeatability of emission measurements when the engine runs through its prescribed operation. We nevertheless expect manufacturers to design for controlling emissions under broader ambient conditions, as described in Section V.D.5.

The warm-up segment begins with a cold-start. This means that the engine should be near room temperature before the test cycle begins. (Starting with an engine that is still warm from previous testing is allowed if good engineering judgment indicates that this will not affect emissions.) Once the engine is started, it operates over the first 3 minutes of the specified transient duty cycle without emission measurement. The engine then idles for 30 seconds before starting the prescribed transient cycle. The purpose of the warm-up segment is to bring the engine up to normal operating temperature in a standardized way. For severe-duty engines, the warm-up period is extended up to 15 minutes to account for the additional time needed to stabilize operating temperatures from air-cooled engines. The warm-up period allows enough time for engine-out emissions to stabilize, for the catalyst to warm up enough to become active, and for the engine to start closed-loop operation. This serves as a defined and achievable target for the design engineer to limit cold-start emissions to a relatively short period. In addition, we require manufacturers to activate emission-control systems as soon as possible after engine starting to make clear that it is not acceptable to design the emission-control system to start working only after the defined warm-up period is complete. In addition, we may measure emissions during the warm-up period to evaluate whether manufacturers are employing defeat devices. In contrast, transient testing of heavy-duty highway engines requires separate cold-start and hot-start measurements, with an 86-percent weighting assigned to the hot-start portion in calculating an engine's composite emission level. We believe this approach for nonroad engines serves to limit cold-start emissions without forcing manufacturers to focus design and testing resources on this portion of operation.

The transient segment of the general duty cycle is a composite of forklift and welder operation. This duty cycle was developed by selecting segments of measured engine operation from two forklifts and a welder as they performed their normal functions. This transient segment captures the wide variety of operation from a large majority of Large SI engines as fork-lifts and constant-speed engines represent about 90 percent of the Large SI market. Emissions measured during this segment are averaged over the entire transient segment to give a single value in g/kW.

Steady-state testing consists of engine operation for an extended period at several discrete speed-load combinations. Associated with these test points are weighting factors that allow a single weighted-average steady-state emission level in g/kW. While any steady-state duty cycle is limited in how much it can represent operation of engines that undergo transient operation, the distribution of the C2 modes and their weighting values aligns significantly with expected and measured engine operation from Large SI engines. In particular, these engines are generally not designed to operate for extended periods at high-load, rated speed conditions. Field measurement of engine operation shows, however, that forklifts operate extensively at lower speeds than those included in the C2 duty cycle. While we believe the test points of the C2 duty cycle are representative of engine operation from many applications of Large SI engines, supplementing the steady-state testing with a transient duty cycle is necessary to adequately include engine operation characteristic of what occurs in the field.

A separate transient duty cycle applies to engines that are certified for constant-speed applications only. These engines maintain a constant speed, but can experience widely varying loads. Th transient duty cycle for these engines includes 20 minutes of engine operation based on the way engines work in a welder. Note that manufacturers selling engines for both constant-speed and variable-speed applications may omit the constant-speed transient test, since that type of operation is included in the general transient test.

A subset of constant-speed engines are designed to operate only at high load. To address the operating limitations of these engines, we are adopting a modified steady-state duty cycle if the manufacturer provides clear evidence showing that engines rarely operate below 75 percent of full load at rated speed. Since most Large SI engines are clearly capable of operating for extended periods at light loads, we expect these provisions to apply to very few engines. This modified duty cycle consists of two equally weighted points, 75 percent and 100 percent of full load, at rated speed. Since the transient cycle described above involves extensive light-load operation, engines qualifying for this high-load duty cycle would not need to measure emissions over the transient cycle. Note that the field-testing emission standards still apply to engines that don't certify to transient duty-cycle standards.

Some diesel-derived engines operating on natural gas with power ratings up to 1,500 or 2,000 kW may be covered by these emission standards. Engine dynamometers with transient-control capabilities are generally limited to testing engines up to 500 or 600 kW. At this time emission standards and testing requirements related to transient duty cycles will not apply for engines rated above 560 kW. We will likely review this provision for Large SI engines once we have reached a conclusion on the same issue for nonroad diesel engines. For example, if we propose provisions for nonroad diesel engines that address testing issues for these very large engines, we would likely propose those same provisions for Large SI engines.

Test procedures related to evaporative emissions are described in Section V.C.4 above. In general, this involves measuring evaporative losses during a three-day period of cycling ambient temperatures between 72° and 96° F.

2. What fuels are used during emission testing?

For gasoline-fueled Large SI engines, we are adopting the same specifications we have established for testing gasoline-fueled highway vehicles and engines. This includes the revised specification to cap sulfur levels at 80 ppm (65 FR 6698, February 10, 2000). These fuel specifications apply for both exhaust and evaporative emissions.

For LPG, we are adopting the same specifications established by California ARB. We understand that in-use fuel quality for LPG varies significantly in different parts of the country and at different times of the year. Not all in-use fuels outside California meet California ARB specifications for certification fuel, but fuels meeting the California specifications are nevertheless widely available. Test data show that LPG fuels with a much lower propane content have only slightly higher NOx and CO emissions (see Chapter 4 of the Final Regulatory Support Document for additional information). These data support our belief that engines certified using the specified fuel will achieve the desired emission reduction for a wide range of in-use fuels. At certification manufacturers provide deterioration factors that take into account any effects related to the varying quality of commercially available fuels.

For natural gas, we are adopting specifications similar to those adopted by California ARB. As described in the Summary and Analysis of Comments, we have adjusted some of the detailed specifications from the proposal to reflect new data submitted after the proposal regarding ranges of fuel properties reflecting current commercial fuels.

Unlike California ARB, we apply the fuel specifications to testing only for emission measurements, not to service accumulation. Service accumulation between emission tests may involve certification fuel or any commercially available fuel of the appropriate type. We similarly allow manufacturers to choose between certification fuel and any commercial fuel for in-use measurements to show compliance with field-testing emission standards.

Since publishing the proposal, we learned about issues related to Large SI engines that operate around landfills or oil wells, where engines may burn naturally occurring gases that are otherwise emitted to the atmosphere. These gases generally consist of methane, but a wide range of other constituents may also be mixed in. As a result, engines may require adjustment over a wide range of settings for spark timing and air-fuel ratio to maintain consistent combustion. We generally believe that engine manufacturers should design their engines to operate with automatic feedback controls as much as possible to avoid the need for operators to manually adjust engines. However, in cases involving these noncommercial fuels, there is no way to improve the quality of the fuel to conform to any standardized specifications. Also, it is clearly preferred to capture and burn these gases than to emit them directly to the atmosphere, both to prevent greenhouse-gas emissions and to avoid wasting this source of fuel. To address this concern, we are adopting special provisions for engines burning noncommercial fuels if they are unable to meet emission standards over the full range of adjustability needed to accommodate the varying fuel properties. Manufacturers would show that these engines can meet emission standards using normal certification fuels, but the normal provisions related to adjustable parameters would not apply. To properly constrain this provision, we are including four requirements. First, manufacturers would need to add information on an engine label instructing operators how to make adjustments that would allow for maintained emission control and overall engine performance. Second, manufacturers would include additional label language to warn operators that the engine may be used only in applications involving noncommercial fuels. Third, manufacturers must separate these engines into a distinct engine family. Fourth, manufacturers must keep a record of individual sales of such engines.

3. Are there production-line testing provisions for Large SI engines?

The provisions described in Section II.C.4 apply to Large SI engines. These requirements are consistent with those adopted by California ARB. One new issue specific to Large SI engines relates to the duty cycles for measuring emissions from production-line engines.

For routine production-line testing, we require emission measurements only with the steady-state duty cycles used for certification. Due to the cost of sampling equipment for transient engine operation, we do not require routine transient testing of production-line engines. Transient testing of production-line engines would add a substantial burden, since many manufacturers have limited emission-sampling capability at production facilities; also, these production facilities might be located at multiple sites. We believe that steady-state emission measurements will give a good indication of the manufacturers' ability to build engines consistent with the prototypes on which their certification data are based. We reserve the right, however, to direct a manufacturer to measure emissions with a transient duty cycle if we believe it is appropriate. One indication of the need for this transient testing would be if steady-state emission levels from production-line engines are significantly higher than the emission levels reported in the application for certification for that engine family. For manufacturers with the capability of measuring transient emission levels at the production line, we recommend doing transient tests to better ensure that in-use tests will not reveal problems in controlling emissions during transient operation. Manufacturers need not make any measurements to show that production-line engines meet field-testing emission standards.

We expect manufacturers generally to certify their engines to the evaporative requirements using a design-based approach. Accordingly, the technologies we expect manufacturers to use for controlling evaporative emissions are not subject to variation as a result of production procedures, so we are not requiring production-line testing related to the evaporative requirements.

4. Are there in-use testing provisions for Large SI engines?

While the certification and production-line compliance requirements are important to ensure that engines are designed and produced in compliance with established emission limits, there is also a need to confirm that manufacturers build engines with sufficient durability to meet emission limits as they age in service. Consistent with the California ARB program, we are requiring engine manufacturers to conduct emission tests on a small number of field-aged engines to show they meet emission standards.

We may generally select up to 25 percent of a manufacturer's engine families in a given year to be subject to in-use testing. Most companies will need to test at most one engine family per year. Manufacturers may conduct in-use testing on any number of additional engine families at their discretion.

Manufacturers in unusual circumstances may develop an alternate plan to fulfill any in-use testing obligations, consistent with a similar program we have adopted for outboard and personal watercraft marine engines. These circumstances include total sales for an engine family below 200 per year, installation only in applications where testing is not possible without irreparable damage to the vehicle or engine, or any other unique feature that prevents full emission measurements.

While the regulations allow us to select an engine family every year from an engine manufacturer, there are several reasons why small-volume manufacturers may expect a less demanding approach. These manufacturers may have only one or two engine families. If a manufacturer shows that an engine family meets emission standards in an in-use testing exercise, that may provide adequate data to show compliance for that engine family for a number of years, provided that the manufacturer continues to produce those engines without significantly redesigning them in a way that might affect their in-use emissions performance and that we do not have other reason to suspect noncompliance. Also, where we have evidence that a manufacturer’s engines are likely in good in-use compliance, we generally take the approach of selecting engine families based on some degree of proportionality. To the extent that manufacturers produce a smaller than average proportion of engines, they may expect us to select their engine families less frequently, especially if other available data pointed toward in-use compliance. In addition, our experience in implementing a comparable testing program for recreational marine engines provides a history of how we implement in-use testing requirements.

Engines can be tested one of two ways. First, manufacturers can remove engines from vehicles or equipment and test the engines on a laboratory dynamometer using certification procedures. For 2004 through 2006 model year engines, this is the same steady-state duty cycle used for certification; manufacturers may optionally test engines on the dynamometer under transient operating conditions. For 2007 and later model year engines, manufacturers must test engines using both steady-state and transient duty cycles, as in certification.

As an alternative, manufacturers may use the specified equipment and procedures for testing engines without removing them from the equipment (referred to in this document as field testing). See Section V.D.5 for a more detailed description of how to measure emissions from engines during normal operation in the field. Since engines operating in the field cannot be controlled to operate on a specific duty cycle, compliance is demonstrated by comparing the measured emission levels to the field-testing emission standards, which have higher numerical value to account for the possible effects of different engine operation. Because the engine operation can be so variable, however, engines tested to show compliance only with the field-testing emission standards are not eligible to participate in the in-use averaging, banking, and trading program (described below).

Clean Air Act section 213 requires engines to comply with emission standards throughout their regulatory useful lives, and section 207 requires a manufacturer to remedy in-use nonconformity when we determine that a substantial number of properly maintained and used engines fail to conform with the applicable emission standards (42 U.S.C. 7541). Along with the in-use testing program, we would allow manufacturers to demonstrate that they have designed their engines to control emissions substantially below the emission standards that apply. If manufacturers are able to show that they have already been reducing emissions more than required by the standards, including appropriate consideration for deterioration and compliance margins, this may allow us to conclude that these accumulated additional emission reductions are sufficient to offset the high emissions from a failing engine family. In concept, this approach serves much like a banking program to recognize manufacturers' efforts to go beyond the minimum required emission reductions.

This approach differs from the specific in-use emission-credit program that we proposed. This more general approach is preferred for two primary reasons. First, while we proposed to limit the in-use emission-credit program to transient testing in the laboratory, manufacturers will now be able to use emission data generated from field testing to characterize an engine family's average emission level. This becomes necessarily more subjective, but allows us to consider a wider range of information in evaluating the degree to which manufacturers are complying with emission standards across their product line. Second, this approach makes clearer the role of the emission credits in our consideration to recall failing engines. As we described in the proposal, we plan to consider average emission levels from multiple engine families in deciding whether to recall engines from a failing engine family. We therefore believe it is not appropriate to have a detailed emission-credit program defining precisely how and when to calculate, generate, and use credits that do not necessarily have value elsewhere.

The regulations do not specify how manufacturers would generate emission credits to offset a nonconforming engine family. This gives us the ability to consider any appropriate test data in deciding what action to take. In generating this kind of information, some general guidelines would apply. For example, we would expect manufacturers to share test data from all engines and all engine families tested under the in-use testing program, including nonstandard tests that might be used to screen engines for later measurement. This allows us to understand the manufacturers' overall level of performance in controlling emissions to meet emission standards. Average emission levels should be calculated over a running three-year period to include a broad range of testing without skewing the results based on old designs. Emission values from engines certified to different tiers of emission standards or tested using different measurement procedures should not be combined to calculate a single average emission level. Average emission levels should be calculated according to the following equation, rounding the results to 0.1 g/kW-hr:

$$\text{Average EL} = \left[\sum_i (\text{STD-CL})_i \times (\text{UL})_i \times (\text{Sales})_i \times \text{Power}_i \times \text{LF}_i \right] \div \left[\sum_i (\text{UL})_i \times (\text{Sales})_i \times \text{Power}_i \times \text{LF}_i \right]$$

Where:

Average EL = Average emission level in g/kW-hr.

Sales$_i$ = The number of eligible sales, tracked to the point of first retail sale in the U.S., for the given engine family during the model year.

(STD-CL)$_i$ = The difference between the emission standard and the average emission level for an in-use testing family in g/kW-hr.

UL$_i$ = Useful life in hours.

Power$_i$ = The sales-weighted average rated brake power for an engine family in kW.

LF$_i$ **=** Load factor or fraction of rated engine power utilized in use; use 0.50 for engine families used only in constant-speed applications and 0.32 for all other engine families.

The anticipated crankcase and evaporative emission-control technologies generally are best evaluated simply by checking whether or not they continue to function as designed, rather than implementing a program to measure these emissions from in-use engines. As a result, we may inspect in-use engines to verify that these systems continue to function properly throughout the useful life, but are not requiring manufacturers to include crankcase or evaporative measurements as part of the in-use testing program described in this section.

5. What are the field-testing emission standards and test procedures?

To address concerns for controlling emissions outside of the certification duty cycles and to enable field-testing of Large SI engines, we are adopting procedures and standards that apply to a wider range of normal engine operation.

a. What is the field-testing concept?

Measuring emissions from engines in the field as they undergo normal operation while installed in nonroad equipment addresses two broad concerns. First, testing of in-use engines has shown that emissions can vary dramatically under certain modes of operation.
Second, this provides a low-cost method of testing in-use engines, which facilitates in-use compliance programs. Field-testing addresses this by including emission measurements over the broad range of normal engine operation. This may include varying engine speeds and loads according to real operation and may include a reasonable range of ambient conditions, as described below.

No engine operating in the field can follow a prescribed duty cycle for a consistent measure of emission levels. Similarly, no single test procedure can cover all real-world applications, operations, or conditions. Specifying parameters for testing engines in the field and adopting an associated emission standard provides a framework for requiring that engines control emissions under the whole range of normal operation in the relevant nonroad equipment.

To ensure that emissions are controlled from Large SI engines over the full range of speed and load combinations seen in the field, we are adopting supplemental emission standards that apply more broadly than the duty-cycle standard, as detailed below. These standards apply to all regulated pollutants (NOx, HC, and CO) under all normal operation (steady-state or transient). We exclude abnormal operation (such as very low average power and extended idling time), but do not restrict operation to any specific combination of speeds and loads. In addition, the field-testing standards apply under a broad range of in-use ambient conditions, both to ensure robust emission controls and to avoid overly restricting the times available for testing. These provisions are described in detail below.

b. How do the field-testing standards apply?

Manufacturers have expressed an interest in using field-testing procedures before the 2007 model year to show that they can meet emission standards as part of the in-use testing program. While we are not adopting specific field-testing standards for 2004 through 2006 model year engines, we will allow this as an option. In this case, manufacturers would conduct the field testing as described here to show that their engines meet the 5.4 g/kW-hr HC+NOx standard and the 50 g/kW-hr CO standard. This may give manufacturers the opportunity to do testing at significantly lower cost compared with laboratory testing. Preliminary certification data from California ARB show that manufacturers are reaching steady-state emission levels well below emission standards, so we expect any additional variability in field-testing measurements not to affect manufacturers' ability to meet the same emission standards.

The 2007 field-testing standards are based on emission data measured on engines with the same emission-control technology used to establish the duty-cycle standards. As described above for the duty-cycle standards, we are adopting a flexible approach to address the tradeoff between HC+NOx and CO emissions. Table V.D-1 shows the range of values that define the standard for showing compliance for field-testing measurements. The higher numerical values of the Tier 2 standards for field testing (compared with duty-cycle testing) reflect the observed variation in emissions for varying engine operation, and the projected effects of ambient conditions on the projected technology. Conceptually, we believe that field-testing standards should primarily require manufacturers to adjust engine calibrations to effectively manage air-fuel ratios under varying conditions. The estimated cost of complying with emission standards includes an allowance for the time and resources needed for this recalibration effort (see Section IX.B. for total estimated costs per engine).

Table V.D-1
Samples of Possible Alternative Field-Testing
Emission Standards for Large SI Engines(g/kW-hr)*

HC+NOx	CO
3.8	6.5
3.1	8.5
2.4	11.7
1.8	16.8
1.4	23.1
1.1	31

*As described in the Final Regulatory Support Document and the regulations, the values in the table are related by the following formula: $(HC+NOx) \times CO^{0.791} = 16.78$. These values follow directly from the logarithmic relationship presented with the proposal in the Draft Regulatory Impact Analysis.

We generally require manufacturers to show at certification that they are capable of meeting all standards that apply for the useful life. This adds a measure of assurance to both EPA and manufacturers that the engine design is sufficient for any in-use engines to pass any later testing. For Large SI engines, manufacturers must show in their application for certification that they are able to meet the field-testing standards. Manufacturers must submit a statement that their engines will comply with field-testing emission standards under all conditions that may reasonably be expected to occur in normal vehicle operation and use. Manufacturer will provide a detailed description of any testing, engineering analysis, and other information that forms the basis for the statement. This will likely include a variety of steady-state emission measurements not included in the prescribed duty cycle. It may also include a continuous trace showing how emissions vary during the transient test or it may include emission measurements during other segments of operation manufacturers believe are representative of the way their engines normally operate in the field.

Two additional provisions are necessary to allow emission testing without removing engines from equipment in the field. Manufacturers must design their engines to broadcast instantaneous speed and torque values to the onboard computer and ensure that emission sampling is possible after engine installation.

The test equipment and procedures for showing compliance with field-testing standards also hold promise to reduce the cost of production-line testing. Companies with production facilities that have a dynamometer but no emission measurement capability may use the field-testing equipment and procedures to get a low-cost, valid emission measurement at the production line. Manufacturers may also choose to use the cost advantage of the simpler measurement to sample a greater number of production-line engines. This would provide greater assurance of consistent emissions performance, but would also provide valuable quality-control data for overall engine performance. See the discussion of alternate approaches to production-line testing in Section II.C.4 for more information.

c. What limits are placed on field testing?

The field-testing standards apply to all normal operation. This may include steady-state or transient engine operation. Given a set of field-testing standards, the goal for the design engineer is to ensure that engines are properly calibrated for controlling emissions under any reasonably expected mode of engine operation. Engines may not be able to meet the emissions limit under *all* conditions, however, so we are adopting several parameters to narrow the range of engine operation that is subject to the field-testing standards. For example, emission sampling for field testing does not include engine starting.

Engines can often operate at extreme environmental and geographic conditions (temperature, altitude, etc.). To narrow the range of conditions for the design engineer, we are limiting emission measurements during field testing to ambient temperatures from 13° to 35° C (55° to 95° F), and to ambient pressures from 600 to 775 millimeters of mercury (which should cover almost all normal pressures from sea level to 7,000 feet above sea level). This allows testing under a wider range of conditions in addition to helping ensure that engines are able to control emissions under the whole range of conditions under which they operate.

Some additional limits to define “normal” operation apply to field testing. These restrictions are intended to provide manufacturers with some certainty about what their design targets are and to ensure that compliance with the field-testing standards is feasible. These restrictions apply to both variable-speed and constant-speed engine applications.

First, measurements with more than 2 minutes of continuous idle are excluded. This means that an emission measurement from a forklift while it idled for 5 minutes will not be considered valid. On the other hand, an emission measurement from a forklift that idled for multiple 1-minute periods and otherwise operated at 40-percent power for several minutes would be considered a valid measurement. Measurements with in-use equipment in their normal service show that idle periods for Large SI engines are short, but relatively frequent. We therefore do not automatically exclude an emission sample if it includes an idling portion. At the same time, controlling emissions during extended idling poses a difficult design challenge, especially at low ambient temperatures. Exhaust and catalyst temperatures under these conditions can decrease enough that catalyst conversion is significantly less effective. Since extended idling is not an appropriate focus of extensive development efforts at this stage, we believe the 2-minute threshold for continuous idle appropriately balances the need to include measurement during short idling periods with the technical challenges of controlling emissions under difficult conditions.

Second, measured power during the sampling period must be above 5 percent of maximum power for an emission measurement to be considered valid. Brake-specific emissions (g/kW-hr) can be very high at low power because they are calculated by dividing the g/hr emission rate by a very small power level (kW). By ensuring that brake-specific emissions are not calculated by dividing by power levels less than 5 percent of the maximum, we can avoid this problem. The data presented in Chapter 4 of the Final Regulator Support Document show that engines can meet the emission standards when operating above 5 percent of rated power.

Third, some engines need to run rich of stoichiometric combustion during extended high-load operation to protect against engine failure. This increases HC and CO emissions. We are adopting provisions allowing manufacturers to meet separate standards for these engines for steady-state operation. For engines qualifying for these different steady-state standards, we specify that a valid sample for field testing must include less than 10 percent of operation at 90 percent or more of maximum power. We expect it to be uncommon for engine installations to call for such high power demand due to the shortened engine lifetime at very high-load operation. A larger engine can generally produce the desired power at a lower relative load, without compromising engine lifetime. Alternatively, applications that call for full-load operation typically use diesel engines. Manufacturers may request a different threshold to allow more open-loop operation. Before we approve such a request, the engine manufacturer would need to have a plan for ensuring that the engines in their final installation do not routinely operate at loads above the specified threshold.

An additional parameter to consider is the minimum sampling time for field testing. A longer period allows for greater accuracy, due mainly to the smoothing effect of measuring over several transient events. On the other hand, an overly long sampling period can mask areas of engine operation with poor emission-control characteristics. To balance these concerns, we are applying a minimum sampling period of 2 minutes. In other rules for diesel engines, we have allowed sampling periods as short as 30 seconds. Spark-ignition engines generally don't have turbochargers and they control emissions by maintaining air-fuel ratio with closed-loop controls through changing engine operation. Spark-ignition engines are therefore much less prone to consistent emission spikes from off-cycle or unusual engine operation. We believe the 2-minute sampling time requirement will ensure sufficient measurement accuracy and will allow for more meaningful measurements from engines that may be operated with very frequent but brief times at idle.

We do not specify a maximum sampling time. We expect manufacturers testing in-use engines to select an approximate sampling time before measuring emissions; however, the standards apply for any sampling time that meets the minimum. When selecting an engine family for the in-use testing program, we will develop a plan with direction related to the way manufacturers conduct the emission-sampling effort, such as sampling time or specific types of engine operation, to ensure that testing provides relevant data.

d. How do I test engines in the field?

To test engines without removing them from equipment, analyzers are connected to the engine's exhaust to detect emission concentrations during normal operation. Exhaust volumetric flow rate and continuous power output are also needed to convert the analyzer responses to units of g/kW-hr for comparing to emission standards. These values can be calculated from measurements of the engine intake flow rate, the exhaust air-fuel ratio and the engine speed, and from torque information.

Available small analyzers and other equipment may be adapted for measuring emissions from field equipment. A portable flame ionization detector can measure total hydrocarbon concentrations. Methane measurement currently requires more expensive laboratory equipment that is impractical for field measurements. Field-testing standards are therefore be based on total hydrocarbon emissions. A portable analyzer based on zirconia technology measures NOx emissions. A nondispersive infrared (NDIR) unit can measure CO. Emission samples can best be drawn from the exhaust flow directly downstream of the catalyst material to avoid diluting effects from the end of the tailpipe. Installing a sufficiently long tailpipe extension is also an acceptable way to avoid dilution. Mass flow rates also factor into the torque calculation; this may either be measured in the intake manifold or downstream of the catalyst.

Calculating brake-specific emissions depends on determining instantaneous engine speed and torque levels. Manufacturers must therefore design their engines to continuously monitor engine speed and torque. The tolerance for speed measurements, which is relatively straightforward, is ±5 percent. For torque, the onboard computer needs to convert measured engine parameters into useful units. Manufacturers generally will need to monitor a surrogate value such as intake manifold pressure or throttle position (or both), then rely on a look-up table programmed into the onboard computer to convert these torque indicators into newton-meters. Manufacturers may also want to program the look-up tables for torque conversion into a remote scan tool. Because of the greater uncertainty in these measurements and calculations, manufacturers must produce their systems to report torque values that are within 85 and 105 percent of the true value. This broader range allows appropriately for the uncertainty in the measurement, while providing an incentive for manufacturers to make the torque reading as accurate as possible. Under-reporting torque values would over-predict emissions. These tolerances are taken into account in the selection of the field-testing standards, as described in Chapter 4 of the Final Regulatory Support Document.

E. Special Compliance Provisions

We are adopting hardship provisions to address the particular concerns of small-volume manufacturers, which generally have limited capital and engineering resources. These hardship provisions are generally described in Section VII.C. For Large SI engines, we are adopting a longer available extension of the deadline, up to four years, for meeting emission standards for companies that qualify for special treatment under the hardship provisions. We will, however, not extend the deadline for compliance beyond the four-year period. This approach considers the fact that, unlike most other engine categories, qualifying small businesses are more likely to be manufacturers designing their own products. Other types of engines more often involve importers, which are limited more by available engine suppliers than design or development schedules.

We are not finalizing the proposed interim emission standards proposed for small-volume manufacturers. We believe we can accomplish the same objectives with more flexibility, and potentially with greater net emission reductions, by relying on the hardship provisions.

In addition, we are waiving the requirement for small-volume manufacturers to broadcast engine speed and torque values. These companies may choose to do this to enable field-testing of their products, but may be constrained in developing this capability to the extent that they rely on component suppliers to provide systems that meet EPA requirements.

F. Technological Feasibility of the Standards

We are adopting emission standards that depend on the industrial versions of established automotive technologies. The most recent advances in automotive technology have made possible even more dramatic emission reductions. However, we believe that transferring some of these most advanced technologies is not appropriate for nonroad engines at this time, especially considering the much smaller sales volumes for amortizing fixed costs and the additional costs associated with the first-time regulation of these engines.

To comply with the 2004 model year standards, manufacturers should not need to do any development, testing, or certification work that is not already necessary to meet California ARB standards in 2004. As shown in Chapter 4 of the Final Regulatory Support Document, manufacturers can meet these standards with three-way catalysts and closed-loop fuel systems. These technologies have been available for industrial engine applications for several years. Moreover, several manufacturers have already completed the testing effort to certify with California ARB that their engines meet these standards. Complying with emission standards nationwide in 2004 will therefore generally require manufacturers only to produce greater numbers of the engines complying with the California standards.

Chapter 4 of the Final Regulatory Support Document further describes data and rationale showing why we believe that the 2007 model year emission standards under the steady-state and transient duty-cycles and field-testing procedures are feasible. In summary, testing from Southwest Research Institute and other data show that the same catalyst and fuel-system technologies needed to meet the 2004 standards can be optimized to meet more stringent emission standards. Applying further development allows the design engineer to fine-tune control of air-fuel ratios and address any high-emission modes of operation to produce engines that consistently control emissions to very low levels, even considering the wide range of operation experienced by these engines. The numerical emission standards are based on measured emission levels from engines that have operated for at least 5,000 hours with a functioning emission-control system. These engines demonstrate the achievable level of control from catalyst-based systems and provide a significant degree of basic development that should help manufacturers in optimizing their own engines.

We believe it is appropriate to initiate the second stage of standards in 2007, because we believe that applying these emission standards earlier does not allow manufacturers enough stability between introduction of different phases of emission standards to prepare for complying with the full set of requirements in this final rule and to amortize their fixed costs. Three years of stable emission standards, plus the remaining lead time before 2004, allows manufacturers enough time to go through the development and certification effort to comply with the new standards including new test cycle requirements. The provisions to allow “family banking” for early compliance provide an additional tool for companies that choose to spread out their design and certification efforts.

The new emission standards will either have no impact or a positive impact with respect to noise, energy, and safety, as described in Chapter 4 of the Final Regulatory Support Document. In particular, the anticipated fuel savings associated with the expected emission-control technologies will provide a very big energy benefit related to new emission standards. The projected technologies are currently available and are consistent with those anticipated for complying with the emission standards adopted by California ARB. The lead time for the near-term and long-term emission standards allows manufacturers enough time to optimize these designs to most effectively reduce emissions from the wide range of Large SI equipment applications.

VI. Recreational Marine Diesel Engines

This section describes the new provisions for 40 CFR part 94, which apply to engine manufacturers and importers. We are applying the same general compliance provisions from 40 CFR part 94 for engine manufacturers, equipment manufacturers, operators, rebuilders, and others. See Section II for a description of our general approach to regulating nonroad engines and how manufacturers show that they meet emission standards.

A. Overview

We are adopting exhaust and crankcase emission standards for recreational marine diesel engines with power ratings greater than or equal to 37 kW. We are adopting emission standards for HC, NOx, CO, and PM beginning in 2006. We believe manufacturers will be able to use technology developed for land-based nonroad and commercial marine diesel engines. To encourage the introduction of low-emission technology, we are also adopting voluntary "Blue Sky" standards which are 40 percent lower than the mandatory standards. We also recognize that there are many small businesses that manufacture recreational marine diesel engines. We are therefore including several regulatory options for small businesses that will help minimize any unique burdens caused by emission regulations.

Diesel engines are primarily available in inboard marine configurations, but may also be available in sterndrive and outboard marine configurations. Inboard diesel engines are the primary choice for many larger recreational boats.

B. Engines Covered by This Rule

The standards in this section apply to recreational marine diesel engines. We excluded these engines from the requirements applying to commercial marine diesel engines because at the time we thought their operation in planing mode might impose design requirements on recreational boat builders and to allow us more time for further evaluation prior to setting standards (64 FR 73300, December 29, 1999). Commercial marine vessels tend to be displacement-hull vessels, designed and built for a unique commercial application (such as towing, fishing, or general cargo). Power ratings for engines used on these vessels are analogous to land-based applications, and these engines generally have warranties for 2,000 to 5,000 hours of use. Recreational vessels, on the other hand, tend to be planing vessels. Engines used on these vessels are designed to achieve higher power output with less engine weight. This increase in power reduces the lifetime of the engine, so recreational marine engines have shorter warranties than their commercial counterparts. In our previous rulemaking, recreational engine industry representatives raised concerns about the ability of these engines to meet the commercial standards without substantial changes in the size and weight of the engine. Such changes may have an impact on vessel builders, who might have to redesign vessel hulls to accommodate the new engines. Because most recreational vessel hulls are made with fiberglass molds, this may be a significant burden for recreational vessel builders.

Our further evaluation of these issues leads us to conclude that recreational marine diesel engines can achieve those same emission standards without significant impacts on engine size and weight, and therefore without significant impacts on vessel design. Section VI.G of this document, Chapters 3 and 4 of the Final Regulatory Support Document, and Section II.A of the Summary and Analysis of Comments describe the several technological changes we anticipate manufacturers will use to comply with the new emission standards. None of these technologies has an inherent negative effect on the performance or power density of an engine. As with engines in land-based applications, we expect that manufacturers will be able to use the range of technologies available to maintain or even improve the performance capabilities of their engines. We are establishing a separate regulatory program for recreational marine diesel engines in this rule, with most aspects the same as for commercial marine diesel engines but with certain aspects of the program tailored to these applications, notably the not-to-exceed emissions requirements.

To distinguish between commercial and recreational marine diesel engines for the purpose of emission controls, it is necessary to define "recreational marine diesel engine." The commercial marine diesel engine rule defined recreational marine engine as a propulsion marine engine that is intended by the manufacturer to be installed on a recreational vessel. The engine must be labeled to distinguish it from a commercial marine diesel engine. The label must read: "THIS ENGINE IS CATEGORIZED AS A RECREATIONAL ENGINE UNDER 40 CFR PART 94. INSTALLATION OF THIS ENGINE IN ANY NONRECREATIONAL VESSEL IS A VIOLATION OF FEDERAL LAW SUBJECT TO PENALTY."

We are revising this definition to include a requirement that a recreational marine engine must be a Category 1 marine engine (have a displacement of less than 5 liters per cylinder). Category 2 marine engines are generally designed with characteristics similar to commercial marine engines. Vessels using engines of this size generally require engines that can operate longer at higher power than typical recreational boats; therefore, these engines generally have a lower power density and are not offered in a "recreational" rating.

For the purpose of the recreational marine diesel engine definition included in the proposal, recreational vessel was defined as "a vessel that is intended by the vessel manufacturer to be operated primarily for pleasure or leased, rented, or chartered to another for the latter's pleasure." Because certain vessels that are used for pleasure may have operating characteristics that are more similar to commercial marine vessels (such as excursion vessels and charter craft), we drew on the Coast Guard's definition of a "small passenger vessel" (46 U.S.C 2101 (35)) to further delineate what would be considered to be a recreational vessel. Specifically, the term "operated primarily for pleasure or leased, rented or chartered to another for the latter's pleasure" does not include the following vessels: (1) vessels of less than 100 gross tons that carry more than 6 passengers; (2) vessels of 100 gross tons or more that carry one or more passengers; or (3) vessels used solely for competition. For the purposes of this definition, a passenger is defined by 46 U.S.C 2101 (21, 21a) which generally means an individual who pays to be on the vessel.

We received several comments in this rulemaking on these definitions. Engine manufacturers were concerned that the definitions may be unworkable for engine manufacturers, because they cannot know whether a particular recreational vessel might carry more than six passengers at a time. All they can know is whether the engine they manufacture is intended by them for installation on a vessel designed for pleasure and having the corresponding characteristics for planing, power density, and performance requirements.

We are not revising our existing definition of recreational marine vessel. As discussed in the Summary and Analysis of Comments, a vessel will be considered recreational if the boat builder intends that the customer will operate it consistent with the recreational-vessel definition. Relying on the boat builder's intent is necessary because manufacturers need to establish a vessel's classification before it is sold, whereas the Coast Guard definitions apply at the time of use. The definition therefore relies on the intent of the boat builder to establish that the vessel will be used consistent with the above criteria. If a boat builder manufactures a vessel for a customer who intends to use the vessel for recreational purposes, we would always consider that a recreational vessel, regardless of how the owner (or a subsequent owner) actually uses it. The engine manufacturer will not be expected to ensure that their engines are used only in recreational craft; however, they would be required to label their recreational engines as described above. The vessel builders will then be required to install properly certified recreational (or commercial) marine engines in recreational vessels and certified commercial marine engines in commercial vessels.

C. Emission Standards for Recreational Marine Diesel Engines

This section describes the new emission standards and implementation dates, with an outline of the technology that can be used to achieve these levels. The technological feasibility discussion below (Section VI.G) describes our technical rationale in more detail.

1. What are the emission standards and compliance dates?

The emission standards for recreational marine diesel engines are the same as the Tier 2 standards for commercial marine diesel engines with two years additional lead time. We are setting the standards at the same level because recreational marine diesel engines can use all the technologies projected for Tier 2 and these technologies are expected to lead to compliance. As with commercial marine engines this technology will be available in the lead time provided to allow compliance with the emission standards. Many of these engines already use this technology. This includes electronic fuel management, turbocharging, and separate-circuit aftercooling. In fact, because recreational engines have much shorter design lives than commercial engines, it is easier to apply raw-water aftercooling to these engines, which allows manufacturers to enhance performance while reducing NOx emissions.

Engine manufacturers will generally increase the fueling rate in recreational engines, compared to commercial engines, to gain power from a given engine size. This helps bring a planing vessel onto the water surface and increases the maximum vessel speed without increasing the weight of the vessel. This difference in how recreational engines are designed and used affects emissions. However, the technology listed above can be used to meet the emission standards while still meeting the performance requirements of a recreational engine.

We are adopting the commercial marine engine standards for recreational marine diesel engines, allowing two years beyond the dates that standards apply for the commercial engines. This gives engine manufacturers additional lead time in adapting technology to their recreational marine diesel engines. For manufacturers producing only recreational marine engines the implementation dates provide three to six years of lead time beyond this notice. Based on our evaluation of the industry, we believe that manufacturers who produce only recreational marine engines would likely be small businesses and would have the option of additional lead time, and other flexibility, as discussed in Section VI.E. The emission standards and implementation dates for recreational marine diesel engines are presented in Table VI.C-1. The subcategories refer to engine displacement in liters per cylinder.

Table VI.C-1
Recreational Marine Diesel Emission Standards and Implementation Dates

Subcategory	HC+NOx g/kW-hr	PM g/kW-hr	CO g/kW-hr	Implementation Date
power ≥ 37 kW disp < 0.9	7.5	0.40	5.0	2007
0.9 ≤ disp < 1.2	7.2	0.30	5.0	2006
1.2 ≤ disp < 2.5	7.2	0.20	5.0	2006
disp ≥ 2.5	7.2	0.20	5.0	2009

Manufacturers commented that engines with less than 2.5 liters per cylinder, but more than 560 kW would have no lead time beyond the land-based nonroad diesel engine standards and that some commercial marine engines in this category would actually have to certify two years before nonroad engines. In this case this is caused by the way we define subclasses, but has technology and cost implications for the engines involved. To address this, we are providing an optional implementation date of 2008 for certain commercial and recreational marine engines (see the Summary and Analysis of Comments for more detail). To be eligible for this option, the engine must be derived from a land-based nonroad engine with a rated power greater than 560 kW and have a displacement of 2.0 to 2.5 liters per cylinder. To use this option, we are requiring that engines certified under this option meet an HC+NOx standard of 6.4 g/kW-hr through model year 2012. We believe this emission level, which matches the Tier 2 level for land-based nonroad engines, should be achievable given the extra lead time for development. Testing would still be performed on the appropriate marine duty cycles. Based on our analysis in the Final Regulatory Impact Analysis for commercial marine engines, HC+NOx emissions measured over the marine duty cycles should be similar to those measured over the land-based nonroad duty cycle.

We are also adopting not-to-exceed emission standards and related requirements similar to those finalized for commercial marine diesel engines. This is discussed below in Section VI.C.8.

2. Will I be able to average, bank, or trade emissions credits?

Manufacturers may use emission credits from recreational marine diesel engines to show that they meet emission standards. Section II.C.3 gives an overview of the emission-credit program, which is consistent with what we have adopted for Category 1 commercial marine diesel engines. The emission-credit program covers HC+NOx and PM emissions, but not CO emissions.

Consistent with our land-based nonroad and commercial marine diesel engine regulations, manufacturers may not simultaneously generate HC+NOx credits while using PM credits on the same engine family, and vice versa. This is necessary because of the inherent trade-off between NOx and PM emissions in diesel engines.

We are adopting the same maximum value of the Family Emission Limit (FEL) as for commercial marine diesel engines. For engines with a displacement of less than 1.2 liters/cylinder, the maximum values are 11.5 g/kW-hr HC+NOx and 1.2 g/kW-hr PM; for larger engines, the maximum values are 10.5 g/kW-hr HC+NOx and 0.54 g/kW-hr PM. These maximum FEL values were based on the comparable land-based emission-credit program and will ensure that the emissions from any given family certified under this program not be significantly higher than the applicable emission standards. We believe these maximum values will prevent backsliding of emissions above the baseline levels for any given engine model. Also, we are concerned that the higher emitting engines may cause increased emissions in areas such as ports that may have a need for PM or NOx emission reductions. Nonetheless, it is acknowledged that recreational marine diesel engines constitute a small fraction of PM and HC + NOx emissions in nonattainment areas.

Emission credits generated under this program have no expiration, with no discounting applied. This is consistent with the commercial marine credit program and gives manufacturers more options in implementing their engine designs. However, if we revisit these standards later, we will have to reevaluate this issue in the context of whether future advances in technology would result in a large amount of accumulated credits that would adversely impact the timely implementation of any new requirements.

Consistent with the land-based nonroad diesel rule, we will also not allow manufacturers to use credits generated on land-based engines for demonstrating compliance with marine diesel engines. In addition, credits may not be exchanged between recreational and commercial marine engines. The emission standards for recreational engines are based on the baseline levels of current recreational marine engines and the capability of technology to reduce emissions from recreational marine engines. The standard is, therefore, premised on the capability and use of recreational marine technology and not on the capability and use of technology on other engines. Emissions from land-based, commercial, and recreational marine engines are measured over different duty cycles and have different useful lives. Correction factors would be difficult to generate and they would add complexity and uncertainty to the value of the credits. Furthermore, we are concerned that allowing cross program trading could create an inequity between manufacturers with diverse product lines and those with more limited offerings, thereby potentially creating a competitive advantage for diverse companies over small companies selling only recreational marine engines. If a manufacturer were to do this, we do not believe it is likely that they would sell emission credits at a price that would be economical for small manufacturers.

We will allow early banking of emission credits relative to the standard. Early banking of emission credits may allow for a smoother implementation of the recreational marine standards. These credits are generated relative to the new emission standards and are undiscounted.

We will also allow manufacturers to generate early credits relative to their pre-control emission levels. If manufacturers choose this option they will have to develop baseline emission levels specific to each participating engine family. Credits will then be calculated relative to the manufacturer-generated baseline emission rates, rather than the standards. To generate the baseline emission rates, a manufacturer must test three engines from the family for which the baseline is being generated. The baseline will be the average emissions of the three engines. Under this option, engines must still certify to the standards to generate credits, but the credits will be calculated relative to the generated baseline rather than the standards. Any credits generated between the level of the standards and the generated baseline will be discounted 10 percent. This is to account for the variability of testing in-use engines to establish the family-specific baseline levels, which may result from differences in hours of use and maintenance practices as well as other sources of potential uncertainty about the representativeness if the baseline. Manufacturers commented that credits should not be generated under the early banking program for the portion of NOx reductions above the MARPOL Annex VI standard. We believe this approach is reasonable since this should be a common upper limit for all engines. Therefore, if manufacturers use this option, any baseline NOx levels determined to be above the MARPOL Annex VI standard must be adjusted to that level for determining early credits.

3. Is EPA proposing voluntary standards for these engines?

a. Blue Sky

We are adopting voluntary emission standards based on a 45-percent reduction beyond the mandatory standards. An engine family meeting the voluntary standards qualifies for designation as Blue Sky Series engines. These voluntary standards are the same as those adopted for commercial marine diesel engines (see Table VI.C-2). While the Blue Sky Series emission standards are voluntary, a manufacturer choosing to certify an engine under this program must comply with all the requirements that apply to this category of engines, including allowable maintenance, warranty, useful life, rebuild, and deterioration factor provisions. This program is effective immediately when we publish this rule. To maximize the potential for other groups to create incentive programs, without double-counting, we do not allow manufacturers to earn marketable credits for their Blue Sky Engines.

Table VI.C-2
Blue Sky Voluntary Emission Standards for
Recreational Marine Diesel Engines (g/kW-hr)

Rated Brake Power (kW)	HC+NOx	PM
power ≥ 37 kW displ.<0.9	4.0	0.24
0.9≤displ.<1.2	4.0	0.18
1.2≤displ.<2.5	4.0	0.12
2.5≤displ.	5.0	0.12

b. MARPOL Annex VI

The MARPOL Annex VI standards are for NOx emissions from marine diesel engines rated above 130 kW. We encourage engine manufacturers to make Annex VI-compliant engines available and boat builders to purchase and install them before we apply the EPA Tier 2 standards. If the treaty enters into force, the standards would go into effect retroactively to all boats built January 1, 2000 or later. One advantage of using MARPOL-compliant engines is that if this happens, users will be in compliance with the standard without having to make any changes to their engines.

4. What durability provisions apply?

Several provisions help ensure that engines control emissions throughout a lifetime of operation. Section II.C gives a general overview of durability provisions associated with emissions certification. This section discusses these provisions specifically for recreational marine diesel engines.

a. How long do my engines have to comply?

Manufacturers must produce engines that comply over a useful life of ten years or until the engine accumulates 1,000 operating hours, whichever occurs first. The hours requirement is a minimum value for useful life, and manufacturers must comply for a longer period in those cases where they design their engines to be operated longer than 1,000 hours. In making the determination that engines are designed to last longer than the 1,000 hour value, we will consider evidence such as whether the engines continue to reliably deliver the necessary power output without an increase in fuel consumption that the user would find unacceptable and thus might trigger a maintenance or rebuild action by the user.

b. How do I demonstrate emission durability?

We are extending the durability demonstration requirements for commercial marine diesel engines to also cover recreational marine diesel engines. This means that recreational marine engine manufacturers, using good engineering judgment, will generally need to test one or more engines for emissions before and after accumulating the number of hours consistent with the engine useful life (usually performed by continuous engine operation in a laboratory). The results of these tests are referred to as "durability data," and are used to determine the rates at which emissions are expected to increase over the useful life of the engine for each engine family The rates are known as deterioration factors. However, in many cases, manufacturers may use durability data from a different engine family, or for the same engine family in a different model year. Because of this allowance to use the same data for multiple engine families, we expect durability testing to be very limited.

We also specify that manufacturers must collect durability data and generate deterioration factors using the same methods established for commercial marine diesel engines. These requirements are in 40 CFR 94.211, 94.218, 94.219, and 94.220. These sections describe when durability data from one engine family can be used for another family, how to select to the engine configuration that is to be tested, how to conduct the service accumulation, and what maintenance can be performed on the engine during this service accumulation. Under 40 CFR 94.220, manufacturers may project deterioration rates from engines with an accumulation of less than 1,000 hours, as long as the amount of service accumulation completed and projection procedures are determined using good engineering judgment.

c. What maintenance may be done during service accumulation?

For engines certified to a 1,000-hour useful life, the only maintenance that may be done must be (1) regularly scheduled, (2) unrelated to emissions, and (3) technologically necessary. This typically includes changing engine oil, oil filter, fuel filter, and air filter. For recreational marine diesel engines certified to longer lives, these engines will be subject to the same minimum allowable maintenance intervals as commercial marine engines. These intervals and the allowable maintenance are specified in 40 CFR 94.211.

d. Are there production-line testing provisions?

We are adopting the production-line testing requirements from commercial marine engines for recreational marine diesel engines, with the additional provisions described in II.C.4. A manufacturer must test one percent of its total projected annual sales of Category 1 engines each year to meet production-line testing requirements. We are not adopting a minimum number of tests, so a manufacturer who produces no more than 100 marine diesel engines is not required to do any production-line testing. Similar to the commercial marine requirements, manufacturers have the option of using alternative production-line testing programs with EPA approval.

Manufacturers commented that we should limit the number of engines tested for a given engine family to five, arguing that five engines would be sufficient to demonstrate compliance with the standards. Although there isn't necessarily an engineering rationale for capping the number of tests for each engine family to five, we believe that statistical certainty can be determined using the Cumulative Sum method described for recreational vehicles in 40 CFR part 1051, subpart D. Therefore, we are providing the option of using the Cumulative Sum method for determining sample sizes under the production-line testing program. For marine engines, PM would need to be included in this methodology. Under the Cumulative Sum method, a statistical analysis is applied to test results to establish the number of tests needed. This may limit the number of engines tested to less than 1 percent of the production volume in cases where there is low variability in the test data.

5. Do these standards apply to alternative-fueled engines?

These new standards apply to all recreational marine diesel engines, without regard to the type of fuel used. While we are not aware of any alternative-fueled recreational marine diesel engines currently being sold into the U.S. market, alternate forms of the hydrocarbon standards address the potential for natural gas-fueled and alcohol-fueled engines. In our regulation of highway vehicles and engines, we determined that nonmethane standards should be used in place of total hydrocarbon standards for engines fueled with natural gas (which is comprised primarily of methane) (59 FR 48472, September 21, 1994). These alternate forms follow the precedent set in previous rulemakings to make the standards similar in stringency and environmental impact.

Similarly, we are applying HC-equivalent (HCE) standards instead of total hydrocarbon standards to alcohol-fueled highway engines and vehicles (54 FR 14426, April 11, 1989). HC-equivalent emissions are calculated from the oxygenated organic components and non-oxygenated organic components of the exhaust, summed together based on the amount of organic carbon present in the exhaust. Alcohol-fueled recreational marine engines must therefore comply with total hydrocarbon equivalent (THCE) plus NOx standards instead of THC plus NOx standards.

6. Is EPA controlling crankcase emissions?

Manufacturers must prevent crankcase emissions from recreational marine diesel engines, with one exception. Turbocharged recreational marine diesel engines may be built with open crankcases, as long as the crankcase ventilation system allows for measurement of crankcase emissions. For these engines with open crankcases, we will require crankcase emissions to be either routed into the exhaust stream to be included in the exhaust measurement, or to be measured separately and added to the measured exhaust mass. These measurement requirements do not add significantly to the cost of testing, especially where the crankcase vent is simply routed into the exhaust stream prior to the point of exhaust sampling. These provisions are consistent with our previous regulation of crankcase emissions from such diverse sources as commercial marine engines, locomotives, and passenger cars.

7. What are the smoke requirements?

We are not adopting smoke requirements for recreational marine diesel engines. Marine diesel engine manufacturers have stated that many of their engines, though currently unregulated, are manufactured with smoke limiting controls at the request of customers. Users seek low smoke emissions both because they dislike the exhaust residue on decks and because they can be subject to penalties in ports with smoke emission requirements. In many cases, marine engine exhaust gases are mixed with water prior to being released. This practice reduces smoke visibility. Moreover, we believe that applying PM standards will have the effect of limiting smoke emissions as well.

8. What are the not-to-exceed standards and related requirements?

a. Concept

Our goal is to achieve control of emissions over the broad range of in-use speed and load combinations that can occur on a recreational marine diesel engine so that real-world emission control is achieved, rather than just controlling emissions under certain laboratory conditions. An important tool for achieving this goal is an in-use program with an objective emission standard and an easily implemented test procedure. Prior to this concept, our approach has been to set a numerical standard on a specified test procedure and rely on the additional prohibition of defeat devices to ensure in-use control over a broad range of operation not included in the test procedure.

We are applying the defeat device provisions established for commercial marine engines to recreational marine diesel engines in addition to the NTE requirements (see 40 CFR 94.2). A design in which an engine met the standard at the steady-state test points but was intentionally designed to approach the NTE limit everywhere else would be considered to be defeating the standard. Electronic controls that recognize and modulate the emission-control system when the engine is not being tested for emissions and increases the emissions from the engine would be an example of a defeat device, regardless of the emissions performance of the engine with regard to the standards.

No single test procedure can cover all real-world applications, operations, or conditions. Yet to ensure that emission standards are providing the intended benefits in use, we must have a reasonable expectation that emissions under real-world conditions reflect those measured on the test procedure. The defeat-device prohibition is designed to ensure that emission controls are employed during real-world operation, not just under laboratory or test-procedure conditions. However, the defeat-device prohibition is not a quantified standard and does not have an associated test procedure, so it does not have the clear objectivity and ready enforceability of a numerical standard and test procedure. As a result, relying on just a using a standardized test procedure and the defeat device prohibition makes it harder to ensure that engines will operate with the same level of control in the real world as in the test cell.

Because the ISO E5 duty cycle uses only five modes on an average propeller curve intended to characterize typical marine engine operation for this industry, we are concerned that an engine designed to the duty cycle may not necessarily perform the same way over the range of speed and load combinations normally seen on a boat nor will it always follow the average curve. These duty cycles are based on an average propeller curve, but a propulsion marine engine may never be fitted with an "average propeller." In addition, even if fitted with an "average propeller," an engine fit to a specific boat may operate differently based on how heavily the boat is loaded.

To ensure that emissions are controlled from recreational marine engines over the full range of speed and load combinations normally seen on boats, we are establishing a zone under the engine's power curve where the engine may not exceed a specified emission limit. This limit applies to all of the regulated pollutants under steady-state operation. Testing in this "not-to-exceed" (NTE) zone may include the whole range of real ambient conditions. The NTE zone, limit, and ambient conditions are described below.

We believe there are significant advantages to taking this approach. The test procedure is flexible enough to represent the majority of in-use engine operation and ambient conditions. Therefore, the NTE approach takes all of the benefits of a numerical standard and test procedure and expands it to cover a broad range of conditions. Also, a standard that requires laboratory testing makes it harder to perform in-use testing because either the engines must be removed from the vessel or laboratory-type conditions must be achieved on the vessel. With the NTE approach, in-use testing becomes much easier to implement since emissions may be sampled during normal vessel use. Because this approach is objective, it makes enforcement easier and provides more certainty to the industry in terms of what control is expected in-use versus over a fixed laboratory test procedure.

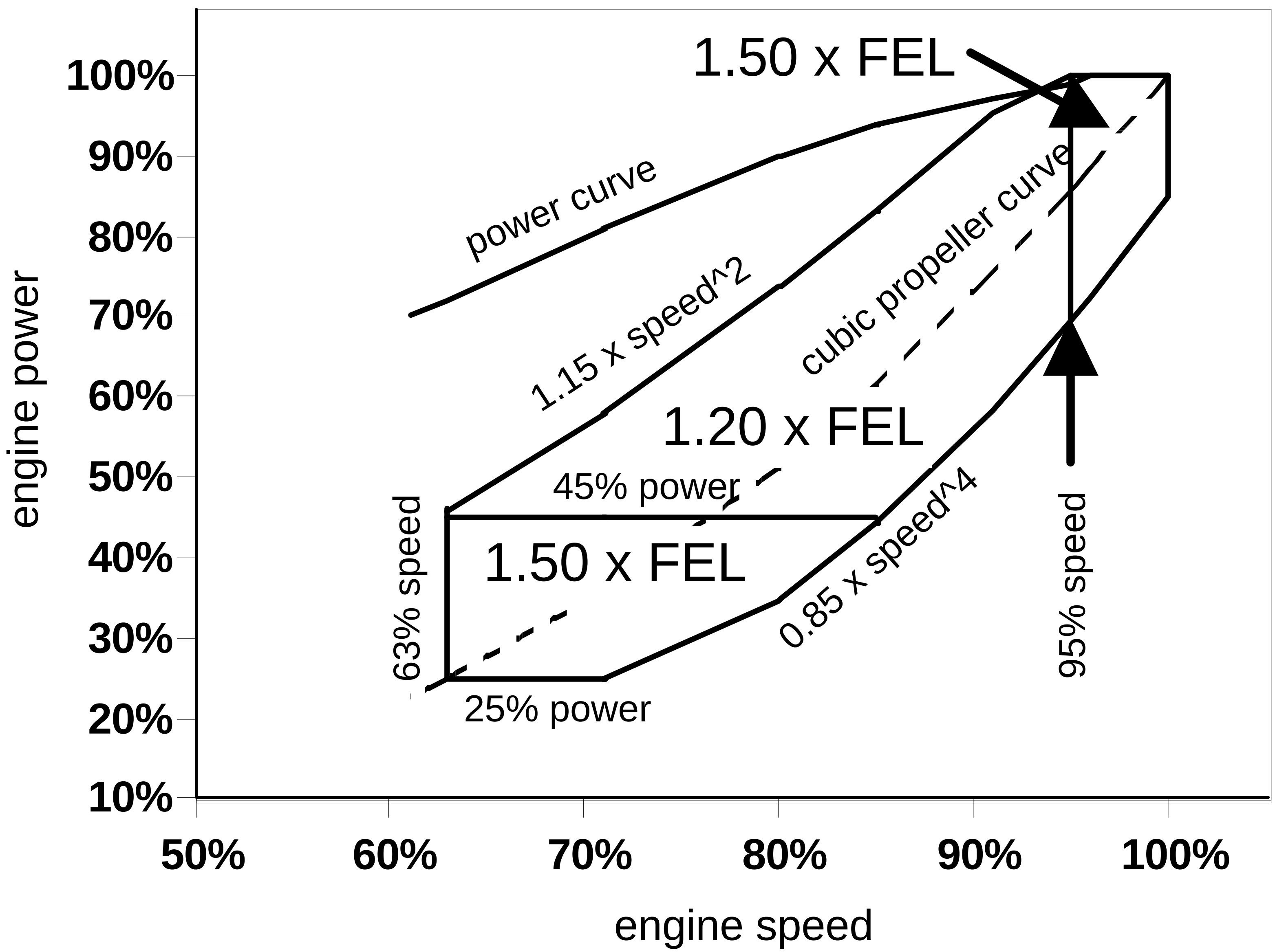
Even with the NTE requirements, we believe it is important to retain standards based on the steady-state duty cycles. This is the standard that we expect the certified marine engines to meet on average in use. The NTE testing is more focused on maximum emissions for segments of operation. We believe basing the emission standards on a distinct cycle and using the NTE zone to better ensure in-use control creates a comprehensive program. In addition, the steady-state duty cycles give a basis for calculating credits for averaging, banking, and trading.

As described in the Summary and Analysis of Comments, the same technology that can be used to meet the standards over the E5 duty cycle can be used to meet the NTE caps in the NTE zone. We therefore do not expect these standards to cause recreational marine diesel engines to need more advanced technology that is used by the nonroad and commercial marine engines from which they are derived. We do not believe the NTE concept results in a large amount of additional testing, because these engines should be designed to perform as well in use as they do over the steady-state five-mode certification test. However, our cost analysis in Chapter 5 of the Final Regulatory Support Document accounts for some additional testing, especially in the early years, to provide manufacturers with assurance that their engines will meet the NTE requirements.

b. Shape of the NTE zone

Figure VI.C-1 illustrates the NTE zone for recreational marine diesel engines. We based this zone on the range of conditions that these engines might typically see in use. Also, we divide the zone into subzones of operation which have different limits as described below. Chapter 4 of the Final Regulatory Support Document describes the development of the boundaries and conditions associated with the NTE zone. The NTE zone for recreational marine diesel engines is the same for commercial marine diesel engines operating on a propeller curve, except that an additional subzone is added at speeds over 95 percent of rated to address the typical recreational design for higher rated power.

Figure VI.C-1: NTE Zone for Recreational Marine Diesel Engines



EPA may approve adjustments to the size and shape of the NTE zone for certain engines if the manufacturer demonstrates that the engine will not see operation outside of the revised NTE zone in use. This way, manufacturers can avoid having to test their engines under operation that they will not see in use. However, manufacturer are responsible for ensuring that their specified operation represents real-world operation. In addition, if a manufacturer designs an engine for operation at speeds and loads outside of the NTE zone (i.e., variable-speed engines used with variable-pitch propellers), the manufacturer is responsible for notifying us, so the NTE zone for that engine family can be modified to include this operation.

c. Transient operation

NTE testing includes only steady-state operation with a minimum sampling time of 30 seconds. We specify the ISO E5 steady-state duty cycle for showing compliance with average emission standards. The goal of adopting NTE standards and procedures is to cover the operation away from the five modes that are on the assumed propeller curve. Our understanding is that the majority of marine engine operation is steady-state; however, we recognize that recreational marine use is likely more transient than commercial marine use. At this time we do not have enough data on marine engine operation to accurately determine the amount of transient operation that occurs or to set an NTE standard for transient operation. We are aware that the high-load transient operation seen when a boat comes to plane is not included in the NTE zone as defined, even if we were to require compliance with NTE standards during transient operation. We are also aware that these speed and load points cannot be achieved under steady-state operation for a properly loaded boat in use. If we find that excluding transient operation from the compliance requirements results in a significant increase in emissions, we will revisit this provision in the future. Also, an engine designed, with multiple injection timing maps based on operation, to operate at higher emissions during transient operation than during steady-state testing would be in noncompliance with our defeat device prohibition.

d. Emission standards

We are requiring emissions caps for the NTE zones that represent a multiplier times the weighted test result used for certification for all of the regulated pollutants (HC+NOx, CO, and PM). This is consistent with the concept of a weighted modal emission test such as the steady-state tests included in this rule. The standard itself is intended to represent the average emissions under steady-state conditions. Because it is an average, some points can be higher, some lower, and the manufacturer will design to maximize performance and still meet the engine standard. The NTE limit is on top of this. It is designed to make sure that no part of the engine operation and that no application goes too far from the average level of control.

Consistent with the requirements for commercial marine engines, recreational marine diesel engines must meet a cap of 1.50 times the certified level for HC+NOx, PM, and CO for the speed and power subzone below 45 percent of rated power and a cap of 1.20 times the certified levels at or above 45 percent of rated power. However, we are applying an additional subzone at speeds greater than 95 percent of rated, with a corresponding standard of 1.50 times the certified levels for this subzone. This additional subzone addresses the typical recreational design for higher rated power. We understand that this power is needed to ensure that the engine can bring the boat to plane. Chapter 4 of the Final Regulatory Support Document provides more detail on how we determined the standards.

We are aware that marine diesel engines may not be able to meet the emissions limit under all conditions. Specifically, there are times when emission control must be compromised for startability or safety. Engine starting is not included in NTE testing. In addition, manufacturers have the option of petitioning the Administrator to allow emissions to increase under engine protection strategies, such as when an engine overheats. This is also consistent with the requirements for commercial marine engines.

e. Ambient conditions

Variations in ambient conditions can affect emissions. Such conditions include air temperature, humidity, and (especially for aftercooled engines) water temperature. We are applying the commercial marine engine ranges for these variables. Chapter 4 of the Final Regulatory Support Document provides more detail on how we determined these ranges. Within the ranges, there is no calculation to correct measured emissions to standard conditions. Outside of the ranges, emissions can be corrected back to the nearest end of the range. The ambient variable ranges are 13 to 35°C (55 to 95°F) for intake air temperature, 7.1 to 10.7 g water/kg dry air (50 to 75 grains/pound dry air) for intake air humidity, and 5 to 27°C (41 to 80°F) for ambient water temperature.[84]

f. Certification

At the time of certification, manufacturers must submit a statement that its engines will comply with these requirements under all conditions that may reasonably be expected to occur in normal vessel operation and use. The manufacturer also provides a detailed description of all testing, engineering analysis, and other information that forms the basis for the statement. This statement may be based on testing or and other research that validly supports such a statement, consistent with good engineering judgment. EPA may review the basis of this statement during the certification process.

D. Testing Equipment and Procedures

The regulations detail specifications for test equipment and procedures that apply generally to commercial marine engines (including NTE testing) in 40 CFR part 94. We have based the recreational marine diesel engine test procedures on this part. Section VIII gives a general discussion of testing requirements; this section describes procedures that are specific to recreational marine such as the duty cycle for operating engines for emission measurements. Chapter 4 of the Draft Regulatory Support Document describes these duty cycles in greater detail. In addition to the information provided above, the following section discusses issues concerning test equipment and procedures.

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[84]The range of intake air temperature is 13 to 30°C for engines that draw air from outside the engine room.

1. Which duty cycles are used to measure emissions?

For recreational marine diesel engines, we specify the ISO E5 duty cycle. This is a 5-mode steady state cycle, including an idle mode and four modes lying on a cubic propeller curve. ISO intends for this cycle to be used for all engines in boats less than 24 meters in length. We apply it to all recreational marine diesel engines to avoid the complexity of tying emission standards to boat characteristics. A given engine may be used in boats longer and shorter than 24 meters; engine manufacturers generally will not know the size of the boat into which an engine will be installed. Also, we expect that most recreational boats will be under 24 meters in length. Chapter 4 of the Final Regulatory Support Document provides further detail on the ISO E5 duty cycle.

2. What fuels will be used during emission testing?

We are applying the same specifications for recreational marine diesel engines that we established for commercial marine diesel engines. That means that the recreational engines will use the same test fuel that is required for testing Category 1 commercial marine diesel engines, which is a regular nonroad test fuel with moderate sulfur content. We are not aware of any difference in fuel specifications for recreational and commercial marine engines of comparable size.

3. How does in-use testing work?

In-use testing on marine engines may be used to ensure compliance in use. This testing may include taking in-use marine engines out of the vessel and testing them in a laboratory, as well as field testing of in-use engines on the boat, in a marine environment.

We plan to use field-testing data in two ways. First, we may use it as a screening tool, with follow-up laboratory testing over the ISO E5 duty cycle or NTE zone where appropriate. Second, we may use the data directly as a basis for compliance determinations, as long as field-testing equipment and procedures are capable of providing reliable information from which conclusions can be drawn regarding what emission levels would be with laboratory-based measurements. Because it would likely be difficult to match the E5 test points exactly on an engine in use on a vessel, NTE zone testing will reduce the difficulty of in-use compliance determinations.

For marine engines that expel exhaust gases underwater or mix their exhaust with water, manufacturers must equip engines with an exhaust sample port where a probe can be inserted for in-use exhaust emission testing. It is important that the location of this port allow a well-mixed and representative sample of the exhaust. This provision is intended to simplify in-use testing. In cases where the engine manufacturer does not supply enough of the exhaust system to add a sample port, the engine manufacturer would be required to provide installation instructions for a sample port. Vessel manufacturers would be required to follow this and any other emission-related installation instructions.

One of the advantages of the not-to-exceed requirements will be to facilitate in-use testing. This will allow us to perform compliance testing in the field. As long as the engine is operating under steady-state conditions in the NTE zone, we will be able to measure emissions and compare them to the NTE limits. To assist in this testing, engines with electronic controls will be required to broadcast engine torque (as percent of maximum) and engine speed on their controller area networks.

4. How is the maximum test speed determined?

To ensure that a manufacturer's declared maximum speed is representative of actual engine operating characteristics and is not improperly used to influence the parameters under which their engines are certified, we are applying the definition of maximum test speed used for commercial marine engines. This definition of maximum test speed is the single point on an engine's normalized maximum power versus speed curve that lies farthest away from the zero-power, zero-speed point.

In establishing this definition of maximum test speed, it was our intent to specify the highest speed at which the engine is likely to be operated in use. Under normal circumstances this maximum test speed should be close to the speed at which peak power is achieved. However, as some manufacturers indicated in their comments, it is possible under this definition for the maximum test speed to be very different than the speed at which peak power is achieved. This could result in the certification test cycle and the NTE zone (which are both defined in part by the maximum test speed) being unrepresentative of in-use operation. Since we were aware of this potential during the development of the commercial marine regulations, we included two provisions to address issues such as these. First, §94.102 allows EPA to modify test procedures in situations where the specified test procedures would otherwise be unrepresentative of in-use operation. Thus, in cases in which the definition of maximum test speed resulted in an engine speed that was not expected to occur with in-use engines, we would work with the manufacturers to determine the maximum speed that would be expected to occur in-use.

Second, §94.106(c)(2) allows EPA to specify during certification a broader NTE zone to include actual in-use operation. In those cases where we could not specify a single maximum test speed under §94.102 that would sufficiently cover the range of in-use engine speeds, we would specify a broader NTE zone. For example, we would generally expect that the NTE zone would include the peak power point. If the maximum test speed derived under §§94.102 and 94.107 resulted in an NTE zone that did not include the peak power point, we would likely specify that the NTE zone be broadened to include that point. Similarly, we would expect that a manufacturer's advertised rated power/speed point should be within the NTE zone, and could broaden the NTE zone to include that point as well.

E. Special Compliance Provisions

The provisions discussed here are designed to minimize regulatory burdens on manufacturers needing added flexibility to comply with emission standards. These manufacturers include engine dressers, small-volume engine marinizers, and small-volume boat builders. Commenters generally supported these provisions as proposed.

1. What are the burden reduction approaches for engine dressers?

Many recreational marine diesel engine manufacturers take a new, land-based engine and modify it for installation on a marine vessel. Some of the companies that modify an engine for installation on a boat make no changes that might affect emissions. Instead, the modifications may consist of adding mounting hardware and a generator or reduction gears for propulsion. It can also involve installing a new marine cooling system that meets original manufacturer specifications and duplicates the cooling characteristics of the land-based engine, but with a different cooling medium (such as sea water). In many ways, these manufacturers are similar to nonroad equipment manufacturers that purchase certified land-based nonroad engines to make auxiliary engines. This simplified approach of producing an engine can more accurately be described as dressing an engine for a particular application. Because the modified land-based engines are subsequently used on a marine vessel, however, these modified engines will be considered marine diesel engines, which then fall under these requirements.

To clarify the responsibilities of engine dressers under this rule, we will not treat them as a manufacturer of a recreational marine diesel engine and therefore they would not be required to obtain a certificate of conformity, as long as they meet the following seven conditions.

(1) The engine being dressed (the "base" engine) must be a highway, land-based nonroad, or locomotive engine, certified pursuant to 40 CFR part 86, 40 CFR part 89, or 40 CFR part 92, respectively, or a marine diesel engine certified pursuant to this part.

(2) The base engine's emissions, for all pollutants, must meet the otherwise applicable recreational marine emission limits. In other words, starting in 2005, a dressed nonroad Tier 1 engine will not qualify for this exemption, because the more stringent standards for recreational marine diesel engines go into effect at that time.

(3) The dressing process must not involve any modifications that can change engine emissions. We do not consider changes to the fuel system to be engine dressing because this equipment is integral to the combustion characteristics of an engine.

(4) All components added to the engine, including cooling systems, must comply with the specifications provided by the engine manufacturer.

(5) The original emissions-related label must remain clearly visible on the engine.

(6) The engine dresser must notify purchasers that the marine engine is a dressed highway, nonroad, or locomotive engine and is exempt from the requirements of 40 CFR part 94.

(7) The engine dresser must report annually to us the models that are exempt pursuant to this provision and such other information as we deem necessary to ensure appropriate use of the exemption.

Any engine dresser not meeting all these conditions will be considered an engine manufacturer and will accordingly need to obtain a certificate of conformity for these new engines, consistent with this rule's provisions, and label the engine showing that it is available for use as a marine engine.

An engine dresser violating the above criteria might be liable under anti-tampering provisions for any change made to the land-based engine that affects emissions. The dresser might also be subject to a compliance action for selling new marine engines that are not certified to the required emission standards. For an engine dresser complying with the above provisions, the original certificate would remain in effect and the certifier of the engine would remain liable for the emissions performance of the engine.

2. What special provisions is EPA adopting for small entities?

In addition to provisions for engine dressers, we are also finalizing special provisions designed to provide flexibility to small entities. Prior to the proposal, we conducted an inter-agency Small Business Advocacy Review Panel as described in Section XI.C. With input from small-entity representatives, the panel drafted a report with findings and recommendations on how to reduce the potential small-business burden resulting from this rule. The inter-agency panel's recommendations were proposed by EPA and are now being finalized as proposed. The following sections describe these provisions.

3. What are the burden reduction approaches for small-volume engine marinizers?

We are providing additional options for small-volume engine marinizers. The purpose of these options is to reduce the burden on companies for which fixed costs cannot be distributed over a large number of engines. For this reason, we are defining a small-volume engine manufacturer based on annual U.S. sales of engines and are providing the additional options on this basis rather than on business size in terms of number of employees, revenue, or other such measures. The production count we are using includes all engines (automotive, other nonroad, etc.) and not just recreational marine engines. We consider recreational marine diesel engine manufacturers to be small volume for purposes of this provision if they produce fewer than 1,000 internal combustion engines per year. Based on our characterization of the industry, there is a natural break in production volumes above 500 engine sales where the next smallest manufacturers make tens of thousands of engines. We chose 1,000 engines as a limit because it groups together all the marinizers most needing relief, while still allowing for reasonable sales growth.

The options for small-volume marinizers are discussed below.

a. Broaden engine families

We have established engine criteria for distinguishing between engine families, which is intended to divide a manufacturer's product line into multiple engine families. We are allowing small-volume marinizers to put all of their models into one engine family (or more as necessary) for certification purposes. Marinizers would then certify using the "worst-case" configuration. This approach is consistent with the option offered to post-manufacture marinizers under the commercial marine regulations. The advantage of this approach is that it minimizes certification testing because the marinizer can use a single engine in the first year to certify their whole product line. As for large companies, the small-volume manufacturers could then carry-over data from year to year until changing engine designs in a way that might significantly affect emissions.

We understand that this option alone still requires a certification test and the associated burden for small-volume manufactures. We consider this to be the foremost cost concern for some small-volume manufacturers, because the test costs are spread over low sales volumes. Also, we recognize that it may be difficult to determine the worst-case emitter without additional testing. We are requiring testing because we need a reliable, test-based technical basis to issue a certificate for these engines. Manufacturers will be able to use carry-over to spread costs over multiple years of production.

b. Minimize compliance requirements

Production-line and deterioration testing requirements do not apply to small-volume marinizers. We will assign a deterioration factor for use in calculating end-of-life emission factors for certification. The advantages of this approach would be to minimize compliance testing. Production-line and deterioration testing would be more extensive than a single certification test.

c. Expand engine dresser flexibility

We are expanding the engine dresser definition for small-volume marinizers to include water-cooled turbochargers where the goal is to match the performance of the non water-cooled turbocharger on the original certified configuration. We believe this would provide more opportunities for diesel marinizers to be excluded from certification testing if they operate as dressers.

d. Streamlined certification

We will allow small-volume marinizers to certify to the not-to-exceed (NTE) requirements with a streamlined approach. We believe small-volume marinizers can make a satisfactory showing that they meet NTE standards with limited test data. Similar to the standard NTE program, once these manufacturers test engines over the five-mode certification duty cycle (E5), they can use those or other test points to extrapolate the results to the rest of the NTE zone. For example, an engineering analysis may consider engine timing and fueling rate to determine how much the engine's emissions may change at points not included in the E5 cycle. For this streamlined NTE approach, keeping all four test modes of the E5 cycle within the NTE standards will be enough for small-volume marinizers to certify compliance with NTE requirements, as long as there are no significant changes in timing or fueling rate between modes.

e. Delay standards for five years

Applying a five-year delay, the standards take effect from 2011 to 2014 for small-volume marinizers, depending on engine size. Marinizers may apply this five-year delay to all or just a portion of their production. They may therefore still sell engines that meet the standards when possible on some product lines while delaying introduction of emission-control technology on other product lines. This option provides more time for small marinizers to redesign their products, allowing time to learn from the technology development of the rest of the industry. Boat builders may use these uncertified engines in their vessels.

While we are concerned about the loss of emission control from part of the fleet during this time, we recognize the special needs of small-volume marinizers and believe the added time may be necessary for these companies to comply with emission standards. This additional time will allow small-volume marinizers to obtain and implement proven, cost-effective emission-control technology.

f. Hardship provisions

We are adopting two hardship provisions for small-volume marinizers. Marinizers may apply for this relief on an annual basis. First, small marinizers may petition us for additional time to comply with the standards. The marinizer must show that it has taken all possible steps to comply but the burden of compliance costs will have a major impact on the company's solvency. Also, if a certified base engine is available, the marinizer must generally use this engine. We believe this provision will protect small-volume marinizers from undue hardship due to certification burden. Also, some emission reduction can be gained if a certified base engine becomes available.

Second, small-volume marinizers may also apply for hardship relief if circumstances outside their control caused the failure to comply (such as a supply contract broken by parts supplier) and if failure to sell the subject engines will have a major impact on the company's solvency. We consider this relief mechanism to be an option of last resort. We believe this provision will protect small-volume marinizers from circumstances outside their control. We, however, intend to not grant hardship relief if contract problems with a specific company prevent compliance for a second time.

Although the inter-agency panel did not specify a time limit for these hardship provisions, and we are not finalizing any such time limits, we envision these hardship provisions as transitional in nature. We would expect their use to be limited to the early years of the program, in a similar time frame as we are establishing for the recreational vehicle hardship provisions, as discussed in Section VII.C.

4. What are the burden reduction approaches for small-volume boat builders using recreational marine diesel engines?

The inter-agency panel also recommended burden reduction approaches for small-volume boat builders. The recommendations were based on the concerns that, although boat builders are not subject to the engine-based emission standards, they are required to use certified engines and may need to redesign engine compartments on some boats if engine designs were to change significantly. EPA proposed the flexibilities recommended by the panel and are finalizing them as proposed.

We are adopting four options for small-volume vessel manufacturers using recreational marine diesel engines. These options are intended to reduce the burden on companies for which fixed costs cannot be distributed over a large number of vessels. As proposed, we are therefore defining a small-volume boat builder as one that produces fewer than 100 boats for sale in the U.S. in one year and has fewer than 500 employees. The production count includes all engine-powered recreational boats. These options may be used at the manufacturer's discretion. The options for small-volume boat builders are discussed below.

a. Percent-of-production delay

Manufacturers with a written request from a small-volume boat builder and prior approval from us may produce a limited number of uncertified recreational marine diesel engines. From 2006 through 2010, small-volume boat builders may purchase uncertified engines to sell in boats for an amount equal to 80 percent of engine sales for one year. For example, if the small boat builder sells 100 engines per year, a total of 80 uncertified engines may be sold over the five-year period. This will give small boat builders an option to delay using new engine designs for a portion of business. Engines produced under this flexibility must be labeled accordingly so that customs inspectors know which uncertified engines can be imported. We continue to believe this approach is appropriate and are finalizing it as proposed.

b. Small-volume allowance

This allowance is similar to the percent-of-production allowance, but is designed for boat builders with very small production volumes. The only difference with the above allowance is that the 80-percent allowance described above may be exceeded, as long as sales do not exceed either 10 engines per year or 20 engines over five years (2006 to 2010). This applies only to engines less than or equal to 2.5 liters per cylinder.

c. Existing inventory and replacement engine allowance

Small-volume boat builders may sell their existing inventory after the implementation date of the new standards. However, no purposeful stockpiling of uncertified engines is permitted. This provision is intended to allow small boat builders the ability to turn over engine designs.

d. Hardship relief provision

Small boat builders may apply for hardship relief if circumstances outside their control caused the problem (for example, if a supply contract were broken by the engine supplier) and if failure to sell the subject vessels will have a major impact on the company's solvency. This relief allows the boat builder to use an uncertified engine and is considered a mechanism of last resort. These hardship provisions are consistent with those currently in place for post-manufacture marinizers of commercial marine diesel engines.

F. Technical Amendments

The regulations include a variety of amendments to the programs already adopted for marine spark-ignition and diesel engines, as described in the following paragraphs.

1. 40 CFR part 91: outboards and personal watercraft

We have identified four principal amendments to the requirements for outboard and personal watercraft engines. First, we are adding a definition of United States which is “the States, the District of Columbia, the Commonwealth of Puerto Rico, the Commonwealth of the Northern Mariana Islands, Guam, American Samoa, the U.S. Virgin Islands, and the Trust Territory of the Pacific Islands.” This definition is consistent with that included in 40 CFR part 94 for marine diesel engines. This is especially helpful in clearing up questions related to U.S. territories in the Carribean Sea and the Pacific Ocean. Second, we have found two typographical errors in the equations needed for calculating emission levels in 40 CFR 91.419. Third, we are adjusting the regulation language to clarify testing rates for the in-use testing program. The regulations currently specify a maximum rate of 25 percent of a manufacturer’s engine families subject to in-use testing. The revised language states that for manufacturers with fewer than four engine families subject to in-use testing, the maximum testing rate is one family per year in place of the percentage calculation. Finally, we are revising the regulatory provision prohibiting emission controls that lead to increases of noxious or toxic compounds that would pose an unreasonable risk to the public, as described in Section II.B.2.

2. 40 CFR part 94: commercial marine diesel engines

We are adopting several regulatory amendments to the program for commercial marine diesel engines. Many of these are straightforward edits for correct grammar and cross references. We are also changing the definition of United States, as described in the previous section.

We are adding a definition for spark-ignition, consistent with the existing definition for compression-ignition, which will allow us to define compression-ignition as any engine that is not spark-ignition. This will help ensure that marine emission standards for the different types of engines fit together appropriately.

The discussion of production-line testing in Section II.C.4 specifies reduced testing rates after two years of consistent good performance. We are extending this provision to commercial marine diesel engines as well.

The test procedures for Category 2 marine engines give a cross-reference to 40 CFR part 92, which defines the procedures for testing locomotives and locomotive engines. Part 92 specifies a wide range of ambient temperatures for testing, to allow for outdoor measurements. We expect all testing of Category 2 marine engines to occur indoors and are therefore adopting a range of 13˚ to 30˚ C (55˚ to 86˚ F) for emission testing.

Finally, we are revising the regulatory provision prohibiting emission controls that lead to increases of noxious or toxic compounds that would pose an unreasonable risk to the public, as described in Section II.B.2.

G. Technological Feasibility

We have concluded that the emission-reduction strategies expected for land-based nonroad diesel engines and commercial marine diesel engines can also be applied to recreational marine diesel engines, such that these emission reductions strategies will provide compliance with recreational marine diesel emission standards. Marine diesel engines are generally derivatives of land-based nonroad and highway diesel engines. Marine engine manufacturers and marinizers make modifications to the engine to make it ready for use in a vessel. These modifications can range from basic engine mounting and cooling changes to a restructuring of the power assembly and fuel management system. Chapters 3 and 4 of the Final Regulatory Support Document discuss this process in more detail. Also, we have collected emission data demonstrating the feasibility of the steady state average standard and not-to-exceed requirements. These data are presented in Chapter 4 of the Final Regulatory Support Document.

1. Implementation schedule

For recreational marine diesel engines, the implementation schedule allows an additional two years of delay beyond the commercial marine diesel standards. This represents up to a five-year lead time relative to the implementation dates of the land-based nonroad standards. This allows time for the carryover of technology from land-based nonroad and commercial marine diesel engines. In addition, these implementation dates represent three to six years of lead time beyond publication of this final rule.

2. Standard levels

Marine diesel engines are typically derived from or use the same technology as land-based nonroad and commercial marine diesel engines and should therefore be able to effectively use the same emission-control strategies. In fact, recreational marine engines can better use the water they operate in as a cooling medium compared with commercial marine, because they are able to use raw-water aftercooling. This can help them reduce charge-air intake temperatures more easily than the commercial models and much more easily than land-based nonroad diesel engines. Cooling the intake charge reduces the formation of NOx emissions and thus indirectly enables other HC and PM control strategies. As a result, baseline recreational engines generally have lower NOx emissions than uncontrolled commercial marine engines. Therefore, we believe that recreational marine engines can meet the same standard levels as are in place for commercial marine engines without sacrificing power or increasing weight of the engine.

3. Technological approaches

We anticipate that manufacturers will meet the new emission standards for recreational marine diesel engines primarily with technology that will be applied to land-based nonroad and commercial marine diesel engines. Much of this technology has already been established in highway applications and is being used in limited land-based nonroad and marine applications. Our analysis of this technology is described in detail in Chapters 3 and 4 of the Final Regulatory Support Document and is summarized here.

By adopting standards that don't go into place until 2006, we are providing engine manufacturers with substantial lead time for developing, testing, and implementing emission-control technologies. This lead time and the coordination of standards with those for land-based nonroad engines allows time for a comprehensive program to integrate the most effective emission-control approaches into the manufacturers' overall design goals related to durability, reliability, and fuel consumption.

Engine manufacturers have already produced limited numbers of low-NOx marine diesel engines. More than 80 of these engines have been placed into service in California through demonstration programs. Through the demonstration programs, we were able to gain some insight into what technologies can be used to meet the new emission standards. Chapter 4 presents data on 25 of these engines tested over the E5 duty cycle. Although only one of these engines has been shown to meet the HC+NOx and PM standards, many of these engines are well below either the HC+NOx or PM standards or are close to meeting both. With further optimization, we believe these engine designs can be used to meet the exhaust emission standards for recreational marine diesel engines.

Highway engines have been the leaders in developing new emission-control technology for diesel engines. Because of the similar engine designs in land-based nonroad and marine diesel engines, it is clear that much of the technological development that has led to lower-emitting highway engines can be transferred or adapted for use on land-based nonroad and marine engines. Much of the improvement in emissions from these engines comes from "internal" engine changes such as variation in fuel-injection variables (injection timing, injection pressure, spray pattern, rate shaping), modified piston bowl geometry for better air-fuel mixing, and improvements intended to reduce oil consumption. Introduction and ongoing improvement of electronic controls have played a vital role in facilitating many of these improvements.

Turbocharging is widely used now in marine applications, especially in larger engines, because it improves power and efficiency by compressing the intake air. Turbocharging may also be used to decrease particulate emissions in the exhaust. Today, marine engine manufacturers generally have to rematch the turbocharger to the engine characteristics of the marine version of a nonroad engine and often will add water jacketing around the turbocharger housing to keep surface temperatures low. Once the nonroad Tier 2 engines are available to the marine industry, matching the turbochargers for the engines will be an important step in achieving low emissions.

Aftercooling is a well established technology for reducing NOx by decreasing the temperature of the charge air after it has been heated during compression. Decreasing the charge-air temperature directly reduces the peak cylinder temperature during combustion, which is the primary cause of NOx formation. Air-to-water and water-to-water aftercoolers are well established for land-based applications. For engines in marine vessels, there are two different types of aftercooling: jacket-water and raw-water aftercooling. With jacket-water aftercooling, the fluid that extracts heat from the aftercooler is itself cooled by ambient water. This cooling circuit may either be the same circuit used to cool the engine or it may be a separate circuit. By incorporating a separate circuit, marine engine manufacturers can further reduce charge-air temperatures. This separate circuit can result in even lower temperatures with raw water as the coolant. This means that ambient water is pumped directly to the aftercooler. Raw-water aftercooling is currently widely used in recreational applications. Because of the access that marine engines have to a large ambient water cooling medium, we anticipate that marine diesel engine manufacturers will largely reduce NOx emissions with aftercooling.

Electronic controls also offer great potential for improved control of engine parameters for better performance and lower emissions. Unit pumps or injectors allow higher-pressure fuel injection with rate shaping to carefully time the delivery of the whole volume of injected fuel into the cylinder. Marine engine manufacturers can take advantage of modifications to the routing of the intake air and the shape of the combustion chamber of nonroad engines for improved mixing of the fuel-air charge. Separate-circuit aftercooling (both jacket-water and raw-water) will likely gain widespread use in turbocharged engines to increase performance and lower NOx.

Fuel injection changes and other NOx control strategies typically reduce engine noise, sometimes dramatically. One important source of noise in diesel combustion is the sound associated with the combustion event itself. When a premixed charge of fuel and air ignites, the very rapid combustion leads to a sharp increase in pressure, which is easily heard and recognized as the characteristic sound of a diesel engine. The conditions that lead to high noise levels also cause high levels of NOx formation.

The impact of the new emission standards on energy is measured by the effect on fuel consumption from complying engines. Many of the marine engine manufacturers are expected to retard engine timing which increases fuel consumption somewhat. Most of the technology changes anticipated in response to the new standards, however, have the potential to reduce fuel consumption as well as emissions. Redesigning combustion chambers, incorporating improved fuel injection systems, and introducing electronic controls provide the engine designer with powerful tools for improving fuel efficiency while simultaneously controlling emission formation. To the extent that manufacturers add aftercooling to non aftercooled engines and shift from jacket-water aftercooling to raw-water aftercooling, there will be a marked improvement in fuel-efficiency. Manufacturers of highway diesel engines have been able to steadily improve fuel efficiency even as new emission standards required significantly reduced emissions.

There are no apparent safety issues associated with the new emission standards. Marine engine manufacturers will likely use only proven technology that is currently used in other engines such as nonroad land-based diesel applications, locomotives, and diesel trucks. The main technological approach will likely be optimization and calibration of their fuel injection and air management systems.

4. Our conclusions

The new emission standards for recreational marine diesel engines reasonably reflect what manufacturers can achieve through the application of available technology to current recreational marine diesel engines. Recreational marine engine manufacturers will need to use the available lead time to develop the necessary emission-control strategies, including transfer of technology from land-based nonroad and commercial marine diesel engines. This development effort will require not only achieving the targeted emission levels, but also ensuring that each engine will meet all performance and emission requirements over its useful life. As discussed in Section IX, the new standards represent significant reductions compared with baseline emission levels.

Based on information currently available, we conclude it is feasible for recreational marine diesel engine manufacturers to meet the new emission standards using combinations of technological approaches discussed above and in Chapters 3 and 4 of the Final Regulatory Support Document. While the technologies described above are expected to yield the full degree of emission reduction anticipated, it is possible that manufacturers may also rely on a modest degree of fuel-injection timing retard as a strategy for complying with emission standards. This is due to variations in engine designs and baseline injection timing. For instance, an engine with very advanced injection timing in its baseline configuration would likely need to employ some timing retard to meet the standards.

The transfer of technology from land-based nonroad and commercial marine engines is an important factor in our determination that the recreational marine diesel engine standards are feasible. Most marine diesel engine models also serve in land-based applications. Sales of land-based versions of these engines are usually much greater than those of the marine counterpart versions, so manufacturers typically focus their primary technology development efforts on their land-based products. Manufacturers then modify these engines for use in marine applications. These changes can be extensive, but they rarely involve basic R&D for new technologies. We do not anticipate the use of advanced technology such as particulate filters and NOx adsorbers on trucks until the 2007 time frame. Therefore, we do not believe that it would be appropriate to implement standards, at this time, that would require the use of advanced technology that has yet to be developed for the higher volume land-based diesel engine market. We would, however, consider this technology in the future for setting further tiers of marine engine emission standards.

In addition, we have incorporated various options that will permit marinizers and boat builders to respond to engine changes in an orderly way. We expect that meeting these requirements will pose a challenge, but one that is feasible taking into consideration the availability and cost of technology, time, noise, energy, and safety.

VII. General Nonroad Compliance Provisions

This section describes a wide range of compliance provisions that apply generally to all the spark-ignition engines and vehicles subject to the new emission standards. Several of these provisions apply not only to manufacturers and importers, but also to equipment manufacturers installing certified engines, remanufacturing facilities, operators, and others.

The regulatory text for the compliance requirements for Large SI engines and recreational vehicles are in a new Part 1068 of Title 40, entitled "General Compliance Programs for Nonroad Engines." The compliance provisions for recreational marine diesel engines are generally the same as those already adopted for commercial marine diesel engines (40 CFR part 94).

The following discussion of the general nonroad provisions follows the regulatory text. For ease of reference, the subpart designations for 40 CFR part 1068 are provided. Where different provisions apply to the marine engines, we note those differences in this section.

A. Miscellaneous Provisions (Part 1068, subpart A)

This subpart contains general provisions to define terms and the scope of application for all of 40 CFR part 1068. Other provisions concern how we handle confidential information, how the EPA Administrator delegates decision-making authority, and when we may inspect a manufacturer's facilities, engines, or records.

The process of testing engines and preparing an application for certification requires the manufacturer to make a variety of judgments. This includes, for example, selecting test engines, operating engines between tests, and developing deterioration factors. The regulations describe the methodology we use to evaluate concerns related to how manufacturers use good engineering judgment in cases where the manufacturer has such discretion (see 40 CFR 1068.5 and 40 CFR 94.221). If we find a problem in these areas, we will take into account the degree to which any error in judgment was deliberate or in bad faith. This subpart is consistent with provisions already adopted for light-duty highway vehicles and commercial marine diesel engines.

B. Prohibited Acts and Related Requirements (Part 1068, subpart B)

The provisions in this subpart establish a set of prohibitions for engine manufacturers (including importers), equipment manufacturers, operators, engine rebuilders, and owners/operators to ensure that engines meet the emission standards. These provisions are intended to help ensure that each new engine sold or otherwise entered into commerce in the United States is certified to the relevant standards, that it remains in its certified configuration throughout its lifetime, and that only certified engines are used in the appropriate nonroad equipment.

1. General prohibitions (§1068.101)

This regulation contains several prohibitions consistent with the Clean Air Act. No one may sell a new engine subject to the emission standards (or equipment containing such an engine) in the United States without a valid certificate of conformity issued by EPA, deny us access to relevant records, or keep us from entering a facility to test or inspect engines. In addition, no one may remove or disable a device or design element that may affect an engine's emission levels, or manufacture any device that will make emission controls ineffective, which we consider tampering. Other prohibitions reinforce manufacturers' obligations to meet various certification requirements. We also prohibit selling engine parts that prevent emission-control systems from working properly. Finally, for engines that are excluded because they are used in applications not covered by these regulations (for example, stationary or solely for competition), we generally prohibit using these engines in regulated applications.

These prohibitions are the same as those that apply to other engines we have regulated in previous rulemakings. Each prohibited act has a corresponding maximum penalty as specified in Clean Air Act section 205. As provided for in the Federal Civil Penalties Inflation Adjustment Act of 1990, Pub. L. 10-410, these maximum penalties are periodically adjusted by regulation to account for inflation. The current penalty amount for each violation is $31,500.[85]

2. Equipment manufacturer provisions (§1068.105)

Equipment manufacturers may not sell new equipment with uncertified engines once the emission standards begin to apply. We allow a grace period for equipment manufacturers to use up their supply of uncertified engines, as long as they follow their normal inventory practices for buying engines.

We require equipment manufacturers to observe the engine manufacturers' emission-related installation specifications to ensure that the engine remains in its certified configuration. This may include such things as radiator specifications, placement of catalytic converters, diagnostic signals and interfaces, and steps to minimize evaporative emissions.

If equipment manufacturers install a certified engine in a way that obscures the engine label, they must add a duplicate label on the equipment.

If equipment manufacturers don't fulfill the responsibilities we describe in this section, we consider them to be violating one or more of the prohibited acts described above.

[85]EPA acted to adjust the maximum penalty amount in 1996 (61 FR 69364, December 31, 1996) and 2002 (67 FR 41343, June 18, 2002). See also 40 CFR part 19.

3. In-service engines (§1068.110)

The regulations prevent manufacturers from requiring owners to use any certain brand of aftermarket parts and give the manufacturer responsibility for engine servicing related to emissions warranty, leaving the responsibility for all other maintenance with the owner. This regulation also reserves our right to do testing (or require testing) to determine compliance with emission standards and investigate potential defeat devices, as authorized by the Act.

4. Engine rebuilding (§1068.120)

We are establishing rebuild provisions for all the nonroad engines subject to the emission standards in this final rule. This approach is similar to what applies to heavy-duty highway engines, nonroad diesel engines, and commercial marine diesel engines. This is necessary to prevent an engine rebuilder from rebuilding engines in a way that disables the engine's emission controls or compromises the effectiveness of the emission-control system. For businesses involved in commercial engine rebuilding, we are adopting minimal recordkeeping requirements so rebuilders can show that they comply with regulations.

In general, we require anyone rebuilding a certified engine to restore it to its original (or a lower-emitting) configuration. We are adding unique requirements for rebuilders to replace some critical emission-control components such as fuel injectors and oxygen sensors in all rebuilds for engines that use those technologies, unless there is reason to believe that those components are still working properly. We also require that rebuilders replace an existing catalyst if there is evidence that it is not functional; for example, if a catalyst has lost its physical integrity with loose pieces rattling inside, it would need to be replaced.

The rebuilding provisions define good rebuilding practices to avoid violating the prohibition on "removing or disabling" emission-control systems. We are therefore extending these provisions to individuals who rebuild their own engines, but without any recordkeeping requirements.

C. Exemptions (Part 1068, subpart C)

We are including several exemptions for certain specific situations. Most of these are consistent with previous rulemakings. We highlight the new or different provisions in the following paragraphs. In general, exempted engines must comply with the requirements only in the sections related to the exemption. Note that additional restrictions may apply to importing exempted engines (see Section VII.D). Also, we may require manufacturers (or importers) to add a permanent label describing that the engine is exempt from emission standards for a specific purpose. In addition to helping us enforce emission standards, this helps ensure that imported engines clear Customs without difficulty.

1. Testing

Anyone may request an exemption for engines used only for research or other investigative purposes.

2. Manufacturer-owned engines

Engines that are used by engine manufacturers for development or marketing purposes may be exempted from regulation if they are maintained in the manufacturers' possession and are not used for any revenue-generating service.

3. Display engines

Anyone may request an exemption for engines intended for only for display.

4. National security

In general, engines installed in combat-related equipment are exempt from emission standards. In addition, engine manufacturers may request and receive an exemption for other engines if they are needed by an agency of the federal government responsible for national defense. The request for exemptions in these cases must include the endorsement of the procuring government agency.

5. Exported engines

Engines that will be exported to countries that don't have the same emission standards as those that apply in the United States are exempted without a request. This exemption is not available if the destination country has the same emission standards as those in the United States.

6. Competition engines

New engines used solely for competition are generally excluded or exempted from regulations that apply to nonroad engines. For purposes of our certification requirements, manufacturers receive an exemption if they can show that they produce an engine model specifically for use solely in competition. In addition, engines that have been modified for use in competition are exempt from the prohibition against tampering described above (without need for request). The literal meaning of the term "used solely for competition" would apply for these modifications. We therefore do not allow anyone to use the engine for anything other than competition once it has been modified. This also applies to someone who later buys the engine, so we require the person modifying the engine to remove or deface the original engine label and inform a subsequent buyer in writing of the conditions of the exemption.

7. Replacement engines

An exemption is available to engine manufacturers without request if that is the only way to replace an engine from the field that was produced before the current emission standards took effect. If less stringent standards applied to the old engine when it was new, the replacement engine must at a minimum meet those standards.

8.	Hardship related to economic burden

There are two types of hardship provisions. The first type of hardship program allows small businesses to petition EPA for up to three years of additional lead time to comply with the standards. A small manufacturer must demonstrate that it has taken all possible business, technical, and economic steps to comply but the burden of compliance costs will have a significant impact on the company's solvency. A manufacturer must provide a compliance plan detailing when and how it will achieve compliance with the standards. Hardship relief may include requirements for reducing emission on an interim basis and/or purchasing and using emission credits. The length of the hardship relief decided during review of the hardship application may be up to one year, with the potential to extend the relief as needed. The second hardship program allows companies to apply for hardship relief if circumstances outside their control cause the failure to comply (such as a supply contract broken by parts supplier) and if the failure to sell the subject engines will have a major impact on the company's solvency. We would, however, not grant hardship relief if contract problems with a specific company prevent compliance for a second time.

9.	Hardship for equipment manufacturers

Equipment manufacturers in many cases depend on engine manufacturers to supply certified engines in time to produce complying equipment by the date emission standards begin to apply. This is especially true for industrial and marine applications. In other programs, equipment manufacturers have raised concerns of certified engines being available too late for equipment manufacturers to adequately accommodate changing engine size or performance characteristics. To address this concern, in unusual circumstances, equipment manufacturers may request up to one extra year before using certified engines if they are not at fault and will face serious economic hardship without an extension.

In addition, we are aware that some manufacturers of nonroad engines are dependent on another engine manufacturer to supply base engines that are then modified for the final application. Much like equipment manufacturers, these "secondary engine manufacturers" may face difficulty in producing certified engines if the manufacturer selling the base engine makes an engine model unavailable with short notice. These secondary manufacturers generally each buy a relatively small number of engines and would therefore not necessarily be able to influence the marketing or sales practices of the engine selling the base engines. In this rulemaking, this is of particular concern for Large SI engine manufacturers subject to new standards in 2004. As a result, we are allowing secondary engine manufacturers to sell uncertified engines or engines certified at emission levels above the standard for a short period after emission standards begin to apply. However, these companies control the final design of the engines, so we would not approve any exemption unless the manufacturer committed to a plan to make up for any calculated loss in environmental benefit. For example, based on an alternate compliance level for 2004 model year engines, we could calculate the number of 2006 model year engines that would need to be certified early to the 2007 emission standards. Provisions similar to these were adopted for commercial marine diesel engines and will apply equally to recreational marine diesel engines. See the regulatory text in 40 CFR 1068.255 and 40 CFR 94.209 for additional information.

D. Imports (Part 1068, subpart D)

In general, the same certification requirements apply to engines and equipment whether they are produced in the U.S. or are imported. This regulation also includes some additional provisions that apply if someone wants to import an exempted or excluded engine. For example, the importer needs appropriate documentation before importing nonconforming engines; this is true even if an exemption for the same reason doesn't require approval for engines produced in the U.S. These declaration forms are available on the Internet at http://www.epa.gov/OMS/imports/ or by phone at 202-564-9660.

All the exemptions described above for new engines also apply to importation, though some of these apply only on a temporary basis. If we approve a temporary exemption, it is available only for a defined period and could require the importer to post bond while the engine is in the U.S. There are several additional exemptions that apply only to imported engines.

- Identical configuration: This is a permanent exemption to allow individuals to import engines that were designed and produced to meet applicable emission standards. These engines may not have the emission label only because they were not intended for sale in the United States. This exemption applies to all the engines covered by 40 CFR part 1068.
- "Antique" engines: We generally treat used engines as new if they are imported without a certificate of conformity. However, this permanent exemption allows for importation of uncertified engines if they are more than 20 years old and still in their original configuration.
- Repairs or alterations: This is a temporary exemption to allow companies to repair or modify engines. This exemption does not allow for operating the engine, except as needed to do the intended work.
- Diplomatic or military: This is a temporary exemption to allow diplomatic or military personnel to use uncertified engines during their term of service in the U.S.
- Engines subject to other programs: This is a temporary exemption that allows someone to import an uncertified engine that will be converted for use in a different application. For example, someone may want to import a land-based nonroad engine to modify it and eventually sell it as a marine engine. This exemption expires when the engine modifications are complete, since one of the following scenarios will apply (1) the company modifying the engine will modify the engine to meet emission standards that apply to the modified engine, (2) the company will have a valid exemption under the program that applies to the modified engine, or (3) the modified engine will not be subject to emission standards, in which case an exemption is no longer necessary.

E. Selective Enforcement Audit (Part 1068, subpart E)

Clean Air Act section 206(b) gives us the discretion in any program with vehicle or engine emission standards to do selective enforcement auditing of production engines. In selective enforcement auditing, we choose an engine family and give the manufacturer a test order detailing a testing program to show that production-line engines meet emission standards. The regulation text describes the audit procedures in greater detail.

We intend generally to rely on manufacturers' testing of production-line engines to show that their production process is producing engines in compliance they comply with emission standards. However, we reserve our right to do selective enforcement auditing if, for example, we have reason to question the emission testing conducted and reported by the manufacturer.

F. Defect Reporting and Recall (Part 1068, subpart F)

In Part 1068, Subpart F, we are adopting defect reporting requirements that obligate manufacturers to tell us when they learn that emission control systems are defective and to conduct investigations under certain circumstances to determine if an emission-related defect is present. We are also requiring that manufacturers use warranty information, parts shipments, and any other information which may be available to trigger these investigations. For the purpose of this subpart, we are considering defective any part or system that does not function as originally designed for the regulatory useful life of the engine or the scheduled replacement interval specified in the manufacturer's maintenance instructions. For recreational vehicles and nonroad spark-ignition engines over 19 kW, this approach to defect reporting takes into account the varying sales volumes of the different products.

We believe the investigation requirement in this rule will allow both EPA and the engine manufacturers to fully understand the significance of any unusually high rates of warranty claims and parts replacement for systems or parts that may have an impact on emissions. We believe that any prudent and responsible engine manufacturer would, and should, conduct a thorough investigation as part of its normal product quality practices when in possession of data indicating an usually high number of recurring parts failures.

In the past, defect reports were submitted based on a very low threshold with the same threshold applicable to all size engine families and with little information about the full extent of the problem. The new approach should result in fewer overall defect reports being submitted by manufacturers than would otherwise be required under the old defect reporting requirements because the number of defects triggering the submission requirement rises with the engine family size.

The defect reporting requirements under other vehicle and engine regulations do not explicitly require investigations or reporting based on information available to the manufacturer about warranty claims or parts shipments. Such information is valuable and readily available to most manufacturers and should be considered when determining whether or not there is a defect of an emission-related part.

We are aware that counting warranty claims and part shipments will likely include many claims that are not emission-related or that do not represent defects, so we are establishing a relatively high threshold for triggering the manufacturer's responsibility to investigate whether there is in fact a real occurrence of an emission-related defect. Manufacturers are not required to count towards the investigation threshold any replacement parts they require to be replaced during the useful life, as specified in the application for certification and maintenance instructions to the owner, because such part shipments clearly do not represent defects.

Subpart F is intended to require manufacturers to use information we would expect them to keep in the normal course of business. We believe in most cases manufacturers will not be required to institute new programs or activities to monitor product quality or performance. A manufacturer that does not keep warranty or replacement part information may ask for our approval to use an alternate defect-reporting methodology that is at least as effective in identifying and tracking potential emissions related defects as the requirements of subpart F. However, until we approve such a request, the thresholds and procedures of subpart F continue to apply.

For engines with rated power below 560 kW, the investigation thresholds in 40 CFR 1068.501 are 4 percent of total production, or 4,000 engines, whichever is less, for any single engine family in one model year. The thresholds are reduced by 50 percent for defects related to aftertreatment devices, because these components typically play such a significant role in controlling engine emissions. For example, for an engine family with a sales volume of 20,000 units in a given model year, the manufacturer must investigate for emission-related defects if there were warranty claims for replacing electronic control units in 800 or more engines or catalytic converters on 400 or more engines. For a family with sales volume of 200,000 units in a given model year, the manufacturer must investigate for emission-related defects if there were warranty claims for replacing electronic control units in 4,000 or more engines or catalytic converters on 2,000 or more engines.

For engines rated above 560 kW, each engine emits much greater levels of emissions, both because of the higher power rating and the fact that these engines generally operate at high load and for long periods. In addition, the engine family for such engines are typically of smaller volume compared to the lower power engines. We are therefore adopting a requirement that manufacturers investigate defects for these engines if they learn of 5 or more defects that may be emission-related, or 1 percent of total production, whichever is greater.

The second threshold in 40 CFR 1068.501 specifies when a manufacturer must report that there is an emission-related defect. This threshold involves a smaller number of engines because each possible occurrence has been screened to confirm that it is an emission-related defect. In counting engines to compare with the defect-reporting threshold, the manufacturer must consider a single engine family and model year. However, when a defect report is required, the manufacturer must report all occurrences of the same defect in all engine families and all model years. For engines with rated power below 560 kW, the threshold for reporting a defect is 0.25 percent of total production for any single engine family, or 250 defects, whichever is less. The thresholds are reduced 50 percent for reporting defects related to aftertreatment devices. For engines with rated power greater than 560kW, the threshold for reporting defects is 0.5 percent of total production, or 2 engines, whichever is greater.

If the number of engines with a specific defect is found to be less than the threshold for submitting a defect report, but information, such as warranty or parts shipment data, later indicates that there may be additional defective engines, all the information must be considered in determining whether the threshold for submitting a defect report has been met. If a manufacturer has actual knowledge from any source that the threshold for submitting a defect report has been met, a defect report must be submitted even if the trigger for investigating has not yet been met. For example, if manufacturers receive from their dealers, technical staff or other field personnel information showing **conclusively** that there is a recurring emission-related defect, they must submit a defect report.

At specified times the manufacturer must also report the open investigations as well as recently closed investigations that did not require a defect report. One manufacturer indicated that investigations of potential defects can sometimes take a long time. We agree and, therefore, are not specifying a time limit for manufacturers to complete their investigations. The periodic reports required by the regulations, however, will allow us to monitor these investigations and determine if it is necessary or appropriate for us to take further action.

In general, we believe this updated approach to defect reporting will decrease the number of defect reports submitted by manufacturers overall while significantly improving their quality and their value to both EPA and the manufacturer.

We are adopting the defect-reporting requirements for recreational marine diesel engines that already apply to Category 1 commercial marine diesel engines (40 CFR 94.403). In general, this requires the manufacturer to report to us if they learn that 25 or more models have a specific defect, without considering what percentage of the total engines that represents. This applies to the occurrence of the same defect and is not constrained by engine family or model year. We believe it would not be appropriate to have different defect-reporting requirements for different types of marine diesel engines, so we are not adopting the defect-reporting provisions described above for recreational marine diesel engines at this time. In the future we may consider whether the defect-reporting methodology described above should apply to recreational and commercial marine diesel engines.

Under Clean Air Act section 207, if we determine that a substantial number of engines within an engine family, though properly used and maintained, do not conform to the appropriate emission standards, the manufacturer will be required to conduct a recall of the noncomplying engine family to remedy the problem. However, we also recognize the practical difficulty in implementing an effective recall program for nonroad engines. It may be difficult to properly identify all the affected owners absent a nationwide registration requirement similar to that for cars and trucks. The response rate for affected owners or operators to an emission-related recall notice is also a critical issue to consider. We recognize that in some cases, recalling noncomplying nonroad engines may not achieve sufficient environmental protection, so our intent in such situations is generally to allow manufacturers to nominate alternative remedial measures to address most potential noncompliance situations. We expect that successful implementation of appropriate alternative remediation would obviate the need for us to make a determination of substantial nonconformity under section 207 of the Act. Alternatives nominated by a manufacturer will be evaluated based on the following criteria. The alternatives should–

(1) represent a new initiative that the manufacturer was not otherwise planning to perform at that time, with a clear connection to the emission problem demonstrated by the engine family in question;

(2) cost more than foregone compliance costs and consider the time value of the foregone compliance costs and the foregone environmental benefit of the engine family;

(3) offset at least 100 percent of the emission exceedance relative to that required to meet emission standards (or Family Emission Limits); and

(4) be possible to implement effectively and expeditiously and to complete in a reasonable time.

These criteria, and any other appropriate factors, will guide us in evaluating projects to determine whether their nature and burden is appropriate to remedy the environmental impact of the nonconformity.

G. Hearings (Part 1068, subpart G)

Manufacturers have the opportunity to challenge our decisions related to implementing this final rule. We are adopting hearing procedures consistent with those currently in place for highway engines and vehicles.

VIII. General Test Procedures

This rule establishes new engine testing regulations in 40 CFR part 1065. These regulations will apply to anyone who tests engines to show that they meet the emission standards for snowmobiles, ATV, motorcycles, or Large SI engines. This includes certification testing, as well as all production-line and in-use testing. See the program descriptions above for testing provisions that are unique to different engine categories. The regulatory text in 40 CFR part 1065 is written recognizing that we may someday apply these procedures more broadly to other EPA engine testing programs. If we decide to apply these provisions to other engines in future rulemaking, we would incorporate necessary additions or changes at that time. Recreational marine diesel engines must be tested using the procedures already adopted in 40 CFR part 94.

A. General Provisions

As we have done in previous programs, we are adopting specific test procedures to define how to measure emissions, but allow alternate procedures if they are shown to be equivalent to our specified procedures. The test procedures in 40 CFR part 1065 are derived from our test procedures in 40 CFR part 86 for highway heavy-duty gasoline engines and light-duty vehicles. The procedures have been simplified (and to some extent generalized) to better fit nonroad engines.

B. Laboratory Testing Equipment

The regulations do not specify the type of engine or chassis dynamometer to use during testing. Rather, they include performance criteria that must be met during each test. These criteria are intended to ensure that deviations from the specified speed and load duty cycle are small.

Measuring emissions during transient operation calls for a greater degree of sophistication than steady-state testing. For chassis testing of recreational vehicles, we are adopting the specifications established in 40 CFR part 86 for highway engines. For Large SI engines, we based the dynamometer specifications around the capabilities of current dynamometers with enhanced control capabilities. While EPA confirmatory testing with transient duty cycles must meet the prescribed specifications, manufacturers may ask for approval to run tests with relaxed requirements for following the trace of the transient duty cycle. Manufacturers would have an incentive to accurately reproduce the test cycle to ensure compliance with emission standards, but would be able to use otherwise invalidated tests if the degree of variance from the test cycle does not call into question the engine’s reported emission levels.

In addition, for transient testing with recreational vehicles and any testing with Large SI engines, the regulations specify that emissions must be measured using a full-dilution constant-volume sampler (CVS) like those used to measure emissions from highway engines. This means that during a test, an engine's exhaust is routed into a dilution tunnel where it is mixed with air and then sampled using a bag sampler system. After the test, the concentrations of HC, CO, and NOx in the bag is measured using conventional laboratory analyzers.

For Large SI engines and snowmobiles, the steady-state test procedures specify measuring emissions with dilute-sampling equipment. Some manufacturers have expressed a preference to continue with their established practice of using raw-sampling equipment and procedures. While we believe dilute-sampling is most appropriate for these engines, the provisions for alternate testing procedures may allow for raw-sampling measurements for steady-state testing. As specified in 40 CFR 1065.10(c)(3) of the regulations, we allow manufacturers to use alternate procedures shown to be equivalent to the specified procedures. We are also including an interim provision for snowmobiles to allow manufacturers to use the raw-sampling procedures in 40 CFR part 91 for a few years before they are required to show equivalence with the dilute-sampling procedures. This option will allow manufacturers to focus their engineering efforts on reducing emissions during the start of the program.

C. Laboratory Testing Procedures

The specific procedures for running emission tests are outlined briefly here, with a more detailed description of the most significant aspects. Before testing the engine, it is necessary to operate it enough to stabilize emission levels or to make it more representative of in-use engines. This is called service accumulation and may take one of two forms. In the first method, a new engine is operated for up to 50 hours as a break-in period. This is done for most or all emission-data engines. The second method is much longer, up to the full useful life, and is done to determine deterioration factors.

Once an engine is ready for testing, it is connected to the dynamometer with its exhaust flowing into the dilution tunnel. The dynamometer is controlled to make the engine follow the specified duty cycle. A continuous sample is collected from the dilution tunnel for each test segment or test mode using sample bags. These bags are then analyzed to determine the concentrations of HC, CO, and NOx.

1. Test speeds

The definition of maximum test speed, where speed is the angular velocity of an engine's crankshaft (usually expressed in revolutions per minute, or rpm), is an important aspect of most duty cycles. Until recently, we relied on engine manufacturers to declare reasonable rated speeds for their engines and then used the rated speed as the maximum test speed. However, to have a more objective measure of an engine's maximum test speed, we have established a specific procedure for measuring this engine parameter.[86]

We define the maximum test speed for any engine to be the single point on an engine's maximum-power versus speed curve that lies farthest away from the zero-power, zero-speed point on a normalized maximum-power versus speed plot. In other words, consider straight lines drawn between the origin (speed = 0, load = 0) and each point on an engine's normalized maximum-power versus speed curve. Maximum test speed is defined at that point where the length of this line reaches its maximum value. For constant-speed engines, maximum test speed is the engine's rated speed.

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[86]See the final rule for commercial marine diesel engines for a broader discussion of maximum test speed (64 FR 73300, December 29, 1999)

Intermediate speed for steady-state duty cycles is defined as the speed at which the engine generates its maximum torque value. However, in cases where the maximum torque occurs at a speed that is less than 60 percent or greater than 75 percent of the rated speed, the intermediate speed is often specified as either 60 or 75 percent of rated speed, whichever is closer to the speed of maximum torque. The maximum test speed described above is used to calculate these percentage values relative to rated speed.

2. Maintenance

As described in Section II.C.1, we are limiting the amount of scheduled maintenance manufacturers may prescribe for their customers to ensure that engines continue to meet emission standards. If manufacturers specify unreasonably frequent maintenance, there would be little assurance that in-use engines would continue to operate at certified emission levels. We also apply these minimum maintenance intervals to engines the manufacturer operates for service accumulation before testing for emissions. For example, manufacturers may not install a new catalyst on a Large SI engine after 2,000 hours of operation, then select that engine for the in-use testing program. Similarly, manufacturers may not replace fuel-system components on a recreational vehicle during the course of service accumulation for establishing deterioration factors. We do not restrict scheduling of routine maintenance items, such as changing engine oil and replacing oil, fuel, or air filters. We may also allow changing spark plugs, even though we are aware that spark plugs may affect emissions.

D. Other Testing Procedures

As noted in earlier sections, we are establishing some special test procedures for field testing situations. These special procedures are designed to apply to specific types of engines, and thus do not apply generally to all engines covered by this rulemaking. You should read the specific applicable section to determine if such special test procedures apply to any specific category of engines or vehicles.

IX. Projected Impacts

This section summarizes the projected impacts of the emission standards. The anticipated reduction in emissions is compared with the projected cost of the program for an assessment of the cost per ton of reducing emissions for this rule. The section includes the results of the analysis for the Final Program. We have also analyzed the impacts of different alternatives for each of the program areas. This analysis of alternatives, for the most part, focused on more or less stringent alternative standards. For recreational marine diesels, the alternatives analyzed were applying draft European standards or implementing our primary program two years earlier. For the Large SI category, the alternative focused on adopting a steady-state only 2007 requirement. For off-highway motorcyles, we analyzed a more-stringent 1.0 g/km standard and a less-stringent 4.0 g/km standard for HC + NOx control. With ATVs, the alternatives presented were a 2.0 g/km and a 1.0 g/km HC + NOx standard. For snowmobiles, we analyzed four alternatives, ranging from only adopting one phase of standards in 2006 to a standard that would require, on average, reductions of 85% HC and 50% CO from baseline emissions. Additional detailed discussion on these alternatives and the results of the alternatives analysis are presented in Chapter 11 of the RSD.

A. Environmental Impact

To estimate nonroad engine and vehicle emission contributions, we used the latest version of our NONROAD emissions model. This model computes emission levels for a wide variety of nonroad engines, and uses information on emission rates, operating data, and population to determine annual emission levels of various pollutants. A more detailed description of the methodology used for projecting inventories and projections for additional years can be found in the Chapter 6 of the Final Regulatory Support Document.

Tables IX.A-1 and IX.A-2 contain the projected emission inventories for calendar year 2010 from the engines and vehicles subject to this rulemaking under the base case (i.e., without the standards taking effect) and assuming the standards take effect. Tables IX.A-3 and IX.A-4 contain the projected emission inventories for calendar year 2020. The percent reductions based on a comparison of estimated emission inventories with and without the emission standards are also presented in each of the tables.

Table IX.A-1
2010 Projected HC and NOx Emissions Inventories (thousand short tons)

Category	HC*			NOx		
	base case	with standards	percent reduction	base case	with standards	percent reduction
Large SI	268	88	67	389	118	70
Snowmobiles	297	250	16	3	4	(16)
ATVs	308	211	31	7	6	11
Off-highway motorcycles	193	155	20	1.1	1.2	(8)
Recreational Marine diesel	1.6	1.5	10	49	46	7
Total	1,066	705	34	450	174	61

* The estimate for Large SI includes both exhaust HC and evaporative HC emissions. The estimates for snowmobiles, ATVs and Off-highway motorcycles includes both exhaust HC and permeation HC emissions. The estimate for recreation marine diesel includes exhaust HC emissions.

Table IX.A-2
2010 Projected CO and PM Emissions Inventories (thousand short tons)

Category	CO			PM		
	base case	with standards	percent reduction	base case	with standards	percent reduction
Large SI	2,022	945	53	1.9	1.9	0
Snowmobiles	775	670	14	7.0	6.7	4
ATVs	1,042	989	5	10.8	7.4	32
Recreational marine diesel	8	8	0	1.3	1.2	6
Off-highway motorcycles	266	239	10	7.3	5.8	20
Total	4,113	2,851	31	28.3	23.0	19

Table IX.A-3

2020 HC and NOx Projected Emissions Inventories (thousand short tons)

Category	HC*			NOx		
	base case	with standards	percent reduction	base case	with standards	percent reduction
Large SI	318	34	89	472	43	91
Snowmobiles	358	149	58	5	10	(101)
ATVs	374	53	86	8	6	25
Off-highway motorcycles	232	117	50	1.3	1.5	(19)
Recreational marine diesel	2.0	1.5	28	61	48	21
Total	1,284	355	72	547	109	80

* The estimate for Large SI includes both exhaust HC and evaporative HC emissions. The estimates for snowmobiles, ATVs and Off-highway motorcycles includes both exhaust HC and permeation HC emissions. The estimate for recreation marine diesel includes exhaust HC emissions.

Table IX.A-4

2020 Projected CO and PM Emissions Inventories (thousand short tons)

Category	CO			PM		
	base case	with standards	percent reduction	base case	with standards	percent reduction
Large SI	2,336	277	88	2.3	2.3	0
Snowmobiles	950	508	46	8.4	4.9	42
ATVs	1,250	1,085	13	13.1	1.9	86
Off-highway motorcycles	321	236	26	8.7	4.4	50
Recreational Marine diesel	9	9	0	1.6	1.3	18
Total	4,866	2,115	56	34.2	14.8	57

As described in Section I, we project there will also be environmental benefits associated with reduced haze in many sensitive areas.

Finally, anticipated reductions in hydrocarbon emissions correspond with reduced emissions of the toxic air emissions referenced in Section I.

B. Cost Estimates

In assessing the economic impact of setting emission standards, we have made a best estimate of the necessary technologies and their associated costs. In making our estimates we have relied on our own technology assessment, which includes information supplied by individual manufacturers and our own in-house testing. Estimated costs include variable costs (for hardware and assembly time) and fixed costs (for research and development, retooling, and certification). The analysis also considers total operating costs, including maintenance and fuel consumption. Cost estimates based on the projected technologies represent an expected change in the cost of engines as they begin to comply with new emission standards. All costs are presented in 2001 dollars. Full details of our cost analysis can be found in Chapter 5 of the Final Regulatory Support Document.

Cost estimates based on the current projected costs for our estimated technology packages represent an expected incremental cost of vehicles in the near term. For the longer term, we have identified factors that will cause cost impacts to decrease over time. First, we project that manufacturers will generally recover their fixed costs over a five-year period, so these costs disappear from the analysis after the fifth year of production. Second, the analysis incorporates the expectation that manufacturers and suppliers will apply ongoing research and manufacturing innovation to making emission controls more effective and less costly over time. Research in the costs of manufacturing unrelated to emissions control technologies has consistently shown that as manufacturers gain experience in production and use, they are able to apply innovations to simplify machining and assembly operations, use lower cost materials, and reduce the number or complexity of component parts (see the Final Regulatory Support Document for additional information).[87] The cost analysis assumes this learning effect applies equally well to the adoption of the technologies associated with this rule by decreasing estimated variable costs by 20 percent starting in the third year of production and an additional 20 percent starting in the sixth year of production.

Table IX.B-1 summarizes the projected near-term per unit average costs to meet the new emission standards. These estimates are based on the manufacturing cost rather than predicting price increase; the costs nevertheless take into account anticipated mark-ups to present retail-price equivalent figures. Long-term impacts on engine costs are expected to decrease as manufacturers fully amortize their fixed costs and learn to optimize their designs and production processes to meet the standards more efficiently. The tables also show our projections of reduced operating costs for some engines (calculated on a net present value basis), which generally results from substantial reductions in fuel consumption.

[87]For further information on learning curves, see Chapter 5 of the Economic Impact, from Regulatory Impact Analysis—Control if Air Pollution from New Motor Vehicles: Tier 2 Motor Vehicle Emission Standards and Gasoline Sulfur Control Requirements, EPA420-R-99-023, December 1999. A copy of this document is included in Air Docket A-2000-01, at Document No. II-A-83. The interested reader should also refer to previous final rules for Tier 2 highway vehicles (65 FR 6698, February 10, 2000), marine diesel engines (64 FR 73300, December 29, 1999), nonroad diesel engines (63 FR 56968, October 23, 1998), and highway diesel engines (62 FR 54694, October 21, 1997).

Table IX.B-1

Estimated Average Cost Impacts of Emission Standards

Standards	Dates	Increased Production Cost per Vehicle*	Lifetime Operating Costs per Vehicle (NPV)
Large SI exhaust	2004	$611	$-3,981
Large SI exhaust	2007	$55	$0
Large SI evaporative	2007	$13	$-56
Snowmobile exhaust (Phase 1)	2006	$73	$-57
Snowmobile exhaust (Phase 2)	2010	$131	$-286
Snowmobile exhaust (Phase 3)	2012	$89	$-191
Snowmobile permeation	2008	$7	$-11
ATV exhaust	2006	$84	$-24
ATV permeation	2008	$3	$-6
Off-highway motorcycle exhaust	2006	$155	$-48
Off-highway motorcycle permeation	2008	$3	$-5
Recreational marine diesel exhaust	2006	$346	$0

*These estimates are for near-term costs. The estimated long-term costs decrease by about 35 percent. Costs presented for the Large SI and snowmobile second-phase standards are incremental to the first-phase standards. Costs for Phase 3 are incremental to Phase 2. These costs numbers may not necessarily reflect actual price increases as manufacturer production costs, perceived product enhancements, and other market impacts will affect actual prices to consumers.

We estimate that the anticipated increase in the near-term cost of producing new Large SI engines for the 2004 standards is estimated to range from $550 to $800, depending on fuel type, with a composite estimated cost of $605. This cost is attributed to upgrading engines to operate with closed-loop fuel systems and three-way catalysts. These technologies also improve the overall performance of these engines, including improvements to fuel economy that result in reduced operating costs that fully offset the additional hardware cost. We further estimate additional costs of $50 for the 2007 standards, which primarily involve additional development time to optimize engines using the same closed-loop systems with three-way catalysts. While these costs are a small percentage of the cost of industrial equipment, we are aware that this may not be insignificant in this very competitive market. Given the compelling advantages of improved performance and reduced operating expenses, however, we believe manufacturers will generally be able to recover their costs over time.[88]

[88]Chapter 5 of the Final Regulatory Support Document describes why we believe market forces haven't already led manufacturers to add fuel-saving technologies to their products.

Projected average near-term costs for ATVs and off-highway motorcycles are $84 and $155 per unit, respectively. Standards are based on the emission-control capability of engines four-stroke engines.[89] Those models that convert from two-stroke to four-stroke technology will see substantial fuel savings in addition to greatly reduced emissions. With an averaging program that allows manufacturers to apply varying degrees of technology to different models, we believe they will be able to tailor emission controls in a way that reflects the performance needs for their products. Fuel savings associated with replacing two-stroke engines with four-stroke engines partially offsets the additional cost of producing these vehicles.

We expect that the near-term cost of the 2006 snowmobile standards will average $73 per snowmobile. These costs are based on a mix of technologies including a small increase in the use of four-stroke and direct injection technology. For other engines we expect manufacturers to lean out the air-fuel mixture, improve carburetion for better fuel control and less production variation, and modify the engine to withstand higher temperatures and potential misfire episodes attributed to enleanment. We expect that the 2010 and 2012 standards will be met through inceasing the application of direct injection two-stroke technology and four-stroke engines on a significant portion of the fleet. We project that the near-term incremental cost of the Phase 2 standards will average $131 per snowmobile and Phase 3 will be $89, although we believe these costs will be fully offset by fuel savings.

Recreational marine diesel engines are expected to see increased costs averaging under $400 per engine in the near-term. We expect manufacturers to meet emission standards by improving fuel injection systems and making general design changes to the geometries, configurations, and calibrations of their engines. These figures are somewhat lower than we have projected for the comparable commercial marine engines, since the recreational models generally already have some of the emission-control technologies needed to meet the emission standards.

The above analysis presents unit cost estimates for each type of engine or vehicle. These costs represent the total set of costs the engine or vehicle manufacturers will bear to comply with emission standards. For those categories with engine-based standards, we do not anticipate significant new costs for equipment manufacturers installing certified engines. Operating costs are also taken into account, but where there is an effect, we project these impacts to involve only cost savings for operators. With current and projected estimates of engine and equipment sales, we translate these costs into projected direct costs to the nation for the new emission standards in any year. A summary of the annualized costs to manufacturers by equipment type is presented in Table IX.B-2. (The annualized costs are determined over the first twenty years that the standards will be in effect. Because the standards take effect in different years for the various categories of equipment covered by this rule, the aggregate annualized cost is calculated over a slightly longer period of time encompassing the first twenty years of each of the standards. For this reason, the aggregate annualized cost is not the sum of the individual annualized costs.) The annual cost savings due to reduced operating expenses start slowly, then increase as greater numbers of compliant engines enter the fleet. Table IX.B-2 also presents a summary of the annualized reduction

[89] The program contains an optional set of standards for off-highway motorcycles which could result in the use of direct injection two-stroke technology in some high-performance applications. Chapter 11.3 provides a cost analysis for this option. The costs are projected to be somewhat higher for this option due to the application of technology to high-performance competition models.

in operating costs. Overall, based on currently available information, we project an annualized net savings to the economy of approximately $200 million per year.

Table IX.B-2
Estimated Annual Cost to Manufacturers and
Annual Savings from Reduced Operating Costs of Emission Standards

Engine Type	Annualized Cost to Manufacturers (millions/year)	Annualized Savings from Reduced Operating Costs (millions/year)
Large SI	$84	$324
Snowmobiles	$36	$47
ATVs	$61	$31
Off-highway motorcycles	$25	$14
Marine Diesel	$7	$0
Aggregate*	$192	$410

* Because the standards take effect in different years for the various categories of equipment, the aggregate annualized cost is calculated over a slightly longer period of time. For this reason, the aggregate annualized cost is not the sum of the individual annualized costs.

C. Cost per Ton of Emissions Reduced

We calculated the cost per ton of emission reductions for the emission standards. For snowmobiles, this calculation is on the basis of HC and CO emissions. For all other engines, we attributed the entire cost of the program to the control of ozone precursor emissions (HC or NOx or both).

Table IX.C-1 presents the near-term discounted cost-per-ton estimates for the various engines covered by the rule. (The aggregate cost-per-ton estimates are over the first 20 years of emission standards.) Reduced operating costs more than offset the increased cost of producing the cleaner engines for Phase 1 Large SI, and Phase 2 and Phase 3 snowmobile engines. The cost to society and the associated cost-per-ton figures for these engines, and the aggregate values for all engines covered by this rule, therefore show a net savings resulting from the emission standards. The table presents these as $0 per ton, rather than calculating a negative value that has no clear meaning.

Table IX.C-1
Estimated Cost-per-Ton of Emission Standards

Standards	Dates	Discounted Reductions per Vehicle (short tons)*	Discounted Cost per Ton of HC+NOx		Discounted Cost per Ton of CO	
			Without Fuel Savings	With Fuel Savings	Without Fuel Savings	With Fuel Savings
Large SI exhaust (Composite of all fuels)	2004	3.07	$240	$0	—	—
Large SI exhaust (Composite of all fuels)	2007	0.80	$80	$80	—	—
Large SI evaporative	2007	0.13	$80	$0	—	—
Snowmobile exhaust	2006	HC: 0.40 CO: 1.02	$90	$20	$40	$10
Snowmobile exhaust	2010	HC: 0.10	$1,370	$0	—	—
Snowmobile exhaust	2012	CO: 0.25	—	—	$360	$0
Snowmobile permeation	2008	0.03	$210	$0	—	—
ATV exhaust	2006	0.21	$400	$290	—	—
ATV permeation	2008	0.02	$180	$0	—	—
Off-highway motorcycle exhaust	2006	0.38	$410	$280	—	—
Off-highway motorcycle permeation	2008	0.01	$230	$0	—	—
Recreational marine diesel	2006	0.44	$670	$670	—	—
Aggregate	—	—	$240	$0	$80	$0

* HC reductions for evaporative and permeation, and HC+NOx reductions for exhaust (except snowmobiles where CO reductions are also presented).

D. Economic Impact Analysis

We performed an analysis to estimate the economic impacts of this final rule on producers and consumers of recreational marine diesel vessels (specifically, diesel inboard cruisers), forklifts, snowmobiles, ATVs, off-highway motorcycles, and society as a whole. This economic impact analysis focuses on market-level changes in price, quantity, and economic welfare (social gains or costs) associated with the regulation. A description of the methodology used can be found in Chapter 9 of the Final Regulatory Support Document prepared for this rulemaking.

We did not perform an economic impact analysis for categories of Large SI nonroad engines other than forklifts, even though those other Large SI engines are also subject to the standards contained in this final rule. As explained in more detail in Chapter 9 of the Final Regulatory Support Document, this was due to the large number of different types of equipment that use Large SI engines and data availability constraints for those market segments. For the sake of completeness, the following analysis reports separate estimates for Large SI engines other than forklifts. Engineering costs are assumed to be equal to economic costs for those engines. This approach slightly overestimates the social costs associated with the relevant standards.

Based on the estimated regulatory costs associated with this rule and the predicted changes in prices and quantity produced in the affected industries, the total estimated annual social gains of the rule in the year 2030 is projected to be $553.5 million (in 2000 and 2001 dollars). The net present value of the social gains for the 2002 to 2030 time frame is equal to $4.9 billion, using a 3% discount rate. This value would be $2.4 billion with a 7% discount rate. The social gains are equal to the fuel savings minus the combined loss in consumer and producer surplus (see Table IX.D-1), taking into account producers' and consumers' changes in behavior resulting from the costs associated with the rule.[90] Social gains do not account for the social benefits (the monetized health and environmental effects of the rule).

[90]Consumer and producer surplus losses are measures of the economic welfare loss consumers and producers, respectively are likely to experience as a result of the regulations. Combined these losses represent an estimate of the economic or social costs of the rule. Note that for the Large SI and recreational vehicle rules, fuel efficiency gains must be netted from surplus losses to estimate the social costs or social gains (in cases where fuel efficiency gains exceed surplus losses) attributable to the rules.

Table IX.D-1
Surplus Losses, Fuel Efficiency Gains, and Social Gains/Costs in 2030[a]

Vehicle Category	Surplus Losses in 2030 ($millions)	Fuel Efficiency Gains in 2030 ($millions)	Social Gains/Costs in 2030[b] ($millions)
Recreational marine diesel vessels	$6.6	$0	($6.6)
Forklifts	$47.8	$420.1	$372.3
Other Large SI	$48.1[c]	$138.4	$90.3
Snowmobiles	$41.9	$135.0	$93.1
ATVs	$47.2	$51.4	$4.2
Off-highway motorcycles	$25.0	$25.2	$0.2
All vehicles total	$216.6	$770.1	$553.5
NPV of all vehicles total[d]	$3,231.4	$8,130.3	$4,898.9
NPV of all vehicles total[e]	$1889.5	$4282.3	$2392.8

[a] Figures are in 2000 and 2001dollars.

[b] Figures in this column exclude estimated social benefits. Numbers in parentheses denote social costs.

[c] Figure is engineering costs; see text for explanation.

[d] Net Present Value is calculated over the 2002 to 2030 time frame using a 3 percent discount rate.

[e] Net Present Value is calculated over the 2002 to 2030 time frame using a 7 percent discount rate.

For most of the engine categories contained in this rule, we expect there will be a fuel savings as manufacturers redesign their engines to comply with emission standards. For ATVs and off-highway motorcycles, the fuel savings will be realized as manufacturers switch from two-stroke to four-stroke technologies. For snowmobiles, the fuel savings will be realized as manufacturers switch some of their engines to more fuel efficient two-stroke technologies and some of their engines to four-stroke technologies. For Large SI engines, the fuel savings will be realized as manufacturers adopt more sophisticated and more efficient fuel systems; this is true for all fuels used by Large SI engines. Overall, we project the fuel savings associated with the anticipated changes in technology to be about 800 million gallons per year once the program is fully phased in. These savings are factored into the calculated costs and costs per ton of reduced emissions, as described above.

E. Do the Benefits Outweigh the Costs of the Standards?

While EPA uses relative cost-effectiveness as the primary manner to take costs into consideration, further insight regarding the standards can be provided by benefit-cost analysis. The purpose of this section is to summarize the methods we used and results we obtained in conducting an analysis of the economic benefits of the changes in emissions from engines covered by this rule, and to compare these economic benefits with the estimated economic costs of the rule. In summary, the results of our analysis indicate that the economic benefits of the final standards will exceed the costs of meeting the standards. The annual estimated benefits we were able to quantify were approximately $10 billion in 2030.

1. What was our overall approach to the benefit-cost analysis?

The basic question we sought to answer in the benefit-cost analysis was, ``What are the net yearly economic benefits to society of the reduction in mobile source emissions likely to be achieved by this final rulemaking?" In designing an analysis to address this question, we selected a future year for analysis (2030) that is representative of full-implementation of the program (i.e., when the Large SI and recreational vehicle fleet is composed of virtually only compliant vehicles).

To quantify benefits, we evaluated PM-related health effects (including directly emitted PM and NOx contribution to particulate nitrate) using a benefits transfer technique. Although we expect economic benefits to exist, we were unable to quantify or to value specific changes in visibility, ozone, CO or air toxics because we did not perform additional air quality modeling.

To evaluate the PM-related health effects, we adopted a benefits transfer technique that relies on the extensive particulate matter air quality and benefits modeling conducted for the highway Heavy Duty Engine/Diesel Fuel final rule.[91] That RIA used an analytical structure and sequence similar to that used in the "section 812 studies" to estimate the total benefits and costs of the full Clean Air Act.[92] In the HD Engine/Diesel Fuel analysis, we used many of the same models and assumptions used in the section 812 studies as well as other Regulatory Impact Analyses (RIAs) prepared by the Office of Air and Radiation. By adopting the major design elements, models, and assumptions developed for the section 812 studies and other RIAs, we have largely relied on methods which have already received extensive review by the independent Science Advisory Board (SAB), by the public, and by other federal agencies. Although the underlying method has experienced significant review, the transfer of values from an existing primary benefits analysis to estimate the benefits of a new program has not had this type of review and the transfer technique introduces additional uncertainties.

2. What are the significant limitations of the benefit-cost analysis?

Every benefit-cost analysis examining the potential effects of a change in environmental protection requirements is limited to some extent by data gaps, limitations in model capabilities (such as geographic coverage), and uncertainties in

[91] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, document EPA420-R-00-026, December 2000. Docket No. A-2000-01, Document No. II-A-13. This document is also available at http://www.epa.gov/otaq/diesel.htm#documents. The transfer technique is described in a memorandum, Dr. Bryan Hubbell, Senior Economist, Estimated Nox, Sox, and PM Emissions Health Damages for Heavy Duty Vehicle Emissions, April 22, 2002. A copy of this letter can be found in Docket A-2000-01, Document IV-A-146.

[92] The section 812 studies include: (1) US EPA, Report to Congress: The Benefits and Costs of the Clean Air Act, 1970 to 1990, October 1997 (also known as the ``Section 812 Retrospective Report"); and (2) the first in the ongoing series of prospective studies estimating the total costs and benefits of the Clean Air Act (see EPA report number: EPA-410-R-99-001, November 1999). See Docket A-99-06, Document II-A-21.

the underlying scientific and economic studies used to configure the benefit and cost models. Deficiencies in the scientific literature often result in the inability to estimate quantitative changes in health and environmental effects, such as potential increases in premature mortality associated with increased exposure to carbon monoxide. Deficiencies in the economics literature often result in the inability to assign economic values even to those health and environmental outcomes which can be quantified. While these general uncertainties in the underlying scientific and economics literatures, which can cause the valuations to be higher or lower, are discussed in detail in the Final Regulatory Support Document and its supporting documents and references, the key uncertainties which have a bearing on the results of the benefit-cost analysis of this final rule include the following:

- The exclusion of potentially significant benefit categories (such as health and ecological benefits of reduction in hazardous air pollutants emissions and ozone; improvements in visibility);
- Errors in measurement and projection for variables such as population growth;
- Uncertainties in the estimation of future year emissions inventories and air quality;
- Uncertainties associated with the transfer of the results of the HD Engine/Diesel Fuel analysis to this program, especially regarding the assumption of similarity in geographic distribution between emissions and human populations and years of analysis;[93]
- Variability in the estimated relationships of health and welfare effects to changes in pollutant concentrations;
- Uncertainties in exposure estimation;
- Uncertainties in applying willingness to pay estimates from National Park and Forest visitors to U.S. recreational participants and uncertainties in average number of activity days per year; and
- Uncertainties associated with the effect of potential future actions to limit emissions.

Despite these uncertainties, we believe the benefit-cost analysis provides a reasonable indication of the expected economic benefits of the final rulemaking in future years under a set of assumptions.

One key area of uncertainty is the value of a statistical life (VSL) for reductions in mortality risk. The adoption of a value for the projected reduction in the risk of premature mortality is the subject of continuing discussion within the economic and public policy analysis community. In accordance with the independent Science Advisory Board advice,[94] we

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[93]In the original HD Engine/Diesel Fuel analysis, we modeled air quality and benefits in 2030. There are sufficient non-linearities and interactions among pollutants in the atmospheric chemistry that introduce additional uncertainties in the quantitative estimate of the benefits in years that were not fully modeled in the original analysis.

[94]SAB advised that the EPA ``continue to use a wage-risk-based VSL as its primary estimate, including appropriate sensitivity analyses to reflect the uncertainty of these estimates," and that ``the only risk characteristic for which adjustments to the VSL can be made is the timing of the risk" (EPA-SAB-EEAC-00-013; a copy of this document can be found in Docket A-99-06, Document No. IV-A-19). In developing our primary estimate of the benefits of premature mortality reductions, we have appropriately discounted over the lag period between exposure and premature mortality. However, an empirical basis that meets the SAB's standards of reliability for adjusting the current $6 million VSL for many of these factors does not yet exist. A discussion of these factors is contained in the RIA and supporting documents. EPA recognizes the need for additional research by the scientific community to

use the value of a statistical life (VSL) for risk reductions in mortality in our primary estimate. Alternative calculations of adjustment for age and other factors are presented in the RIA for the HD Engine/Diesel Fuel rule and in the RSD for this rule. The presentation of the other alternative calculations for certain endpoints seeks to demonstrate how much the overall benefit estimate might vary based on the value EPA has given to a parameter (which has uncertainty associated with it) underlying the estimates for human health and environmental effect incidence and the economic valuation of those effects. These alternative calculations represent conditions that might occur; however, EPA has selected the best values supported by current scientific literature for use in the primary estimate. The primary estimate is the source for our benefits transfer technique.

Even with our efforts to fully disclose the uncertainty in our estimate, our uncertainty presentation method does not provide a definitive or complete picture of the true range of monetized benefits estimates. The set of alternative calculations is only representative of those benefits that we were able to quantify and monetize.

3. What are the benefits in the years leading up to 2030?

The final rule has various cost and emission related components, as described earlier in this section. These components would begin at various times and in some cases would phase in over time. This means that during the early years of the program there would not be a consistent match between cost and benefits, especially where the full vehicle cost would be incurred at the time of vehicle purchase, while the fuel savings along with the emission reductions and benefits resulting from all these costs would occur throughout the lifetime of the vehicle. Because of this inconsistency and our desire to more appropriately match the costs and emission reductions of our program, our analysis uses a future year (2030) when the fleet is nearly fully turned over.

In the years before 2030, the benefits from the final rule will be less than those estimated here, because the compliant vehicle fleet will not be fully phased in, and the overall U.S. population would be smaller. Annualized costs, on the other hand, reach nearly their full value within a few years of program initiation (once all phase-ins are completed). Thus, a benefit-cost ratio computed for the earlier years of the program would be expected to be lower than a ratio based on our 2030 analysis when the fleet has fully turned over. The stream of costs and the limited set of quantified benefits over time are presented in the Final Regulatory Support Document. On the other hand, since the estimated benefits are more than 40 times the costs (excluding fuel savings) in 2030, the emission reduction and cost trends suggest that it is likely that annual benefits would exceed costs from a time early in the life of the program.

4. What were the results of the benefit-cost analysis?

The benefit-cost analysis for the final rule reflects a single year picture of the yearly benefits and costs expected to be realized once the standards have been fully implemented and non-compliant vehicles have all been retired.

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develop additional empirical support for adjustments to VSL for the factors mentioned above.

Table IX.E-1 presents EPA's primary estimate of the benefits of the rule, both the estimated reductions in incidences and the estimated economic value of those incidence reductions. In interpreting the results, it is important to keep in mind the limited set of effects we are able to monetize. Specifically, the table lists the avoided PM-related incidences of health effects and the estimated economic value of those avoided incidences.[95] We present estimates for the reductions for the Large SI category only. As the table indicates, we estimate that the final rule will reduce premature mortality associated with fine PM by around 1,000 incidences per year, produce about 600 fewer cases of chronic bronchitis, and result in significant reductions in minor restricted activity days (with an estimated 1 million fewer cases).[96]

[95]Based upon recent preliminary findings by the Health Effects Institute, the concentration-response functions used to estimate reductions in hospital admissions may over- or underestimate the true concentration-response relationship. See Letter from Dan Greenberg, President, Health Effects Institute, May 30, 2002, attached to letter from Dr. Hopke, dated August 8, 2002. Docket A-2000-01, Document IV-A-145.

[96]Our estimate also incorporates significant reductions in 27,000 fewer cases of lower respiratory symptoms, and 26,600 fewer cases of upper respiratory symptoms in asthmatic children each year. In addition, we estimate that this final rule will reduce 23,400 incidents of asthma attacks each year in asthmatics of all ages from reduced exposure to particles. Additional incidents would be avoided from reduced ozone exposures. Asthma is the most prevalent chronic disease among children and currently affects over seven percent of children under 18 years of age.

Table IX.E-1
EPA Primary Estimate of the Annual Quantified
and Monetized Benefits Associated with Improved PM
Air Quality Resulting from the Large SI/Recreational Vehicle Rule in 2030[a]

PM-related Endpoint	Avoided Incidence [a,c] (cases/year)	Monetary Benefits[a,d] (millions 2002$)
Premature mortality[a] (adults, ages 30 and over)	1,000	$7,510
Chronic bronchitis	640	$280
Hospital Admissions from Respiratory Causes[g]	300	<$10
Hospital Admissions from Cardiovascular Causes[g]	300	<$10
Emergency Room Visits for Asthma	300	<$1
Acute bronchitis (children, ages 8-12)	2,200	<$1
Upper respiratory symptoms (asthmatic children, ages 9-11)	20,600	<$1
Lower respiratory symptoms (children, ages 7-14)	23,700	<$1
Asthma attacks (asthmatics, all ages)[a]	20,600	<$1
Work loss days (adults, ages 18-65)	181,300	$20
Minor restricted activity days (adults, ages 18-65) (adjusted to exclude asthma attacks)[a]	944,400	$50
Other health effects[e]	$U_1+U_2+U_3+U_4$	$B_1+B_2+B_3+B_4$
Monetized Total[f]		$7,880 + **B**

[a] Ozone-related benefits are not included, thus underestimating national benefits. Relative to PM related benefits, ozone benefits have typically accounted for only a small portion of total benefits. However, ozone reductions can have a significant impact on asthma attacks in asthma sufferers, as well as contributing to reductions in the overall number of minor restricted activity days.

[b] The value we are transferring assumes that some of the incidences of premature mortality related to PM exposures occur in a distributed fashion over the five years following exposure, and it embeds an annual three percent discount rate to the value of premature mortality occurring in years after our analysis year.

[c] Incidences are rounded to the nearest 100.

[d] Dollar values are rounded to the nearest 10 million. Monetary benefits account for growth in real GDP per capita through 2030.

[e] The Ui are the incidences and the Bi are the values for the unquantified category i. A detailed listing of unquantified PM, ozone, CO, and HC related health and welfare effects is provided in Table IX-E.2. Many of the HC emitted from these vehicles are also hazardous air pollutants listed in the Clean Air Act.

[f] B is equal to the sum of all unmonetized categories, i.e., Ba+B1+B2+...+Bn.

[g] Based upon recent preliminary findings by the Health Effects Institute, the concentration-response functions used to estimate reductions in hospital admissions may over- or under-estimate the true concentration-response relationship.

Total monetized benefits are driven primarily by the reduction in premature fatalities each year, which account for over 80 percent of total benefits.

This table also indicates with a "B" those additional health and environmental benefits which could not be expressed in quantitative incidence and/or economic value terms. A full listing of the benefit categories that could not be quantified or monetized in our estimate are provided in Table IX.E-2. The final rule may also provide some visibility improvements in Class I areas and near where people live, work, and recreate. A full appreciation of the overall economic consequences of the final standards requires consideration of all benefits and costs expected to result from the new standards, not just those benefits and costs which could be expressed here in dollar terms.

Table IX.E-2
Additional, Non-monetized Benefits of the Large SI/Recreational Vehicle Standards

Pollutant	Unquantified Effects
Ozone Health	Premature mortality[a] Increased airway responsiveness to stimuli Inflammation in the lung Chronic respiratory damage Premature aging of the lungs Acute inflammation and respiratory cell damage Increased susceptibility to respiratory infection Non-asthma respiratory emergency room visits Increased school absence rates
Ozone Welfare	Decreased yields for commercial forests (for example, Western US) Decreased yields for fruits and vegetables Decreased yields for non-commercial crops Damage to urban ornamental plants Impacts on recreational demand from damaged forest aesthetics Damage to ecosystem functions
PM Health	Infant mortality Low birth weight Changes in pulmonary function Chronic respiratory diseases other than chronic bronchitis Cardiac endpoints Morphological changes Altered host defense mechanisms Cancer Non-asthma respiratory emergency room visits

Pollutant	Unquantified Effects
PM Welfare	Visibility in Class I areas Residential and recreational visibility in non-Class I areas Soiling and materials damage Damage to ecosystem functions
Nitrogen and Sulfate Deposition Welfare	Impacts of acidic sulfate and nitrate deposition on commercial forests Impacts of acidic deposition to commercial freshwater fishing Impacts of acidic deposition to recreation in terrestrial ecosystems Reduced existence values for currently healthy ecosystems Impacts of nitrogen deposition on commercial fishing, agriculture, and forests Impacts of nitrogen deposition on recreation in estuarine ecosystems Damage to ecosystem functions
CO Health	Premature mortality[a] Behavioral effects Hospital admissions - respiratory, cardiovascular, and other Other cardiovascular effects Developmental effects Decreased time to onset of angina Non-asthma respiratory ER visits
HC Health[b]	Cancer (benzene, 1,3-butadiene, formaldehyde, acetaldehyde) Anemia (benzene) Disruption of production of blood components (benzene) Reduction in the number of blood platelets (benzene) Excessive bone marrow formation (benzene) Depression of lymphocyte counts (benzene) Reproductive and developmental effects (1,3-butadiene) Irritation of eyes and mucus membranes (formaldehyde) Respiratory irritation (formaldehyde) Asthma attacks in asthmatics (formaldehyde) Asthma-like symptoms in non-asthmatics (formaldehyde) Irritation of the eyes, skin, and respiratory tract (acetaldehyde) Upper respiratory tract irritation and congestion (acrolein)
HC Welfare	Direct toxic effects to animals Bioaccumulation in the food chain Damage to ecosystem function

[a] Premature mortality associated with ozone and carbon monoxide is not separately included in this analysis. In this analysis, we assume that the ACS/Krewski, et al. C-R function for premature mortality captures both PM mortality benefits and any mortality benefits associated with other air pollutants. A copy of Krewski, et a., can be found in Docket A-99-06, Document No. IV-G-75.

[b] Many of the key hydrocarbons related to this rule are also hazardous air pollutants listed in the Clean Air Act.

In summary, EPA's primary estimate of the benefits of the final rule is approximately $7.8 billion in 2030. This estimate accounts for growth in real gross domestic product (GDP) per capita between the present and 2030.

The estimated social cost (measured as changes in consumer and producer surplus) in 2030 to implement the final rule from Table IX.D-1 above is $217 million (2001$). The net social gain, considering fuel efficiency, is $554 million. The monetized benefits are approximately $7.8 billion, and EPA believes there is considerable value to the public of the benefits it could not monetize. The net benefit that can be monetized is $8.4 billion. Therefore, implementation of the final rule is expected to provide society with a net gain in social welfare based on economic efficiency criteria. Table IX.E-3 summarizes the costs, benefits, and net benefits.

The net present value of the future benefits have been calculated using a 3% discount rate over the 2002 to 2030 time frame. The net present value of the social gains is $4,899 million and the net present value of the total annual benefits is $77, 177 million + B. Consequently, the net present value of the monetized net benefits of this program is $82,076 million. If a discount rate of 7% is used, the values above change to $2,393 million for social gains and $40,070 million + B for total benefits, giving a total of $42,463 million.

Table IX.E-3

2030 Annual Monetized Costs, Benefits, and Net Benefits for the Final Rule

	Millions of 2001$[a]
Social Gains[f]	$550
Monetized PM-related benefits[b,c]	$7,880 + $\mathbf{B_{PM}}$
Monetized Ozone-related benefits[b,d]	not monetized **(** $\mathbf{B_{Ozone}}$)
HC-related benefits	not monetized **(** $\mathbf{B_{HC}}$**)**
CO-related benefits	not monetized ($\mathbf{B_{CO}}$)
Total annual benefits	$7,880 + $\mathbf{B_{PM}}$ + $\mathbf{B_{Ozone}}$ + $\mathbf{B_{HC}}$ + $\mathbf{B_{CO}}$
Monetized net benefits[e]	$8,430 + **B**

[a] For this section, all costs and benefits are rounded to the nearest 10 million. Thus, figures presented in this chapter may not exactly equal benefit and cost numbers presented in earlier sections of the chapter.

[b] Not all possible benefits or disbenefits are quantified and monetized in this analysis. Potential benefit categories that have not been quantified and monetized are listed in Table IX-E.2**.** Unmonetized PM- and ozone-related benefits are indicated by B_{PM}. And B_{Ozone}, respectively.

[c] Based upon recent preliminary findings by the Health Effects Institute, the concentration-response functions used to estimate reductions in hospital admissions may over- or under-estimate the true concentration-response relationship.

[d]There are substantial uncertainties associated with the benefit estimates presented here, as compared to other EPA analyses that are supported by specific modeling. This analysis used a benefits transfer technique described in the RSD.

[e] **B** is equal to the sum of all unmonetized benefits, including those associated with PM, ozone, CO, and HC.

[f] The social gains are equal to the fuel savings minus the combined loss in consumer and producer surplus**.**

X. Public Participation

A wide variety of interested parties participated in the rulemaking process that culminates with this final rule. This process provided several opportunities for public comment over a period of more than two years. An Advance Notice of Proposed Rulemaking (65 FR 76797, December 7, 2000) announced our intent to address emissions from these engines. Comments received during this period were considered in the development of the proposal and are discussed in that document. These comments included information received from small businesses as a part of the inter-agency Small Business Advocacy Review Panel process which was completed before we published the proposal and is described below under the discussion of the Regulatory Flexibility Act. The formal comment period and public hearing associated with the proposal provided another opportunity for public input. We have also met with a variety of stakeholders at various points in the process, including state and environmental organizations, engine manufacturers, and equipment manufacturers.

We have prepared a detailed Summary and Analysis of Comments document, which describes the comments we received on the proposal and our response to each of these comments. The Summary and Analysis of Comments is available in the docket for this rule and on the Office of Transportation and Air Quality internet home page at http://www.epa.gov/otaq/.

XI. Statutory and Executive Order Reviews

A. EO 12866: Regulatory Planning and Review

Under Executive Order 12866 (58 FR 51735, October 4, 1993), the Agency must determine whether the regulatory action is "significant" and therefore subject to review by the Office of Management and Budget (OMB) and the requirements of this Executive Order. The Executive Order defines a "significant regulatory action" as any regulatory action that is likely to result in a rule that may:

- Have an annual effect on the economy of $100 million or more or adversely affect in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health or safety, or State, Local, or Tribal governments or communities;
- Create a serious inconsistency or otherwise interfere with an action taken or planned by another agency;
- Materially alter the budgetary impact of entitlements, grants, user fees, or loan programs, or the rights and obligations of recipients thereof; or
- Raise novel legal or policy issues arising out of legal mandates, the President's priorities, or the principles set forth in the Executive Order.

A Final Regulatory Support Document has been prepared and is available in the docket for this rulemaking and at the internet address listed under “ADDRESSES” above. This action was submitted to the Office of Management and Budget for review under Executive Order 12866. Annual initial costs of this rulemaking are estimated to be over $100 million per year but this is offset by operating cost savings of over $400 million dollars per year. Even so, this rule is considered economically significant. Written comments from OMB and responses from EPA to OMB comments are in the public docket for this rulemaking.

B. Paperwork Reduction Act

The information collection requirements (ICR) in this rule will be submitted for approval to the Office of Management and Budget (OMB) under the Paperwork Reduction Act, 44 U.S.C. 3501 *et seq.*

The Agency may not conduct or sponsor an information collection, and a person is not required to respond to a request for information, unless the information collection request displays a currently valid OMB control number. The OMB control numbers for EPA's regulations are listed in 40 CFR part 9 and 48 CFR chapter 15.

The reporting requirements in this final rule do not apply until the Office of Management has approved them. We will publish a document in the Federal Register announcing that the information-collection requirements are approved.

C. Regulatory Flexibility Act (RFA), as Amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), 5 USC 601 et seq.

EPA has determined that it is not necessary to prepare a regulatory flexibility analysis in connection with this final rule. EPA has also determined that this rule will not have a significant economic impact on a substantial number of small entities.

For purposes of assessing the impacts of this final rule on small entities, a small entity is defined as: (1) a small business that meet the definition for business based on SBA size standards; (2) a small governmental jurisdiction that is a government of a city, county, town, school district or special district with a population of less than 50,000; and (3) a small organization that is any not-for-profit enterprise which is independently owned and operated and is not dominant in its field. This rulemaking will affect only the small businesses.

In accordance with section 609 of the RFA, EPA conducted an outreach to small entities and convened a Small Business Advocacy Review (SBAR) Panel prior to proposing this rule, to obtain advice and recommendations of representatives of the small entities that potentially would be subject to the rule's requirements. Through the Panel process, we gathered advice and recommendations from small-entity representatives who would be affected by the provisions in the rule relating to large SI engines and land-based recreational vehicles, and published the results in a Final Panel Report, dated July 17, 2001. EPA had previously convened a separate Panel for marine engines and vessels. This panel also produced a report, dated August 25, 1999. We also prepared an Initial Regulatory Flexibility Analysis (IRFA) in accordance with section 603 of the Regulatory Flexibility Act. The IRFA is found in chapter 8 of the Draft Regulatory Support Document. Both Panel reports and the IRFA have been placed in the docket for this rulemaking (Public Docket A-2000-01, items II-A-85, II-F-22, and III-B-01).

EPA proposed the majority of the Panel recommendations, and took comments on these and other recommendations. The information we received during this rulemaking process indicated that fewer small entities would be significantly impacted by the rule than we had originally estimated. During the SBAR Panel process, a concern was raised that importers would have limited access to certified models for import. We received no comments regarding this concern and believe that the supply of four-stroke engines for ATVs and off-highway motorcycles will continue to increase. As a result, we believe all these companies should be able to find manufacturers that are able to supply them with compliant engines. These importers incur no development costs, and they are not involved in adding emission-control hardware or other variable costs to provide a finished product to market. We also expect that the vehicles they import would have fuel tanks and hoses that comply with the permeation standards. However, even if this were not the case, the additional two or three dollars that it would cost to make them compliant with the permeation standards is trifling in comparison with the normal selling price for these vehicles. They should therefore expect to buy and sell their products with the normal markup to cover their costs and profit. As noted below, we expect all 21 known small-business importers to face compliance costs of less than one percent of their revenues. Thus, EPA has determined that this final rule will not have a significant economic impact on a substantial number of small entities. We also made some changes as a result of comments received on the proposal that we believe will further reduce the level of impact to small entities directly regulated by the rule. These can be found below in Section 5, "Steps Taken to Minimize the Impact on Small Entities."

Although this final rule will not have a significant impact on a substantial number of small entities, EPA has prepared a Small Business Flexibility Analysis that examines the impact of the rule on small entities, along with regulatory alternatives that could reduce that impact. This analysis would meet the requirements for a Final Regulatory Flexibility Analysis (FRFA), had that analysis been required. The Small Business Flexibility Analysis can be found in Chapter 8 of the Final Regulatory Support Document, which is available for review in the docket and is summarized below. The key elements of our Small Business Flexibility Analysis include:

–The need for, and objectives of, the rule.

–The significant issues raised by public comments, a summary of the Agency's assessment of those issues, and a statement of any changes made to the proposed rule as a result of those comments.

–The types and number of small entities to which the rule will apply.

–The reporting, record keeping and other compliance requirement of the rule.

–The steps taken to minimize the impact of the rule on small entities, consistent with the stated objectives of the applicable statute.

A fuller discussion of each of these elements can be found in the Small Business Flexibility Analysis (Chapter 8 of the Final Regulatory Support Document).

1. The need for and objectives of this Rule

EPA began a study of emissions from new and existing nonroad engines, equipment, and vehicles in 1991. In 1994, EPA finalized its finding that nonroad engines as a whole “are significant contributors to ozone or carbon monoxide concentrations” in more than one ozone or carbon monoxide nonattainment area.[97] Clean Air Act section 213 (a)(3) then requires EPA to establish standards for all classes and categories of new nonroad engines that cause or contribute to ozone or CO concentrations in more than one ozone or CO nonattainment area that achieve the greatest degree of emissions reductions achievable taking cost and other factors into account.

Since the finding in 1994, EPA has been engaged in the process of establishing programs to control emissions from nonroad engines used in many different applications. Nonroad categories already regulated include:

- Land-based compression-ignition (CI) engines (such as farm and construction equipment),
- Small land-based spark-ignition (SI) engines (such as lawn and garden equipment and string trimmers),
- Marine engines (outboards, personal watercraft, commercial marine diesel, marine diesel engines under 37 kW)
- Locomotive engines

EPA issued an Advance Notice of Proposed Rulemaking (ANPRM) on December 7, 2000, and a Notice of Proposed Rulemaking (NPRM) on September 14, 2001, which continued the process of establishing standards for nonroad engines and vehicles, with proposed new emission standards for recreational marine diesel engines, recreational vehicles, and other nonroad spark-ignition engines over 19 kW. This final rule includes emission standards and related requirements for these vehicles and engines that are consistent with the requirements of the Act.

2. Summary of Significant Issues Raised by Public Comments

We received comments from engine and equipment manufacturers and consumers, both during the SBAR Panel process and during the comment period after we issued the proposal. Small-volume engine and equipment manufacturers commented on the financial hardships they would face in complying with the proposed regulations. Most requested that we consider hardship provisions, primarily an exemption from or a delay in the implementation of the proposed standards, or certain flexibilities in the certification process. Due to the wide variety of engines, vehicles, and equipment covered by this rulemaking, we decided that a variety of provisions were needed to address the concerns of the small entities involved. Changes to the proposal as a result of comments from small-entity representatives or others are noted below in Section 5 for each of the sectors affected by this rule.

The NPRM proposed only exhaust emission controls for recreational vehicles. However, several commenters raised the issue of control of evaporative emissions related to permeation from fuel tanks and fuel hoses. They maintained that our obligations under section 213 of the Clean Air Act included control of permeation emissions, and pointed to work done by the California ARB on emissions from plastic fuel tanks and rubber fuel line hoses, as well as from portable plastic fuel containers. Our own investigation into hydrocarbon emissions related to permeation of fuel tanks and fuel hoses from recreational land-based and marine applications also supported the concerns raised by the commenters. Therefore, on May

[97] 59 FR 31306 (July 17, 1994).

1, 2002, we published a notice in the Federal Register reopening the comment period and requesting comment on possible approaches to regulating permeation emissions from recreational vehicles. The notice also included the expected costs and emission reductions resulting from these approaches. Commenters were given thirty days from May 1, 2002 to provide comments on the notice. We received comments from several affected businesses, including at least one small entity. These comments have been addressed in this final rulemaking, including several changes made to the provisions as a result of the comments.

c. Numbers and Types of Small Entities Affected

The following table provides an overview of the primary SBA small business categories potentially affected by this regulation.

Table XI.B-1: Primary SBA Small Business Categories Potentially Affected by this Regulation

Industry	NAICS[a] Codes	Defined by SBA as a Small Business If:[b]
Motorcycles and motorcycle parts manufacturers	336991	<500 employees
Snowmobile and ATV manufacturers	336999	<500 employees
Independent Commercial Importers of Vehicles and parts	421110	<100 employees
Nonroad SI engines	333618	< 1,000 employees
Internal Combustion Engines	333618	< 1000 employees
Boat Building and Repairing	336612	< 500 employees
Fuel Tank Manufacturers	336211	<1000 employees

[a]North American Industry Classification System

[b]According to SBA's regulations (13 CFR part 121), businesses with no more than the listed number of employees or dollars in annual receipts are considered "small entities" for purposes of a regulatory flexibility analysis.

The small entities directly regulated by this rule are the following:

a. Recreational Vehicles (ATVs, snowmobiles, and off-highway motorcycles)

The ATV sector has the broadest assortment of manufacturers. There are seven large companies representing over 95 percent of total domestic ATV sales. The remaining 5 percent come from small manufacturers or importers, who tend to import inexpensive, youth-oriented ATVs from China and other Asian nations. We have identified 21 small companies that offer off-highway motorcycles, ATVs, or both products. Annual unit sales for these companies can range from a few hundred to several thousand units per year.

There are three small businesses manufacturing off-highway motorcycles in the U.S. Two of these make only competition models, so do not need to certify their products under this regulation. The remaining off-highway motorcycle manufacturer already offers engines that should be meeting the new emission standards, especially under our provisions allowing design-based certification. There is one small business manufacturing two separate youth ATV models. This company already uses four-stroke engines. Also, the standards are based on emissions per watt hour, which are less costly to meet for models with small-displacement engines. As a result, we expect both of these manufacturers to face compliance costs less than one percent of their revenues.

We expect all 21 small-business importers to face compliance costs less than one percent of their revenues. These companies incur no development costs and they are not involved in adding emission-control hardware or other variable costs to provide a finished product to market. As a result, they should expect to buy and sell their products with the normal mark-up to cover their costs and profit. During the SBAR Panel process, the concern was raised that importers might have limited access to certified models for import. We received no comments confirming this concern and believe that the supply of four-stroke engines for ATVs and off-highway motorcycles will continue to increase; as a result all these companies should be able to find manufacturers that are able to supply compliant engines into the U.S. market.

We further believe that compliance with the permeation standards will not place a significant burden on either the small manufacturers or on the importers. We have estimated the incremental cost of compliance for ATVs and off-highway motorcycles at roughly three dollars per vehicle. This estimate includes shipping, and is based on buying the necessary low-permeability hoses and surface treatment for the fuel tanks from outside suppliers. Thus, no capital outlays are required, and the increase in vehicle cost is insignificant, so that it can easily be passed along to the ultimate consumer. However, to ensure that these requirements do not adversely affect small manufacturers, we are implementing, where they are applicable to permeation, the same flexibility options we proposed for the exhaust emission standards.

Based on available industry information, four major manufacturers account for over 99 percent of all domestic snowmobile sales. The remaining one percent comes from very small manufacturers who tend to specialize in unique and high-performance designs. One potential manufacturer is not a small business, but hopes to produce snowmobiles within the next year. Most of these manufacturers build less than 50 units per year. We have identified three small manufacturers of snowmobiles who are still in business (of five originally identified). Two of these companies specialize in high-performance versions of standard recreational snowmobile types (i.e., travel and mountain sleds). The other manufacturer produces a unique design, which is a small scooter-like snowmobile designed to be ridden standing up. This manufacturer provided no response to repeated outreach efforts to determine potential economic effects of the final rule, but could be expected to use production engines certified to the Small SI standards.

There are thus three small businesses currently producing snowmobiles for the U.S. market. One of these currently makes a mix of two-stroke and four-stroke models and will likely rely on the provision allowing separate standards for certain manufacturers to produce low-emitting engines with a streamlined development effort. Estimated compliance costs for this company are less than one percent of revenues. Costs for the company producing the standup snowmobile should also be less than one percent. The third manufacturer sells a single snowmobile model in addition to a sizable business of supplying aftermarket parts for snowmobiles from other manufacturers. We don't have revenue information for the whole company, but with such low sales volumes, we estimate that this company's compliance costs could reach 4-10 percent of annual snowmobile revenues.

Control of permeation emissions was not part of the SBAR Panel process. We received comments from one small snowmobile manufacturer who stated that it would experience additional hardship due to the permeation standards, because they do not have the sales volume to install the barrier treatment for fuel tanks in-house. They also commented that if shipping and processing of fuel tanks took 3-4 months, it would be difficult for a small business to tie up funds for so long. However, we believe that the permeation control requirements should be relatively easy for small businesses to meet, given the relatively low costs involved ($5 to $7 per sled, based on outside vendor costs). This is insignificant in comparison to the cost of the high-end sleds that this company produces and should not materially affect the company's cash flow. We also believe it is not necessary, or cost-effective, for a small entity to make the capital investments for in-house treatment facilities. Low permeation fuel hoses are available from vendors today, and we would expect that surface treatment would be applied through an outside company, rather than installing a treatment facility in house. In any event, to make sure that these requirements do not adversely affect small manufacturers, we are implementing, where they are applicable to permeation, the same flexibility options we proposed for the exhaust emission standards.

b. Marine Vessels

Marine vessels include the boat, engine, and fuel system. Exhaust emission controls including NTE requirements, as addressed in the August 29, 1999 and July 17, 2001 SBAR Panel Reports, may affect the engine manufacturers and may affect boat builders.

We have determined that at least 16 companies manufacture marine diesel engines for recreational vessels. Nearly 75 percent of diesel engines sales for recreational vessels in 2000 can be attributed to three large companies. Six of the 16 identified companies are considered small businesses as defined by SBA. Based on sales estimates for 2000, these six companies represent approximately 4 percent of recreational marine diesel engine sales. The remaining companies each comprise between two and seven percent of sales for 2000.

We are thus aware of six small businesses producing marine diesel engines that may be considered recreational. Three of these companies produce both commercial and recreational models without significant differences, so we expect them to meet the standards in this final rule with little more than the administrative expenses associated with including recreational models in their commercial engine families. High-performance recreational marine diesel engines already include technologies that help control NOx emissions, so our cost estimates include relatively modest development costs to add new technologies. Moreover, the small-business provisions allowing substantial additional lead time provide an opportunity for these companies to spread development and certification costs over several years. As a result, we expect one small business to have compliance costs approaching one percent and one to have compliance costs between 1 and 3 percent. One very small business could have compliance costs of about four percent of annual revenues.

c. Large Spark-ignition Engines

We are aware of two manufacturers of Large SI engines qualifying as small businesses. One of these companies plans to produce engines that meet the standards adopted by California ARB in 2004, with the possible exception of one engine family. The other company is attempting to restart the production of engines from another failed company. This company did not exist during the SBAR Panel process associated with this rule.

The established company will face relatively small compliance costs as a result of this rule, since California-compliant engines will need only a small amount of additional development effort to meet long-term standards. These costs should be less than one percent of revenues.

The start-up company faces significant development costs, though much of this effort is required to improve the engine enough to sustain a market presence as other manufacturers continue to make improvements to competitive engines. Under the hardship provisions, we expect the start-up company to spread compliance costs over several years to reduce the impact of emission standards. We nevertheless estimate that the compliance costs associated with meeting EPA emission standards are about 5 percent of revenues. Since this manufacturer is operating in a niche market, with customers providing public comments citing the need for these engines, we expect that most of the increased cost of production will be recovered by increased revenues.

d. Result for all Small Entities

For this regulation as a whole, we expect 32 small businesses to have total compliance costs less than 1 percent of their annual revenues. We estimate that one company will have compliance costs between 1 and 3 percent of revenues. Three companies will likely have compliance costs exceeding 3 percent of revenues, but at least one will likely be able to benefit from the relief provisions outlined below. These estimates include the costs for compliance with the permeation standards.

4. Reporting, Record Keeping, and Compliance Requirements

For any emission-control program, we need assurance that the regulated engines will meet the standards. Historically, EPA programs have assigned manufacturers the responsibility to provide these assurances. This final rule includes testing, reporting, and record keeping requirements. Testing requirements for some manufacturers include certification (including deterioration testing) and production-line testing. Reporting and record keeping requirements include test data and technical data on the engines, including defect reporting.

5. Steps Taken to Minimize the Impact on Small Entities

The two SBAR Panels considered a variety of provisions to reduce the burden of complying with new emission standards and related requirements. Some of these provisions (such as emission-credit programs) would apply to all companies, while others would be targeted at the unique circumstances faced by small businesses. A complete discussion of the regulatory alternatives recommended by the Panels can be found in the Final Panel Reports. Summaries of the Panels' recommended alternatives for each of the sectors subject to this action can also be found in their respective sections of the preamble.

The following Panel recommendations are being finalized by the Agency, except for a few items as noted below:

A. Related Federal Rules

The Panel recommended that EPA continue to consult with the CPSC in developing the rule to better understand the scope of the Commission's regulations as they may relate to the competition exemption.

B. Regulatory Flexibility Alternatives

The Panel recommended that EPA consider and seek comments on a wide range of alternatives, including the flexibility options described below. As noted above, we issued a subsequent Federal Register notice dated May 1, 2002 (67 FR 21613), seeking comment on applying permeation control standards for fuel tanks and fuel hoses used on recreational vehicles. The flexibilities listed below for recreational vehicles would generally also apply to those controls, which would effectively extend the panel recommendations to the permeation controls as well.

1). Large SI Engines

The Panel recommended that EPA propose several possible provisions to address concerns that the new EPA standards could potentially place small businesses at a competitive disadvantage to larger entities in the industry. These provisions are described below.

a). Using Certification and Emission Standards from Other EPA Programs

The Panel made several recommendations for this provision. First, the Panel recommended that EPA temporarily expand this arrangement to allow small numbers of constant-speed engines up to 2.5 liters (up to 30kW) to be certified to the Small SI standards. Second, the Panel further recommended that EPA seek comment on the appropriateness of limiting the sales level of 300. Third, the Panel recommended that EPA request comment on the anticipated cap of 30 kW on the special treatment provisions outlined above, or whether a higher cap on power rating is appropriate. Finally, the Panel recommended that EPA propose to allow small-volume manufacturers producing engines up to 30kW to certify to the Small SI standards during the first 3 model years of the program. Thereafter, the standards and test procedures which could apply to other companies at the start of the program would apply to small businesses. We are not adopting this provision and are instead relying on the hardship provisions in the final rule, which will allow us to accomplish the objective of the proposed provision with more flexibility.

b). Delay of Emission Standards

The Panel recommended that EPA propose to delay the applicability of the long-term standards to small-volume manufacturers for three years beyond the date at which they would generally apply to accommodate the possibility that small companies need to undertake further design work to adequately optimize their designs and to allow them to recover the costs associated with the near-term emission standards. We are also folding this provision into the scope of the hardship provision, but have decided to increase the delay to up to four years, depending on the nature of the hardship involved..

c). Production-Line Testing

The Panel made several recommendations for this provision. First, the Panel recommended that EPA adopt provisions allowing more flexibility than is available under the California Large SI program or other EPA programs in general to address the concern that production-line testing is another area where small-volume manufacturers typically face a difficult testing burden. Second, the Panel recommended that EPA allow small-volume manufacturers to have a reduced testing rate if they have consistently good test results from testing production-line engines. Finally, the Panel recommended that EPA allow small-volume manufacturers to use alternative low-cost testing options to show that production-line engines meet emission standards.

d). Deterioration Factors

The Panel recommended that EPA allow small-volume manufacturers to develop deterioration factors based on available emission measurements and good engineering judgment.

e). Hardship Provision

The Panel recommended that EPA propose two types of hardship provisions for Large SI engines. First the Panel recommended that EPA allow small businesses to petition EPA for up to three years of additional lead time to comply with the standards. Second, the Panel recommended that EPA allow small businesses to apply for hardship relief if circumstances outside their control cause the failure to comply (such as a supply contract broken by a parts supplier) and if the failure to sell the subject engines would have a major impact on the company's solvency.

2). Off-Highway Motorcycles and ATVs

The NPRM for this rule discussed several flexibility options for small businesses manufacturing recreational vehicles, based on the SBAR Panel process. When we reopened the comment period on May 1, 2002 to request comment on possible approaches to regulating permeation emissions from recreational vehicles, we did not specifically discuss small business issues. However, it is our intent that these provisions carry over to permeation controls as well.

The Panel made the following recommendations for this subcategory:

a). General Recommendations

(1) The Panel recommended that EPA propose to apply the flexibilities described below to engines produced or imported by small entities with combined off-highway motorcycle and ATV annual sales of less than 5,000 units per model year.

(2) The Panel recommended that EPA request comment on the appropriateness of the 5,000 unit per model year threshold.

(3) The Panel recommended that EPA request comment on allowing small entities with sales in excess of 5,000 units to certify using the flexible approaches described below for a number of engines equal to their 2000 or 2001 sales level.

(4) The Panel recommended that EPA describe and seek comment on the effect of the standards on these entities, including a request for any data and/or related studies to estimate the extent to which sales of their products are likely to be reduced as a result of changes in product price that are attributable to the emission standards.

(5) The Panel recommended that, in the final rule, EPA assess any information received in response to this request for purposes of informing the final rule decision making process on whether additional flexibility (beyond that considered in this report) is warranted.

b). Additional Lead-time to Meet Emission Standards

First, the Panel recommended that EPA propose at least a two-year delay, but seek comment on whether a larger time period is appropriate given the costs of compliance for small businesses and the relationship between importers and their suppliers. Second, the Panel recommended that EPA provide additional time for small-volume manufacturers to revise their manufacturing process, and would allow importers to change their supply chain to acquire complying products. Third, the Panel recommended that EPA request comment on the appropriate length for a delay (lead-time).

c). Design Certification

The Panel recommended that EPA propose to permit small entities to use design-based certification. The Panel also recommended that EPA work with the small-entity representatives and other members of the industry to develop appropriate criteria for such design-based certification.

d). Broaden Engine Families

The Panel recommended that EPA request comment on engine family flexibility and conducting design-based certification emissions testing.

e). Production-Line Testing Waiver

The Panel recommended that EPA propose to provide small manufacturers and small importers a waiver from manufacturer production-line testing. The Panel also recommended that EPA request comment on whether limits or the scope of this waiver are appropriate.

f). Use of Assigned Deterioration Factors During Certification

The Panel recommended that EPA propose to provide small business with the option to use assigned deterioration factors.

g). Using Certification and Emission Standards from Other EPA Programs

The Panel recommended that EPA propose to provide small business with this flexibility through the fifth year of the program and request comment on which of the already established standards and programs are believed to be a useful certification option for the small businesses.

h). Averaging, Banking, and Trading

The Panel recommended that EPA propose to provide small business with the same averaging, banking, and trading program flexibilities that would apply for large manufacturers and request comment on how the provisions could be enhanced for small business to make them more useful.

i). Hardship Provisions

The Panel recommended that EPA propose two types of hardship program for off-highway motorcycles and ATVs: First, EPA should allow small manufacturers and small importers to petition EPA for limited additional lead-time to comply with the standards. Second, EPA should allow small manufacturers and small importers to apply for hardship relief if circumstances outside their control cause the failure to comply (such as a supply contract broken by a parts supplier) and if failure to sell the subject engines or vehicles would have a major impact on the company's solvency.

The Panel also recommended that EPA propose both aspects of the hardship provisions for small off-highway motorcycle and ATV manufacturers and importers and seek comment on the implementation provisions.

3). Marine Vessels

a). Delay Standards for Five Years

The Panel recommended that EPA delay the standards for five years for small businesses.

b). Design-Based Certification

The Panel recommended that EPA allow manufacturers to certify by design and to be able use this to generate credits under this approach. The Panel also recommended that EPA provide adequately detailed design specifications and associated emission levels for several technology options that could be used to certify. Although we proposed this approach, we were unable to specify any technology options for diesel engines that could be used for design-based certification. We requested comment on such designs and received no comment. Therefore, we are not finalizing a design-based certification option. However, we are finalizing the engine dresser provisions and expanding these provisions to include water-cooled turbocharging. This will allow some engines to be exempt from the standards based on design.

c). Broadly Defined Product Certification Families

The Panel recommended that EPA take comment on the need for broadly defined emission families and how these families should be defined.

d). Hardship Provisions

The Panel recommended that EPA propose two types of hardship programs for marine engine manufacturers, boat builders and fuel tank manufacturers: First, that we should allow small businesses to petition us for additional lead time to comply with the standards. Second, EPA should allow small businesses to apply for hardship relief if circumstances outside their control cause the failure to comply (such as a supply contract broken by a parts supplier) and if the failure to sell the subject fuel tanks or boats would have a major impact on the company's solvency. The Panel also recommended that EPA work with small manufacturers to develop these criteria and how they would be used.

e). Burden Reduction Approaches Designed for Small Marinizers of Marine Engines with Respect to NTE Provisions

The Panel recommended that EPA specifically include NTE in a design-based approach.

4). Snowmobiles

As noted above, permeation standards were not part of the original NPRM for this rule, which incorporated recommendations from the SBAR Panel process. When we reopened the comment period on May 1, 2002 to request comment on possible approaches to regulating permeation emissions from recreational vehicles, which would apply to snowmobiles as well as to off-highway motorcycles and ATVs, we did not specifically discuss small business issues. However, it is our intent that the proposed flexibilities for exhaust emissions carry over to permeation controls for all three vehicle categories, to the extent that they are applicable.

a). Delay of Emission Standards

The Panel recommended that EPA propose to delay the standards for small snowmobile manufacturers by two years from the date at which other manufacturers would be required to comply. The Panel also recommended that EPA propose that the emission standards for small snowmobile manufacturers be phased in over an additional two year (four years to fully implement the standard). Thus, the 2006 Phase 1 standards would be phased in at 50/100 percent in 2008/2009, the Phase 2 standards would be phased in at 50/100 percent in 2012/2013, and the Phase 3 standards would be phased in at 50/100 percent in 2014/2015.

b). Design-Based Certification

The Panel recommended that EPA take comment on how design-based certification could be applied to small snowmobile manufacturers, and that EPA work with the small entities in the design and implementation of this concept.

c). Broader Engine Families

The Panel recommended that EPA propose a provision for small snowmobile manufactures that would use relaxed criteria for what constitutes an engine or vehicle family.

d). Elimination of Production-Line Testing Requirements

The Panel recommended that EPA propose that small snowmobile manufacturers not be subject to production-line testing requirements.

e). Use of Assigned DF During Certification

The Panel recommended that EPA propose to allow small snowmobile manufacturers to elect to use deterioration factors determined by EPA to demonstrate end of useful life emission levels, thus reducing development/testing burdens, rather than performing a durability demonstration for each engine family as part of the certification testing requirement.

f). Using Certification and Emission Standards from Other EPA Programs

The Panel recommended that EPA propose to provide small business with the flexibility to use an engine certified to another EPA program without recertifying it in its new application provided that the manufacturer does not alter the engine in such a way as to cause it to exceed the emission standards it was originally certified to meet.

g). Averaging, Banking and Trading

The Panel recommended that EPA propose an averaging, banking and trading program for snowmobiles, and seek comment on additional flexibilities related to emission credits that should be considered for small snowmobile manufacturers.

h). Hardship Provisions

The Panel recommended that EPA propose two types of hardship programs for small snowmobile manufacturers. First, EPA should allow small snowmobile manufacturers to petition EPA for additional lead time to comply with the standards. Second, EPA should allow small snowmobile manufacturers to apply for hardship relief if circumstances outside their control cause the failure to comply (such as a supply contract broken by a parts supplier) and if failure to sell the subject engines or vehicles would have a major impact on the company's solvency.

i). Unique Snowmobile Engines

The Panel recommended that EPA seek comment on an additional provision, which would allow a small snowmobile manufacturer to petition EPA for relaxed standards for one or more engine families. The Panel also recommended that EPA allow a provision for EPA to set an alternative standard at a level between the prescribed standard and the baseline level until the engine family is retired or modified in such a way as to increase emission and for the provision to be extended for up to 300 engines per year per manufacturer would assure it is sufficiently available for those manufacturers for whom the need is greatest. However, we received comment that the limit of 300 is too restrictive to be of much assistance to small businesses. Based on this comment we are adopting a limit for this provision of 600 snowmobiles per year. Finally, the Panel recommended that EPA seek comment on initial and deadline dates for the submission of such petitions. We received no comments in this area, but for clarity have decided to require at least nine months lead time by the petitioner.

5). Conclusion

In summary, considering both exhaust emission and permeation regulations, we have found that only three small entities are likely to be impacted by more than 3 percent of their sales, and the degree of impact is likely to be further reduced by the flexibilities that are being finalized in this rulemaking. Therefore, this final rule will not have a significant economic impact on a substantial number of small entities.

D. Unfunded Mandates Reform Act

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA), P.L. 104-4, establishes requirements for federal agencies to assess the effects of their regulatory actions on state, local, and tribal governments and the private sector. Under section 202 of the UMRA, EPA generally must prepare a written statement, including a cost-benefit analysis, for proposed and final rules with "federal mandates" that may result in expenditures to state, local, and tribal governments, in the aggregate, or to the private sector, of $100 million or more in any one year. Before promulgating an EPA rule for which a written statement is needed, section 205 of the UMRA generally requires EPA to identify and consider a reasonable number of regulatory alternatives and adopt the least costly, most cost-effective, or least burdensome alternative that achieves the objectives of the rule. The provisions of section 205 do not apply when they are inconsistent with applicable law. Moreover, section 205 allows EPA to adopt an alternative other than the least costly, most cost-effective, or least burdensome alternative if the Administrator publishes with the final rule an explanation of why that alternative was not adopted.

Before EPA establishes any regulatory requirements that may significantly or uniquely affect small governments, including tribal governments, it must have developed under section 203 of the UMRA a small government agency plan. The plan must provide for notifying potentially affected small governments, enabling officials of affected small governments to have meaningful and timely input in the development of EPA regulatory proposals with significant federal intergovernmental mandates, and informing, educating, and advising small governments on compliance with the regulatory requirements.

This rule contains no federal mandates for state, local, or tribal governments as defined by the provisions of Title II of the UMRA. The rule imposes no enforceable duties on any of these governmental entities. Nothing in the rule would significantly or uniquely affect small governments.

EPA has determined that this rule contains federal mandates that may result in expenditures of more than $100 million to the private sector in any single year. EPA believes that this rule represents the least costly, most cost-effective approach to achieve the air quality goals of the rule. The costs and benefits associated with the rule are discussed in Section IX and in the Small Business Support Document, as required by the UMRA.

E. EO 13132: Federalism

Executive Order 13132, entitled “Federalism” (64 FR 43255, August 10, 1999), requires EPA to develop an accountable process to ensure “meaningful and timely input by State and local officials in the development of regulatory policies that have federalism implications.” “Policies that have federalism implications” are defined in the Executive Order to include regulations that have “substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government.”

Under Section 6 of Executive Order 13132, EPA may not issue a regulation that has federalism implications, that imposes substantial direct compliance costs, and that is not required by statute, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by State and local governments, or EPA consults with State and local officials early in the process of developing the regulation. EPA also may not issue a regulation that has federalism implications and that preempts State law, unless the Agency consults with State and local officials early in the process of developing the regulation.

Section 4 of the Executive Order contains additional requirements for rules that preempt State or local law, even if those rules do not have federalism implications (i.e., the rules will not have substantial direct effects on the States, on the relationship between the national government and the states, or on the distribution of power and responsibilities among the various levels of government). Those requirements include providing all affected State and local officials notice and an opportunity for appropriate participation in the development of the regulation. If the preemption is not based on express or implied statutory authority, EPA also must consult, to the extent practicable, with appropriate State and local officials regarding the conflict between State law and Federally protected interests within the agency's area of regulatory responsibility.

This rule does not have federalism implications. It will not have substantial direct effects on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government, as specified in Executive Order 13132.

Although Section 6 of Executive Order 13132 does not apply to this rule, EPA did consult with representatives of various State and local governments in developing this rule. EPA has also consulted representatives from STAPPA/ALAPCO, which represents state and local air pollution officials.

F. EO 13175: Consultation and Coordination with Indian Tribal Governments

Executive Order 13175, entitled "Consultation and Coordination with Indian Tribal Governments" (65 FR 67249, November 6, 2000), requires EPA to develop an accountable process to ensure "meaningful and timely input by tribal officials in the development of regulatory policies that have tribal implications." "Policies that have tribal implications" is defined in the Executive Order to include regulations that have "substantial direct effects on one or more Indian tribes, on the relationship between the Federal government and the Indian tribes, or on the distribution of power and responsibilities between the Federal government and Indian tribes."

This rule does not have tribal implications. It will not have substantial direct effects on tribal governments, on the relationship between the Federal government and Indian tribes, or on the distribution of power and responsibilities between the Federal government and Indian tribes, as specified in Executive Order 13175. The emission standards and other related requirements for private businesses in this rule have national applicability and therefore do not uniquely affect the communities of Indian Tribal Governments. Further, no circumstances specific to such communities exist that would cause an impact on these communities beyond those discussed in the other sections of this rule. Thus, Executive Order 13175 does not apply to this rule.

G. EO 13045: Protection of Children from Environmental Health & Safety Risks

Executive Order 13045, "Protection of Children from Environmental Health Risks and Safety Risks" (62 F.R. 19885, April 23, 1997) applies to any rule that (1) is determined to be "economically significant" as defined under Executive Order 12866, and (2) concerns an environmental health or safety risk that EPA has reason to believe may have a disproportionate effect on children. If the regulatory action meets both criteria, Section 5-501 of the Order directs the Agency to evaluate the environmental health or safety effects of the planned rule on children, and explain why the planned regulation is preferable to other potentially effective and reasonably feasible alternatives considered by the Agency.

This rule is not subject to the Executive Order because it does not involve decisions on environmental health or safety risks that may disproportionately affect children.

The effects of ozone and PM on children's health were addressed in detail in EPA's rulemaking to establish the NAAQS for these pollutants, and EPA is not revisiting those issues here. EPA believes, however, that the emission reductions from the strategies in this rulemaking will further reduce air toxics and the related adverse impacts on children's health.

H. EO 13211: Actions that Significantly Affect Energy Supply, Distribution, or Use

This rule is not a "significant energy action" as defined in Executive Order 13211, "Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use" (66 Fed. Reg. 28355 (May 22, 2001)) because it is not likely to have a significant adverse effect on the supply, distribution or use of energy. The aim to reduce emissions from certain nonroad engines and have no effect on fuel formulation, distribution, or use. Generally, the final rule leads to reduced fuel usage due to the improvements in engine-based emission-control technologies.

I. National Technology Transfer and Advancement Act

Section 12(d) of the National Technology Transfer and Advancement Act of 1995 ("NTTAA"), Public Law 104-113, § 12(d) (15 U.S.C. 272 note) directs EPA to use voluntary consensus standards in its regulatory activities unless doing so would be inconsistent with applicable law or otherwise impractical. Voluntary consensus standards are technical standards (such as materials specifications, test methods, sampling procedures, and business practices) that are developed or adopted by voluntary consensus standards bodies. NTTAA directs EPA to provide Congress, through OMB, explanations when the Agency decides not to use available and applicable voluntary consensus standards.

This rule involves technical standards. The following paragraphs describe how we specify testing procedures for engines subject to this rule.

The International Organization for Standardization (ISO) has a voluntary consensus standard that can be used to test Large SI engines. However, the current version of that standard (ISO 8178) is applicable only for steady-state testing, not for transient testing. As described in the Final Regulatory Support Document, transient testing is an important part of the emission-control program for these engines. We are therefore not adopting the ISO procedures in this rulemaking.

Underwriters Laboratories (UL) has adopted voluntary consensus standards for forklifts that are relevant to the new requirements for Large SI engines. UL sets a maximum temperature specification for gasoline and, for forklifts used in certain applications, defines requirements to avoid venting from gasoline fuel tanks. We are adopting a different temperature limit, because the maximum temperature specified by UL does not prevent fuel boiling. We are adopting separate measures to address venting of gasoline vapors, because of UL's provisions to allow venting with an orifice up to 1.78 mm (0.070 inches). We believe forklifts with such a vent would have unnecessarily high evaporative emissions. If the UL standard is revised to address these technical concerns, it would be appropriate to reference the UL standard in our regulations. An additional concern relates to the fact that the UL requirements apply only to forklifts (and not all forklifts in the case of the restriction on vapor venting). EPA regulations would therefore need to, at a minimum, extend any published UL standards to other engines and equipment to which the UL standards would otherwise not apply.

The Gas Processors Association has adopted standards with fuel specifications for liquefied petroleum gas. However, there is no existing regulations requiring suppliers to meet these specifications. Comments received on the rule indicate a high level of concern that in-use fuel quality does not meet the published voluntary standards, so we are not relying on these fuel specifications to define fuels for certification testing.

We are adopting requirements to test off-highway motorcycles and all-terrain vehicles with the Federal Test Procedure, a chassis-based transient test. There is no voluntary consensus standard that would adequately address engine or vehicle operation for suitable emission measurement. Furthermore, we are interested in pursuing an engine-based test procedure for all-terrain vehicles. We intend to develop a new duty cycle for this, because there is no acceptable engine duty cycle today that would adequately represent the way these engines operate. For snowmobiles, we are adopting test procedures based on work that has been published, but not yet adopted as a voluntary consensus standard.

For recreational marine diesel engines, we are adopting the same test procedures that we have established for commercial marine diesel engines (with a new duty cycle appropriate for recreational applications). We are again adopting these procedures in place of the ISO 8178 standard that would apply to these engines. We believe that ISO 8178 relies too heavily on reference testing conditions. Because our test procedures need to represent in-use operation typical of operation in the field, they must be based on a range of ambient conditions. We determined that the ISO procedures are not broadly usable in their current form, and therefore should not be adopted by reference. We remain hopeful that future ISO test procedures will be developed that are usable and accurate for the broad range of testing needed, and that such procedures could then be adopted. We expect that any such development of revised test procedures will be done in accordance with ISO procedures and in a balanced and transparent manner that includes the involvement of all interested parties, including industry, U.S. EPA, foreign government organizations, state governments, and environmental groups. In so doing, we believe that the resulting procedures would be "global" test procedures that can facilitate the free flow of international commerce for these products.

J. Congressional Review Act

The Congressional Review Act, 5 U.S.C. 801 et seq., as added by the Small Business Regulatory Enforcement Fairness Act of 1996, generally provides that before a rule may take effect, the agency promulgating the rule must submit a rule report, which includes a copy of the rule, to each House of the Congress and to the Comptroller General of the United States. EPA will submit a report containing this rule and other required information to the U.S. Senate, the U.S. House of Representatives, and the Comptroller General of the United States prior to publication of the rule in the Federal Register. This rule is a "major rule" as defined by 5 U.S.C. 804(2).

K. Plain Language

This document follows the guidelines of the June 1, 1998 Executive Memorandum on Plain Language in Government Writing. To read the text of the regulations, it is also important to understand the organization of the Code of Federal Regulations (CFR). The CFR uses the following organizational names and conventions.

Title 40—Protection of the Environment
- Chapter I—Environmental Protection Agency
  - Subchapter C—Air Programs. This contains parts 50 to 99, where the Office of Air and Radiation has usually placed emission standards for motor vehicle and nonroad engines.
  - Subchapter U—Air Programs Supplement. This contains parts 1000 to 1299, where we intend to place regulations for air programs in future rulemakings.
    - Part 1048—Control of Emissions from New, Large, Nonrecreational, Nonroad Spark-ignition Engines. Most of the provisions in this part apply only to engine manufacturers.
    - Part 1051—Control of Emissions from Recreational Engines and Vehicles. Most of the provisions in this part apply only to vehicle manufacturers.
    - Part 1065—General Test Procedures for Engine Testing. Provisions of this part apply to anyone who tests engines to show that they meet emission standards.
    - Part 1068—General Compliance Provisions for Engine Programs. Provisions of this part apply to everyone.

Each part in the CFR has several subparts, sections, and paragraphs. The following illustration shows how these fit together.

Part 1048
- Subpart A
  - Section 1048.1
    - (a)
    - (b)
      - (1)
      - (2)
        - (i)
        - (ii)

A cross reference to §1048.1(b) in this illustration would refer to the parent paragraph (b) and all its subordinate paragraphs. A reference to "§1048.1(b) introductory text" would refer only to the single, parent paragraph (b).

List of Subjects

40 CFR Part 89

Environmental protection, Administrative practice and procedure, Confidential business information, Imports, Labeling, Motor vehicle pollution, Reporting and recordkeeping requirements, Research, Vessels, Warranties.

40 CFR Part 90

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Labeling, Reporting and recordkeeping requirements, Research, Warranties.

40 CFR Part 91

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Labeling, Penalties, Reporting and recordkeeping requirements, Warranties.

40 CFR Part 94

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Penalties, Reporting and recordkeeping requirements, Vessels, Warranties.

40 CFR Part 1048

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Incorporation by reference, Labeling, Penalties, Reporting and recordkeeping requirements, Research, Warranties.

40 CFR Part 1051

Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Incorporation by reference, Labeling, Penalties, Reporting and recordkeeping requirements, Warranties.

40 CFR Part 1065

Environmental protection, Administrative practice and procedure, Incorporation by reference, Reporting and recordkeeping requirements, Research.

40 CFR Part 1068

Environmental protection, Administrative practice and procedure, Confidential business information, Imports, Motor vehicle pollution, Penalties, Reporting and recordkeeping requirements, Warranties.

Dated_____________

ORIGINAL SIGNED BY
CHRISTINE TODD WHITMAN SEPTEMBER 13, 2002

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Christine Todd Whitman
Administrator.