The EPA Administrator signed the following proposed rule on September 14, 2001. It is being submitted for publication in the *Federal Register*. While EPA has taken steps to ensure the accuracy of this Internet version of the rule, it is not the official version of the rule for purposes of public comment. 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* in the first week of October 2001. 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-   ]

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: Notice of Proposed Rulemaking.

SUMMARY: In this action, we are proposing emission standards for several groups of nonroad engines that cause or contribute to air pollution but that have yet to be regulated by EPA. These engines include large spark-ignition engines such as those used in forklifts and airport tugs; recreational vehicles using spark-ignition engines such as off-highway motorcycles, all-terrain vehicles, and snowmobiles; and recreational marine diesel engines. Nationwide, engines and vehicles in these various categories contribute to ozone, CO, and PM nonattainment. These pollutants cause a range of adverse health effects, especially in terms of respiratory impairment and related illnesses. The proposed standards will help states achieve air quality standards. In addition, the proposed standards will help reduce acute exposure to CO, air toxics, and PM for operators and other people close to the emission source. They will also help address other environmental problems, such as visibility impairment in our national parks.

We expect that manufacturers will be able to maintain or even improve the performance of their products when producing engines and equipment meeting the proposed standards. In fact, many engines will substantially reduce their fuel consumption, partially or completely offsetting any costs associated with the emission standards. Overall, we estimate the gasoline-equivalent fuel savings associated with the anticipated changes in technology resulting from this rule would be about 730 million gallons per year once the program is fully phased in. The proposal also has several provisions to address the unique limitations of small-volume manufacturers.

DATES:
Hearings: We will hold a public hearing in the Washington, DC area on October 24. We will hold a second public hearing on October 30 in Denver, CO.

Comments: Send written comments on this notice by December 19, 2001.

See Section X.B for more information about public hearings and written comments.

ADDRESSES:
Comments: You may send written comments in paper form or by e-mail. We must receive them by the date indicated under “DATES” above. Send paper copies of written comments (in

duplicate if possible) to the contact person listed below. You may also submit comments via e-mail to "NRANPRM@epa.gov." In your correspondence, refer to Docket A-2000-01.

EPA's Air Docket makes materials related to this rulemaking available for review in Public Docket No. A-2000-01 at the following address: U.S. Environmental Protection Agency (EPA), Air Docket (6102), Room M-1500 (on the ground floor in Waterside Mall), 401 M Street, S.W., Washington, D.C. 20460 between 8:00 a.m. to 5:30 p.m., Monday through Friday, except on government holidays. You can reach the Air Docket by telephone at (202) 260-7548, and by facsimile (202) 260-4400. We may charge a reasonable fee for copying docket materials, as provided in 40 CFR part 2.

Hearings: We will hold a public hearing on October 24, 2001 at Washington Dulles Airport Marriott, Dulles, VA 20166 (703-471-9500). We will hold a second public hearing October 30, 2001 at Doubletree Hotel, 3203 Quebec Street, Denver, CO 80207 (303-321-3333). If you want to testify at a hearing, notify the contact person listed below at least ten days before the date of the hearing. See Section X.B for more information on the public-hearing and comment procedures.

FOR FURTHER INFORMATION CONTACT: Margaret Borushko, U.S. EPA, National Vehicle and Fuels Emission Laboratory, 2000 Traverwood, Ann Arbor, MI 48105; Telephone (734) 214-4334; FAX: (734) 214-4816; E-mail: borushko.margaret@epa.gov

SUPPLEMENTARY INFORMATION:

Regulated Entities

This proposed action would affect companies that manufacture or introduce into commerce any of the engines or vehicles that would be subject to the proposed standards. These include: spark-ignition industrial engines such as those used in forklifts and airport tugs; recreational vehicles such as off-highway motorcycles, all-terrain vehicles, and snowmobiles; and recreational marine diesel engines. This proposed action would also affect companies buying engines for installation in nonroad equipment. There are also proposed 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 SI 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	—	Motorcycles and motorcycle parts 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 particular activities may be regulated by this action, you should carefully examine the proposed 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, Draft 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 proposed 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 official *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

Air pollution is a serious threat to the health and well-being of millions of Americans and imposes a large burden on the U.S. economy. Ground-level ozone, carbon monoxide, and particulate matter are linked to potentially serious respiratory health problems, especially respiratory effects and environmental degradation, including visibility impairment in our precious national parks. Over the past quarter century, state and federal representatives have established emission-control programs that significantly reduce emissions from individual sources. Many of these sources now pollute at only a small fraction of their precontrol rates. This proposal further addresses these air-pollution concerns by proposing national emission standards for several types of nonroad engines and vehicles that are currently unregulated. These include industrial spark-ignition engines such as those used in forklifts and airport tugs; recreational vehicles such as off-highway motorcycles, all-terrain vehicles, and snowmobiles; and recreational marine diesel engines.[1] The proposed standards are a continuation of the process of establishing standards for nonroad engines and vehicles, as required by Clean Air Act section 213(a)(3). All the nonroad engines subject to this proposal are still unregulated emission sources.

Nationwide, these engines are a significant source of mobile-source air pollution. They currently account for about 13 percent of mobile-source hydrocarbon (HC) emissions, 6 percent of mobile-source carbon monoxide (CO) emissions, 3 percent of mobile-source oxides of nitrogen (NOx) emissions, and 1 percent of mobile-source particulate matter (PM) emissions.[2] The proposed standards will reduce exposure to these emissions and help avoid a range of adverse health effects associated with ambient ozone, CO, and PM levels, especially in terms of respiratory impairment and related illnesses. In addition, the proposed standards will help reduce acute exposure to CO, air toxics, and PM for persons who operate or who work with or are otherwise active in close proximity to these engines. They will also help address other environmental problems associated with these engines, such as visibility impairment in our national parks and other wilderness areas where recreational vehicles and marine engines are often used.

This proposal follows a final finding published on December 7, 2000 (65 FR 76790). Under this finding, EPA found that industrial spark-ignition (SI) engines rated above 19 kilowatts (kW), as well as all land-based recreational nonroad spark-ignition engines, cause or

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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]While we characterize emissions of hydrocarbons, this can be used as a surrogate for volatile organic compounds (VOC), which is broader group of compounds.

contribute to air quality nonattainment in more than one ozone or carbon monoxide (CO) nonattainment area. We also found that particulate matter (PM) emissions from these engines cause or contribute to air pollution that may reasonably be anticipated to endanger public health or welfare.

This proposal also follows EPA's Advance Notice of Proposed Rulemaking (ANRPM) published on December 7, 2000 (65 FR 76797). In that Advance Notice, we provided an initial overview of possible regulatory strategies for the nonroad vehicles and engines and invited early input to the process of developing standards. We received comments on the Advance Notice from a wide variety of stakeholders, including the engine industry, the equipment industry, various governmental bodies, environmental groups, and the general public. The Advance Notice, the related comments, and other new information provide the framework for this proposal.

B. How Is this Document Organized?

This proposal covers engines and vehicles that vary in design and use, and many readers may be interested in only one or two of the applications. For the purpose of this proposal, we have chosen to group engines by common application (e.g., recreational land-based engines, marine engines, large spark-ignition engines used in commercial applications). We have attempted to organize the document in a way that allows each reader to focus on the applications of particular interest. The Air Quality discussion in Section II is general in nature, however, and applies to all the categories covered by this proposal.

The next four sections contain our proposal for the nonroad engines that are the subject of this action. Sections III contains some general concepts that are relevant to all of the nonroad engines covered by this proposal. Section IV through VI present information specific to each of the nonroad applications covered by the proposal, 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 proposal. 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 this section.

Section IX summarizes the projected impacts and a discussion of the benefits of this proposal. Finally, Sections X and XI contain information about public participation, how we satisfied our administrative requirements, and the statutory provisions and legal authority for this proposal.

The remainder of this Section I summarizes important background information about this proposal, including the engines covered, the proposed standards, and why we are proposing them.

C. What Categories of Vehicles and Engines are Covered in this Proposal?

This proposal presents regulatory strategies for new nonroad vehicles and engines that have yet to be regulated under EPA's nonroad engine programs. This proposal covers 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 proposal, 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 tugs, and various farm, construction, and industrial equipment. This category also includes auxiliary marine engines, but does not include engines used in recreational vehicles. For the purpose of this proposal, we are calling this group of engines "Large SI engines."
- Recreational marine diesel engines.

This proposal 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," "imported," as well as other terms that help define the scope of application of this proposal, is contained in Section III of this preamble.

We intended to include in this proposal emission standards for two additional vehicle categories: new exhaust emission standards for highway motorcycles and new evaporative emission standards for marine vessels powered by spark-ignition engines. Proposals for these two categories are not included in the September 14 deadline mandated by the courts, as is the case for the remaining contents that appear in today's proposed rule. We are committed to issue proposals regarding these categories within the next two to three months. Interested parties will have an opportunity to comment on issues associated with the proposed standards for these two categories during the public review period that will begin after a subsequent proposal or proposals are issued.

D. What Requirements Are We Proposing?

The fundamental requirement for engines under Clean Air Act section 213 is to meet EPA's emission standards. The Act requires that standards 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. Other requirements such as applying for certification, labeling engines, and meeting warranty requirements define a process

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[3]For this proposal, 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.

for implementing the proposed program in an effective way.

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

For recreational vehicles, we are proposing emission standards for snowmobiles separately from off-highway motorcycles and all-terrain vehicles. For snowmobiles, we are proposing a first phase of standards for HC and CO emissions based on the use of clean carburetion or 2-stroke electronic fuel injection (EFI) technology, and a second phase of emission standards for snowmobiles that would involve significant use of direct fuel injection 2-stroke technology, as well as possible limited conversion to 4-stroke engines. For off highway motorcycles and all-terrain vehicles, we are proposing standards that would result in a 50-percent reduction and is based mainly on moving these engines from 2-stroke to 4-stroke technology. In addition, we are proposing a second phase of standards for all-terrain vehicles that would require some catalyst use.

We are also proposing voluntary Blue Sky Series emission standards for recreational marine diesel engines and industrial spark-ignition engines. Blue Sky Series emission standards are intended to encourage the introduction and more widespread use of low-emission technologies. Manufacturers could 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 proposing separate voluntary standards based more on providing consumers with an option of buying low-emission models.

E. Why Is EPA Taking this Action?

There are important public health and welfare reasons supporting the standards proposed in this document. As described in Section II.B, these engines contribute to air pollution which causes public health and welfare problems. Emissions from these engines contribute to ground level ozone and ambient CO and PM levels. Exposure to ground level ozone, CO, and PM can cause serious respiratory problems. These emissions also contribute to other serious environmental problems, including visibility impairment.

We believe existing technology that can be applied to these engines would reduce emissions of these harmful pollutants. Manufacturers can reduce 2-stroke engine emissions by improving fuel management and calibration. In addition, many of the existing 2-stroke engines in these categories can be converted to 4-stroke technology. Finally, there are modifications that can be made to 4-stroke engines, often short of requiring catalysts, that can reduce emissions even further.

F. Putting this Proposal into Perspective

This proposal should be considered in the broader context of EPA's nonroad emission-control programs; state-level programs, particularly in California; and international efforts. Each of these are described in more detail below.

1. EPA's nonroad emission-control programs

a. EPA's nonroad process

Clean Air Act section 213(a)(1) directs us to study emissions from nonroad engines and vehicles to determine, among other things, whether these emissions "cause, or significantly contribute to, air pollution that may reasonably be anticipated to endanger public health or welfare." Section 213(a)(2) further required us to determine whether emissions of CO, VOC, and NOx from all nonroad engines significantly contribute to ozone or CO emissions in more than one nonattainment area. If we determine that emissions from all nonroad engines were significant contributors, section 213(a)(3) then requires us to establish emission standards for classes or categories of new nonroad engines and vehicles that in our judgment cause or contribute to such pollution. We may also set emission standards under section 213(a)(4) regulating any other emissions from nonroad engines that we find contribute significantly to air pollution.

We completed the Nonroad Engine and Vehicle Emission Study, required by Clean Air Act section 213(a)(1), in November 1991.[4] On June 17, 1994, we made an affirmative determination under section 213(a)(2) that nonroad emissions are significant contributors to ozone or CO in more than one nonattainment area. We also determined that these engines make a significant contribution to PM and smoke emissions that may reasonably be anticipated to endanger public health or welfare. In the same document, we set a first phase of emission standards (now referred to as Tier 1 standards) for land-based nonroad diesel engines rated at or above 37 kW. We recently added a more stringent set of Tier 2 and Tier 3 emission levels for new land-based nonroad diesel engines at or above 37 kW and adopted Tier 1 standards for land-based nonroad diesel engines less than 37 kW. Our other emission-control programs for nonroad engines are listed in Table I.F-1. This proposal takes another step toward the comprehensive nonroad engine emission-control strategy envisioned in the Act by proposing an emission-control program for the remaining unregulated nonroad engines.

[4]This study is available in docket A-92-28.

Table I.F-1
EPA's Nonroad Emission-Control Programs

Engine Category	Final Rulemaking	Date
Land-based diesel engines ≥ 37 kW —Tier 1	56 FR 31306	June 17, 1994
Spark-ignition engines ≤19 kW —Phase 1	60 FR 34581	July 3, 1995
Spark-ignition marine	61 FR 52088	October 4, 1996
Locomotives	63 FR 18978	April 16, 1998
Land-based diesel engines —Tier 1 and Tier 2 for engines < 37 kW —Tier 2 and Tier3 for engines ≥ 37 kW	63 FR 56968	October 23, 1998
Commercial marine diesel	64 FR 73300	December 29, 1999
Spark-ignition engines ≤19 kW (Non-handheld) —Phase 2	64 FR 15208	March 30, 1999
Spark-ignition engines ≤19 kW (Handheld) —Phase 2	65 FR 24268	April 25, 2000

b. National standards for marine engines

In the October 1996 final rule for spark-ignition marine engines, we set standards only for outboard and personal watercraft engines. We decided not to finalize emission standards for sterndrive or inboard marine engines at that time. Uncontrolled emission levels from sterndrive and inboard marine engines were already significantly lower than the outboard and personal watercraft engines. We did, however, leave open the possibility of revisiting the need for emission standards for sterndrive and inboard engines in the future.

In December 1999, we published emission standards for commercial marine diesel engines. To allow more time to evaluate the potential impact of the proposed emission limits on the recreational vessel industry, we did not include recreational propulsion marine diesel engines in that rulemaking.

c. National standards for land-based spark-ignition engines

The standards we have set to date for land-based, spark-ignition nonroad engines apply to engines typically used in lawn and garden applications. In adopting these emission standards, we decided not to include engines rated over 19 kW or any engines used in recreational vehicles. The proposed emission-control program in this document addresses these remaining unregulated engines.

2. State initiatives

Under Clean Air Act section 209, California has the authority to regulate emissions from new motor vehicles and new motor vehicle engines. California may also regulate emissions from nonroad engines, with the exception of new engines used in locomotives and new engines used in farm and construction equipment rated under 130 kW.[5] So far, the California Air Resources Board (California ARB) has adopted requirements for four groups of nonroad engines: (1) diesel- and Otto-cycle small off-road engines rated under 19 kW; (2) new land-based nonroad diesel engines rated over 130 kW; (3) land-based nonroad recreational engines, including all-terrain vehicles, snowmobiles, off-highway motorcycles, go-carts, and other similar vehicles; and (4) new nonroad SI engines rated over 19 kW. They have approved a voluntary registration and control program for existing portable equipment.

Other states may adopt emission standards set by California ARB, but are otherwise preempted from setting emission standards for new engines or vehicles. In contrast, there is generally no federal preemption of state initiatives related to the way individuals use individual engines or vehicles.

a. Industrial SI engines

California ARB in 1998 adopted requirements that apply to new nonroad engines rated over 25 hp produced for California starting in 2001. These standards phase in over three years, during which manufacturers show only that engines meet the standards before they start in service. Beginning in 2004, the standards apply to 100 percent of engines sold in California, including a requirement to show that an engine meets emission standards throughout its useful life. As described above, these standards do not apply to engines under 130 kW used in farm or construction equipment. Texas has adopted the California ARB emission standards statewide starting in 2004.

b. Off-highway motorcycles and all-terrain vehicles

California established standards for off-highway motorcycles and all-terrain vehicles which took effect in January 1997 (1999 for vehicles with engines of 90 cc or less). The standards are 1.2 g/km HC and 15.0 g/km CO and are based on the highway motorcycle chassis test procedures. Manufacturers may certify all-terrain vehicles to optional standards, which are based on the utility engine test procedure.[6] These standards are 12 g/hp-hr HC+NOx and 300 g/hp-hr CO, for all-terrain vehicles with engine displacements less than 225 cubic centimeters (cc) and 10 g/hp-hr NC+NOx and 300 g/hp-hr CO, for all-terrain vehicles with engine displacement greater than 225 cc. The utility engine test procedure is the procedure over which Small SI engines are tested. The stringency level of the standards was based on the emissions

[5]The Clean Air Act limits the role states may play in regulating emissions from new motor vehicles and nonroad engines. California is permitted to establish emission standards for new motor vehicles and most nonroad engines; other states may adopt California's programs (sections 209 and 177 of the Act).

[6] 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).

performance of 4-stroke engines and advanced 2-stroke engines equipped with a catalytic converter. California anticipated that the standards would be met initially through the use of high performance 4-stroke engines.

California revisited the program in the 1997 time frame because a lack of certified product from manufacturers was reportedly creating economic hardship for dealerships. The number of certified off-highway motorcycle models was particularly inadequate.[7] In 1998, California revised the program, allowing the use of uncertified products in off-highway vehicle recreation areas with regional/seasonal use restrictions. Currently, noncomplying vehicles can be legally 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 respectively with green and red stickers. Only about one-third of off-highway motorcycles sold in California are certified.

3. Actions in other countries

a. European action - Recreational Marine Engines

The European Commission has proposed emission standards for recreational marine engines, including both diesel and gasoline engines. These requirements would apply to all new engines sold in member countries. The numerical emission standards for recreational diesel marine engines, shown in Table I.F-2, consist of the Annex VI NOx standard for small marine diesel engines, the rough equivalent of Nonroad Diesel Tier 1 emission standards for HC and CO. Emission testing is to be conducted using the ISO D2 duty cycle for constant-speed engines and the ISO E5 duty cycle for all other engines. Table I.F-2 also presents average baseline emissions based on data that we have collected. These data are presented in Chapter 4 of the Draft Regulatory Support Document. We have received comment that we should apply these standards in the U.S., but the proposed European emission standards for recreational marine diesel engines may not result in a decrease in emissions, and may even allow an increase in emissions from engines operated in the U.S.

[7] 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, II-D-08).

Table I.F-2
Proposed European Emission Standards
for Recreational Marine Diesel Engines

Pollutant	Emission Standard (g/kW-hr)	Baseline Emissions (g/kW-hr)
NOx	9.8	8.9
PM	1.4	0.2
HC	1.5[a]	0.3
CO	5.0	1.3

[a] Increases slightly with increasing engine power rating.

b. International Maritime Organization - CI Marine Engines

In response to growing international concern about air pollution and in recognition of the highly international nature of maritime transportation, the International Maritime Organization developed a program to reduce NOx and SOx emissions from marine vessels. No restrictions on PM, HC, or CO emissions were considered. The NOx provisions, contained in Regulation 13 of Annex VI to the International Convention on the Prevention of Pollution from Ships (MARPOL 73/78), specify that each diesel engine with a power output of more than 130 kW installed on a ship constructed on or after January 1, 2000, or that undergoes a major conversion on or after January 1, 2000, must meet the NOx emission standards in Table I.F-3.[8] The Annex does not distinguish between marine diesel engines installed on recreational or commercial vessels; all marine diesel engines above 130 kW would be subject to the standards regardless of their use.

Table I.F-3
MARPOL Annex VI NOx Standards

Engine Speed (n = engine speed, rpm)	NOx (g/kW-hr)
n <130 rpm	17.0
130 rpm$\leq$n<2000 rpm	$45 * n^{(-0.2)}$
n $\geq$ 2000	9.8

After several years of negotiation, the Member States of the International Maritime Organization adopted a final version of Annex VI on September 26, 1997. As stipulated in Article 6 of the Agreement, the Annex will go into force when fifteen States, the combined merchant fleets of which constitute not less than 50 percent of the gross tonnage of the world's

[8]Additional information about the MARPOL Annex VI NOx standards can be found in the documents for our commercial marine diesel standards, which can be found on our website (www.epa.gov/otaq/marine.htm). That website also contains facts sheets and other information about the Annex.

merchant shipping, have ratified it. As of today, three countries have ratified the Annex (Norway, Sweden, Singapore), representing about 7 percent of the world fleet.

Pending entry into force, ship owners and vessel manufacturers are expected to install compliant engines on relevant ships beginning with the date specified in Regulation 13, January 1, 2000. In addition, ship owners are expected to bring existing engines into compliance if the engines undergo a major conversion on or after that date.[9] As defined in Regulation 13 of Annex VI, a major conversion is defined to include those situations when the engine is replaced by a new engine, it is substantially modified, or its maximum continuous rating is increased by more than 10 percent. To facilitate this process, and to allow engine manufacturers to certify their engines before the Annex goes into force, we set up a process for manufacturers to obtain a Statement of Voluntary Compliance.[10] This document will be exchangeable for an Engine International Air Pollution Prevention (EIAPP) certificate once the Annex goes into effect for the United States.

[9]As defined in Regulation 13 of Annex VI, a major conversion means the engine is replaced by a new engine, it is substantially modified, or its maximum continuous rating is increased by more than 10 percent.

[10]For more information about our voluntary certification program, see "guidance for Certifying to MARPOL Annex VI," VPCD-99-02. This letter is available on our website: http://www.epa.gov/otaq/regs/nonroad/marine/ci/imolettr.pdf.

II. Public Health and Welfare Effects of Emissions from Covered Engines

A. Background

This proposal contains regulatory strategies for three sets of new nonroad vehicles and engines that cause or contribute to air pollution but that have not been regulated under EPA's nonroad engine programs. The three sets of nonroad vehicles and engines are:

- *Large Industrial Spark Ignition Engines.* These are spark-ignition nonroad engines rated over 19 kW used in commercial applications. These include engines used in forklifts, electric generators, airport tugs, and a variety of other construction, farm, and industrial equipment. Many of these engines, such as those used in farm and construction equipment, are operated outdoors, predominantly during warmer weather and often in or near heavily-populated urban areas where they contribute to ozone formation and ambient CO and PM levels. These engines are also often operated in factories, warehouses, and large retail outlets throughout the year, where they contribute to high exposure levels to personnel who work with or near this equipment as well as to ozone formation and ambient CO and PM levels. For the purpose of this proposal, we are calling these "Large SI engines."

- *Nonroad Spark-Ignition Recreational Engines*. These are spark-ignition nonroad engines used primarily in recreational applications. These include off-highway motorcycles, all-terrain-vehicles and snowmobiles. Some of these engines, particularly those used on all-terrain vehicles, are increasingly used for commercial purposes within urban areas, especially for mowing lawns and hauling loads. These vehicles are typically used in suburban and rural areas, where they contribute to ozone formation and ambient CO, and PM levels. All these vehicles, and snowmobiles in particular, contribute to visibility impairment problems in our national and state parks. For the purpose of this proposal, we are calling this group of engines "recreational vehicles."

- *Marine Engines*. These are marine diesel engines that are used on recreational vessels such as yachts, cruisers, and other types of pleasure craft. Recreational marine engines are primarily used in warm weather and therefore contribute to ozone formation and PM levels, especially in marinas, which are often located in nonattainment areas.

Nationwide, these engines and vehicles are a significant source of mobile-source air pollution. As described in Section II.C, below, they currently account for about 13 percent of national mobile-source HC emissions, 6 percent of mobile-source CO emissions, 3 percent of mobile-source NOx emissions, and 1 percent of mobile-source PM emissions. Recreational vehicles by themselves account for nearly 10 percent of national mobile-source HC emissions and about 3 percent of national mobile-source CO emissions. Within national parks, snowmobiles are significant contributors to ambient concentrations of fine particulate matter, a leading component of visibility impairment. By reducing these emissions, the proposed standards would provide assistance to states facing ozone and CO air quality problems, which can cause a range of adverse health effects, especially in terms of respiratory impairment and related illnesses. States are required to develop plans to address visibility impairment in national parks, and the reductions proposed in this rule would assist states in those efforts.

In addition, the proposed standards would help reduce acute exposure to CO and air toxics for forklift operators, snowmobile users, national and state park attendants, and other people who may be at particular risk because they operate or work or are otherwise active for long periods of time in close proximity to this equipment. Emissions from these vehicles and equipment can be very high on a per engine basis. In addition, the equipment (e.g., forklifts) is often used in enclosed areas. Similarly, exposure 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. As summarized below and explained in greater detail in the Draft Regulatory Support Document for this proposal, CO emissions have been directly associated with cardisvascular and other health problems, and many types of hydrocarbons are also air toxics.

The standards proposed in this document would require the use of cleaner emission-control technologies. For Large SI engines, we are proposing a two-phase program that will take fuel effects into account. The first phase consists of one set of standards that would apply to all engines regardless of fuel (i.e., gasoline, LPG, CNG). These standards are identical to those recently adopted by California Air Resources Board (CARB) and are based on a steady-state test. The second phase of standards is more stringent than the California standards. The numerical limits differ depending on fuel type and would require optimizing the same emission-control technologies used in Phase 1 but would be based on a transient duty test cycle. These standards would also include new requirements for evaporative emissions and engine diagnostics.

For marine engines, we are proposing to set new standards that would require recreational diesel marine engines to adopt the emission-control technology that will be in use on commercial diesel marine engines.

For nonroad recreational vehicles, we are proposing standards that would require snowmobiles to use cleaner 2-stroke technologies (e.g., clean carburetion, electronic fuel injection). For off-highway motorcycles and all-terrain vehicles, we are proposing standards that would effectively require manufacturers to use more 4-stroke technology for most engines. A second phase of proposed standards for all-terrain vehicles is based on catalyst technology.

When the proposed emission standards are fully implemented in 2020, we expect a 79 percent reduction in HC emissions, 75 percent reduction in NOx emissions, and 56 percent reduction in CO emissions from these engines, equipment, and vehicles (see Section IX below for more details). These emission reductions will reduce ambient concentrations of ozone, CO, and PM fine, which is a health concern and contributes to visibility impairment. The standards will also reduce personal exposure for people who operate or who work with or are otherwise in close proximity to these engines and vehicles.

For the nonroad engines covered by this proposal, the Agency has already established in several previous actions that they cause or contribute to ozone or carbon monoxide pollution in more than one nonattainment area. In three actions in 1996, 1999, and 2000, we made separate determinations that each category of nonroad engines covered by this proposal specifically contributes to ozone and CO nonattainment, and to adverse health effects associated with ambient concentrations of PM. These actions are summarized in Table II.A-1. In addition, pursuant to Section 213(a)(4) of the Act, we are proposing to find that nonroad engines, including construction equipment, farm tractors, boats, planes, locomotives, marine engines, and recreational vehicles (e.g., off-highway motorcycles, all-terrain-vehicles, and snowmobiles), significantly contribute to regional haze, and that these engines, particularly snowmobiles, are significant emitters of pollutants that are known to impair visibility in federal Class I areas. The discussion pertaining to this proposed finding is in Section II.D.1, below.

Table II.A-1
Summary of Nonroad Air Quality Findings

Source	Date of Finding	Pollutants Covered	Emissions Determined to Contribute
CI Marine	December 29, 1999 64 FR 73300	Ozone, PM	HC+NOx, PM, CO
Large SI	December 7, 2000 65 FR 76790	Ozone, CO, PM	HC+NOx, CO, PM
Recreational Vehicles	December 7, 2000 65 FR 76790	Ozone, CO, PM	HC+NOx, CO, PM

B. What Are the Public Health and Welfare Effects Associated with Emissions from Nonroad Engines Subject to the Proposed Standards?

The engines and vehicles that would be subject to the proposed standards generate emissions of HC, CO, PM and air toxics that contribute to ozone and CO nonattainment as well as adverse health effects associated with ambient concentrations of PM and air toxics. Elevated emissions from those recreational vehicles that operate in national parks (e.g., snowmobiles) contribute to visibility impairment. This section summarizes the general health effects of these substances. National inventory estimates are set out in Section II.B, and estimates of the expected impact of the proposed control programs are described in Section IX. Interested readers are encouraged to refer to the Draft Regulatory Support Document for this proposal for more in-depth discussions.

1. Health and welfare effects associated with ground level ozone and its precursors

Volatile organic compounds (VOC) and NOx are precursors in the photochemical reaction which forms tropospheric ozone. Ground-level ozone, the main ingredient in smog, is formed by complex chemical reactions of VOCs and NOx in the presence of heat and sunlight. Hydrocarbons (HC) are a large subset of VOC, and to reduce mobile-source VOC levels we set maximum emissions limits for hydrocarbon and particulate matter emissions.

A large body of evidence shows that ozone can cause harmful respiratory effects including chest pain, coughing, and shortness of breath, which affect people with compromised respiratory systems most severely. When inhaled, ozone can cause acute respiratory problems; aggravate asthma; cause significant temporary decreases in lung function of 15 to over 20 percent in some healthy adults; cause inflammation of lung tissue; produce changes in lung tissue and structure; may increase hospital admissions and emergency room visits; and impair the body's immune system defenses, making people more susceptible to respiratory illnesses. Children and outdoor workers are likely to be exposed to elevated ambient levels of ozone during exercise and, therefore, are at a greater risk of experiencing adverse health effects. Beyond its human health effects, ozone has been shown to injure plants, which has the effect of reducing crop yields and reducing productivity in forest ecosystems.

There is strong and convincing evidence that exposure to ozone is associated with exacerbation of asthma-related symptoms. Increases in ozone concentrations in the air have been associated with increases in hospitalization for respiratory causes for individuals with asthma, worsening of symptoms, decrements in lung function, and increased medication use, and chronic exposure may cause permanent lung damage. The risk of suffering these effects is particularly high for children and for people with compromised respiratory systems.

Ground level ozone today remains a pervasive pollution problem in the United States. In 1999, 90.8 million people (1990 census) lived in 31 areas designated nonattainment under the 1-hour ozone NAAQS.[73] This sharp decline from the 101 nonattainment areas originally identified under the Clean Air Act Amendments of 1990 demonstrates the effectiveness of the last decade's worth of emission-control programs. However, elevated ozone concentrations remain a serious public health concern throughout the nation.

Over the last decade, declines in ozone levels were found mostly in urban areas, where emissions are heavily influenced by controls on mobile sources and their fuels. Twenty-three metropolitan areas have realized a decline in ozone levels since 1989, but at the same time ozone levels in 11 metropolitan areas with 7 million people have increased.[74] Regionally, California and the Northeast have recorded significant reductions in peak ozone levels, while four other regions (the Mid-Atlantic, the Southeast, the Central and Pacific Northwest) have seen ozone

[73]National Air Quality and Emissions Trends Report, 1999, EPA, 2001, at Table A-19. This document is available at http://www.epa.gov/oar/aqtrnd99/. The data from the Trends report are the most recent EPA air quality data that have been quality assured. A copy of this table can also be found in Docket No. A-2000-01, Document No. II-A-64.

[74]National Air Quality and Emissions Trends Report, 1998, March, 2000, at 28. This document is available at http://www.epa.gov/oar/aqtrnd98/. Relevant pages of this report can be found in Memorandum to Air Docket A-2000-01 from Jean Marie Revelt, September 5, 2001, Document No. II-A-63.

levels increase.

The highest ambient concentrations are currently found in suburban areas, consistent with downwind transport of emissions from urban centers. Concentrations in rural areas have risen to the levels previously found only in cities. Particularly relevant to this proposal, ozone levels at 17 of our National Parks have increased, and in 1998, ozone levels in two parks, Shenandoah National Park and the Great Smoky Mountains National Park, were 30 to 40 percent higher than the ozone NAAQS over part of the last decade.[75]

To estimate future ozone levels, we refer to the modeling performed in conjunction with the final rule for our most recent heavy-duty highway engine and fuel standards.[76] We performed ozone air quality modeling for the entire Eastern U.S. covering metropolitan areas from Texas to the Northeast.[77] This ozone air quality model was based upon the same modeling system as was used in the Tier 2 air quality analysis, with the addition of updated inventory estimates for 2007 and 2030. The results of this modeling were examined for those 37 areas in the East for which EPA's modeling predicted exceedances in 2007, 2020, and/or 2030 and the current 1-hour design values are above the standard or within 10 percent of the standard. This photochemical ozone modeling for 2020 predicts exceedances of the 1-hour ozone standard in 32 areas with a total of 89 million people (1999 census) after accounting for light- and heavy-duty on-highway control programs.[78] We expect the NOx and HC control strategies contained in this proposal for nonroad engines will further assist state efforts already underway to attain and maintain the 1-hour ozone standard.

[75]National Air Quality and Emissions Trends Report, 1998, March, 2000, at 32. This document is available at http://www.epa.gov/oar/aqtrnd98/. Relevant pages of this report can be found in Memorandum to Air Docket A-2000-01 from Jean Marie Revelt, September 5, 2001, Document No. II-A-63.

[76]Additional information about this modeling 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. 1-2000-01, Document No. II-A-13. This document is also available at http://www.epa.gov/otaq/diesel.htm#documents.

[77]We also performed ozone air quality modeling for the western United States but, as described further in the air quality technical support document, model predictions were well below corresponding ambient concentrations for out heavy-duty engine standards and fuel sulfur control rulemaking. Because of poor model performance for this region of the country, the results of the Western ozone modeling were not relied on for that rule.

[78] Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements, US EPA, EPA420-R-00-026, December 2000, at II-14, Table II.A-2. Docket No. A-2000-01, Document Number II-A-13. This document is also available at http://www.epa.gov/otaq/diesel.htm#documents.

In addition to the health effects described above, there exists a large body of scientific literature that shows that harmful effects can occur from sustained levels of ozone exposure much lower than 0.125 ppm.[79] Studies of prolonged exposures, those lasting about 7 hours, show health effects from prolonged and repeated exposures at moderate levels of exertion to ozone concentrations as low as 0.08 ppm. The health effects at these levels of exposure include transient pulmonary function responses, transient respiratory symptoms, effects on exercise performance, increased airway responsiveness, increased susceptibility to respiratory infection, increased hospital and emergency room visits, and transient pulmonary respiratory inflammation.

Prolonged and repeated ozone concentrations at these levels are common in areas throughout the country, and are found both in areas that are exceeding, and areas that are not exceeding, the 1-hour ozone standard. Areas with these high concentrations are more widespread than those in nonattainment for that 1-hour ozone standard. Monitoring data indicate that 333 counties in 33 states exceed these levels in 1997-99.[80] The Agency's most recent photochemical ozone modeling forecast that 111 million people are predicted to live in areas that are at risk of exceeding these moderate ozone levels for prolonged periods of time in 2020 after accounting for expected inventory reductions due to controls on light- and heavy-duty on-highway vehicles.[81]

2. Health effects associated with carbon monoxide

Carbon monoxide (CO) is a colorless, odorless gas produced through the incomplete combustion of carbon-based fuels. Carbon monoxide 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.

High concentrations of CO generally occur in areas with elevated mobile-source emissions. Peak concentrations typically occur during the colder months of the year when mobile-source CO emissions are greater and nighttime inversion conditions are more frequent.

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[79]Additional information about these studies can be found in Chapter 2 of "Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements," December 2000, EPA420-R-00-026. Docket No. A-2000-01, Document Number II-A-13. This document is also available at http://www.epa.gov/otaq/diesel.htm#documents.

[80]A copy of these data can be found in Air Docket A-2000-01, Document No. II-A-80.

[81] Memorandum to Docket A-99-06 from Eric Ginsburg, EPA, "Summary of Model-Adjusted Ambient Concentrations for Certain Levels of Ground-Level Ozone over Prolonged Periods," November 22, 2000, at Table C, Control Scenario – 2020 Populations in Eastern Metropolitan Counties with Predicted Daily 8-Hour Ozone greater than or equal to 0.080 ppm. Docket A-2000-01, Document Number II-B-13.

This is due to the enhanced stability in the atmospheric boundary layer, which inhibits vertical mixing of emissions from the surface.

The current primary NAAQS for CO are 35 parts per million for the one-hour average and 9 parts per million for the eight-hour average. These values are not to be exceeded more than once per year. Air quality carbon monoxide value is estimated using EPA guidance for calculating design values. In 1999, 30.5 million people (1990 census) lived in 17 areas designated nonattainment under the CO NAAQS.[82]

Snowmobiles, which have relatively high per engine CO emissions, can be a significant source of ambient CO levels in CO nonattainment areas. Several states that contain CO nonattainment areas also have large populations of registered snowmobiles. This is shown in Table II.B-1. A review of snowmobile trail maps indicates that snowmobiles are used in these CO nonattainment areas or in adjoining counties.[83] These include the Mt. Spokane and Riverside trails near the Spokane Washington CO nonattainment area; the Larimer trails near the Fort Collins, Colorado CO nonattainment area; and the Hyatt Lake, Lake of the Woods, and Cold Springs trails near the Klamath Falls and Medford, Oregon CO nonattainment area. There are also trails in Missoula County, Montana that demonstrate snowmobile use in the Missoula, Montana CO nonattainment area. While Colorado has a large snowmobile population, the snowmobile trails are fairly distant from the Colorado Springs CO nonattainment areas. EPA requests comment on the volume and nature of snowmobile use in these and other CO nonattainment areas. Of particular interest is information about the number of trails in and around CO nonattainment areas, the magnitude of snowmobile use on those trails, and the extent to which snowmobiles are used off-trail.[84]

[82]National Air Quality and Emissions Trends Report, 1999, EPA, 2001, at Table A-19. This document is available at http://www.epa.gov/oar/aqtrnd99/. The data from the Trends report are the most recent EPA air quality data that have been quality assured. A copy of this table can also be found in Docket No. A-2000-01, Document No. II-A-64.

[83]St. Paul, Minnesota was recently reclassified as being in attainment but is still considered a maintenance area. There is also a significant population of snowmobiles in Minnesota, with snowmobile trails in Washington County.

[84]The trail maps consulted for this proposal can be found in Docket No. A-2000-01, Document No. II-A-65.

Table II.B-1
Snowmobile Use in Selected CO Nonattainment Areas

City and State	CO Nonattainment Classification	1998 State snowmobile population[a]
Fairbanks, AK	Serious	12,997
Spokane, WA	Serious	32,274
Colorado Springs, CO	Moderate	28,000
Fort Collins, CO	Moderate	
Klamath Falls, OR	Moderate	13,426
Medford, OR	Moderate	
Missoula, MT	Moderate	14,361

[a]Source: Letter from International Snowmobile Manufacturers Association to US-EPA, July 8, 1999, Docket A-2000-01, Document No. II-G

Exceedances of the 8-hour CO standard were recorded in three of these 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.[85] 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.[86]

Nationally, significant progress has been made over the last decade to reduce CO emissions and ambient CO concentrations. Total CO emissions from all sources have decreased 16 percent from 1989 to 1998, and ambient CO concentrations decreased by 39 percent. During that time, while the mobile source CO contribution of the inventory remained steady at about 77 percent, the highway portion decreased from 62 percent of total CO emissions to 56 percent

[85] 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.

[86] 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.

while the nonroad portion increased from 17 percent to 22 percent.[87] Over the next decade, we would expect there to be a minor decreasing trend from the highway segment due primarily to the more stringent standards for certain light-duty trucks (LDT2s).[88] CO standards for passenger cars and other light-duty trucks and heavy-duty vehicles did not change as a result of other recent rulemakings). As described in Section II.C, below, the engines subject to this rule currently account for about 7 percent of the mobile source CO inventory; this is expected to increase to 10 percent by 2020 without the emission controls proposed in this action.

The state of Alaska recently submitted draft CO attainment SIPs to the Agency for the Fairbanks CO nonattainment area. Fairbanks is located in a mountain valley with a much higher potential for air stagnation than cities within the contiguous United States. Nocturnal inversions that give rise to elevated CO concentrations can persist 24-hours a day due to the low solar elevation, particularly in December and January. These inversions typically last from 2 to 4 days (Bradley et al., 1992), and thus inversions may continue during hours of maximum CO emissions from mobile sources. Despite the fact that snowmobiles are largely banned in CO nonattainment areas by the state, the state estimated that snowmobiles contributed 0.3 tons/day in 1995 to Fairbanks' CO nonattainment area or 1.2 percent of a total inventory of 23.3 tons per day in 2001.[89] While Fairbanks has made significant progress in reducing ambient CO concentrations, existing climate conditions make achieving and maintaining attainment challenging. Fairbanks failed to attain the CO NAAQS by the applicable deadline of December 21, 2000, and EPA approved a one-year extension in May of 2001.[90]

In addition to the health effects that can result from exposure to carbon monoxide, this

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[87] National Air Quality and Emissions Trends Report, 1998, March, 2000; this document is available at http://www.epa.gov/oar/aqtrnd98/. National Air Pollutant Emission Trends, 1900-1998 (EPA-454/R-00-002), March, 2000. These documents are available at Docket No. A-2000-01, Document No. II-A-72. See also Air Quality Criteria for Carbon Monoxide, US EPA, EPA 600/P-99/001F, June 2000, at 3-10. Air Docket A-2000-01, Document Number II-A-29. This document is also available at http://www.epa.gov/ncea/coabstract.htm.

[88] LDT2s are light light-duty trucks greater than 3750 lbs. loaded vehicle weight, up through 6000 gross vehicle weight rating.

[89] 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.

[90] 66 FR 28836, May 25, 2001. Clean Air Act Promulgation of Attainment Date Extension for the Fairbanks North Star Borough Carbon Monoxide Nonattainment Area, AK, Direct Final Rule.

pollutant also can contribute to ground level ozone formation.[91] Recent studies in atmospheric chemistry in urban environments suggest CO can react with hydrogen-containing radicals, leaving fewer of these to combine with non-methane hydrocarbons and thus leading to increased levels of ozone. Few analyses have been performed that estimate these effects, but a study of an ozone episode in Atlanta, GA in 1988 found that CO accounted for about 17.5 percent of the ozone formed (compared to 82.5 percent for volatile organic compounds). While different cities may have different results, the effects of CO emissions on ground level ozone are not insignificant. The engines that are the subject of the proposed standards are contributors to these effects in urban areas, particularly because their per engine emissions are so high. For example, CO emissions from a off-highway motorcycle are high relative to a passenger car, (32 g/mi compared to 4.2 g/mi). The CO controls contained in this proposal will further assist state efforts already underway to attain and maintain the CO NAAQS.

3. Health and welfare effects associated with particulate matter

Nonroad engines and vehicles that would be subject to the proposed standards contribute to ambient particulate matter (PM) levels in two ways. First, they contribute through direct emissions of particulate matter. Second, they contribute to indirect formation of PM through their emissions of organic carbon, especially HC. Organic carbon accounts for between 27 and 36 percent of fine particle mass depending on the area of the country.

Particulate matter represents a broad class of chemically and physically diverse substances. It can be principally characterized as discrete particles that exist in the condensed (liquid or solid) phase spanning several orders of magnitude in size. All particles equal to and less than 10 microns are called PM_{10}. Fine particles can be generally defined as those particles with an aerodynamic diameter of 2.5 microns or less (also known as $PM_{2.5}$), and coarse fraction particles are those particles with an aerodynamic diameter greater than 2.5 microns, but equal to or less than a nominal 10 microns.

Particulate matter, like ozone, has been linked to a range of serious respiratory health problems. Scientific studies suggest a likely causal role of ambient particulate matter (which is attributable to several sources including mobile sources) in contributing to a series of health effects.[92] The key health effects categories 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

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[91]U.S. EPA, Air Quality Criteria for Carbon Monoxide, EPA 600/P-99.001F, June 2000, Section 3.2.3. Air Docket A-2000-01, Document Number II-A-29. This document is also available at http://www.epa.gov/ncea/coabstract.htm.

[92]EPA (1996) 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. 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.

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 noncancer 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. Exposure to fine particles is closely associated with such health effects as premature mortality or hospital admissions for cardiopulmonary disease.

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. Other environmental impacts occur when particles deposit onto soils, plants, water or materials. For example, particles containing nitrogen and sulphur that deposit on to land or water bodies may change the nutrient balance and acidity of those environments. Finally, PM causes soiling and erosion damage to materials, including culturally important objects such as carved monuments and statues. It promotes and accelerates the corrosion of metals, degrades paints, and deteriorates building materials such as concrete and limestone.

The NAAQS for PM_{10} were established in 1987. According to these standards, the short term (24-hour) standard of 150 $\mu g/m^3$ is not to be exceeded more than once per year on average over three years. The long-term standard specifies an expected annual arithmetic mean not to exceed 50 $\mu g/m^3$ over three years. The most recent PM_{10} monitoring data indicate that 14 designated PM_{10} nonattainment areas with a projected population of 23 million violated the PM_{10} NAAQS in the period 1997-99. In addition, there are 25 unclassifiable areas that have recently recorded ambient concentrations of PM_{10} above the PM_{10} NAAQS.[93]

Current 1999 $PM_{2.5}$ monitored values, which cover about a third of the nation's counties, indicate that at least 40 million people live in areas where long-term ambient fine particulate matter levels are at or above 16 $\mu g/m^3$ (37 percent of the population in the areas with monitors).[94] This 16 $\mu g/m^3$ threshold is the low end of the range of long term average $PM_{2.5}$ concentrations in cities where statistically significant associations were found with serious health effects, including premature mortality.[95] To estimate the number of people who live in areas where long-term

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[93]EPA adopted a policy in 1996 that allows areas with PM_{10} exceedances that are attributable to natural events to retain their designation as unclassifiable if the State is taking all reasonable measures to safeguard public health regardless of the sources of PM_{10} emissions.

[94]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.

[95]EPA (1996) 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. Docket Number A-99-06, Documents Nos. II-A-18, 19, 20, and 23. The particulate matter

ambient fine particulate matter levels are at or above 16 μg/m^3 but for which there are no monitors, we can use modeling. According to our national modeled predictions, there were a total of 76 million people (1996 population) living in areas with modeled annual average $PM_{2.5}$ concentrations at or above 16 μg/m^3 (29 percent of the population).[96]

To estimate future $PM_{2.5}$ levels, we refer to the modeling performed in conjunction with the final rule for our most recent heavy-duty highway engine and fuel standards, using EPA's Regulatory Model System for Aerosols and Deposition (REMSAD).[97] The most appropriate method of making these projections relies on the model to predict changes between current and future states. Thus, we have estimated future conditions only for the areas with current $PM_{2.5}$ monitored data (which cover about a third of the nation's counties). For these counties, REMSAD predicts the current level of 37 percent of the population living in areas where fine PM levels are at or above 16 μg/m3 to increase to 49 percent in 2030.[98]

Emissions of HCs from snowmobiles contribute to secondary formation of fine particulate matter which can cause a variety of adverse health and welfare effects, including visibility impairment discussed in Section II.D.1(b) below. 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/m3, the level of the revised national ambient air quality standard for fine particles.[99] 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

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air quality criteria documents are also available at http://www.epa.gov/ncea/partmatt.htm. .

[96]Memorandum to Docket A-99-06 from Eric O. Ginsburg, Senior Program Advisor, "Summary of Absolute Modeled and Model-Adjusted Estimates of Fine Particulate Matter for Selected Years," December 6, 2000. Air Docket A-2000-01, Document No. II-B-14.

[97]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.

[98] 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.

[99] 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.

contribute to ambient concentrations in a neighboring county.[100] These counties are listed in Table II.B-2. To obtain the information about snowmobile trails contained in Table II.B-2, we consulted snowmobile trail maps that were supplied by various states.[101]

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[100] 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.

[101] The trail maps consulted for this proposal can be found in Docket No. A-2000-01, Document No. II-A-65.

Table II.B-2
Counties with Annual $PM_{2.5}$ Levels Above 16 μg/m3 and Snowmobile Trails

State	$PM_{2.5}$ Exceedance County	County with Snowmobile Trails	Proximity to $PM_{2.5}$ Exceedance County
Ohio	Mahoning	Mahoning	—
	Trumbull	Trumbull	—
	Summit	Summit	—
	Montgomery	Montgomery	—
	Portage	Portage	—
	Franklin	Delaware	Borders North
	Marshall/Ohio (WV)	Belmont	Borders West
Montana	Lincoln	Lincoln	—
California	Tulane	Tulane	—
	Butte	Butte	—
	Fresno	Fresno	—
	Kern	Kern	—
Minnesota	Washington	Washington	—
	Wright	Wright	—
Wisconsin	Waukesha	Waukesha	—
	Milwaukee	Milwaukee	—
Oregon	Jackson	Douglas	Borders NNE
	Klamath	Douglas	Borders North
Pennsylvania	Washington	Layette	Borders East
		Somerset	—
Illinois	Rock Island	Rock Island	—
		Henry	Borders East
Iowa	Rock Island (IL)	Dubuque	Borders West

We expect the PM control strategies contained in this proposal would further assist state efforts already underway to attain and maintain the PM NAAQS.

4. Health effects associated with air toxics

In addition to the human health and welfare impacts described above, emissions from the engines covered by this proposal also contain several other substances that are known or suspected human or animal carcinogens, or have serious noncancer health effects. These include benzene, 1,3-butadiene, formaldehyde, acetaldehyde, and acrolein. The health effects of these air toxics are described in more detail in Chapter 1 of the Draft Regulatory Support Document for this rule. Additional information can also be found in the Technical Support Document for our final Mobile Source Air Toxics rule.[102]

The hydrocarbon controls contained in this proposal are expected to reduce exposure to air toxics and therefore may help reduce the impact of these engines on cancer and noncancer health effects.

C. What Is the Inventory Contribution From the Nonroad Engines and Vehicles That Would Be Subject to this Proposal?

The contribution of emissions from the nonroad engines and vehicles that would be subject to the proposed standards to the national inventories of pollutants that are associated with the health and public welfare effects described in Section II.B are considerable. To estimate nonroad engine and vehicle emission contributions, we used the latest version of our NONROAD emissions model. 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 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 Draft Regulatory Support Document.

Baseline emission inventory estimates for the year 2000 for the categories of engines and vehicles covered by this proposal are summarized in Table II.C-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 proposal contribute about 13 percent, 3 percent, 6 percent, and 1 percent of HC, NOx, CO, and PM emissions, respectively, in the year 2000. The results for industrial SI engines indicate they contribute approximately 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 10 percent of HC emissions and 3 percent of CO from mobile sources. Recreational CI marine contribute less than 1 percent to NOx mobile source inventories. When only nonroad emissions are considered, the engines and vehicles that would be subject to the proposed standards would account for a larger share.

Our draft emission projections for 2020 for the nonroad engines and vehicles subject to this proposal show that emissions from these categories are expected to increase over time if left uncontrolled. The projections for 2020 are summarized in Table II.C-2 and indicate that the

[102]See our Mobile Source Air Toxics final rulemaking, 66 FR 17230, March 29, 2001, and the Technical Support Document for that rulemaking. Docket No. A-2000-01, Documents Nos. II-A-42 and II-A-30.

categories of engines and vehicles covered by this proposal are expected to contribute 33 percent, 9 percent, 9 percent, and 2 percent of HC, NOx, CO, and PM emissions in the year 2020. Population growth and the effects of other regulatory control programs are factored into these projections. The relative importance of uncontrolled nonroad engines 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.

Table II.C-1
Modeled Annual Emission Levels for
Mobile-Source Categories in 2000 (thousand short tons)

Category	NOx		HC		CO		PM	
	tons	percent of mobile source	tons	percent of mobile source	tons	percent of mobile source	tons	percent of mobile source
Total for engines subject to proposed standards	**343**	**2.6%**	**985**	**12.9%**	**4,870**	**6.3%**	**8.3**	**1.2%**
Highway Motorcycles	8	0.1%	84	1.1%	329	0.4%	0.4	0.1%
Nonroad Industrial SI > 19 kW	306	2.3%	247	3.2%	2,294	3.0%	1.6	0.2%
Recreational SI	13	0.1%	737	9.7%	2,572	3.3%	5.7	0.8%
Recreation Marine CI	24	0.2%	1	0.0%	4	0.0%	1	0.1%
Marine SI Evap	0	0.0%	89	1.2%	0	0.0%	0	0.0%
Marine SI Exhaust	32	0.2%	708	9.3%	2,144	2.8%	38	5.4%
Nonroad SI < 19 kW	106	0.8%	1,460	19.1%	18,359	23.6%	50	7.2%
Nonroad CI	2,625	19.5%	316	4.1%	1,217	1.6%	253	36.2%
Commercial Marine CI	977	7.3%	30	0.4%	129	0.2%	41	5.9%
Locomotive	1,192	8.9%	47	0.6%	119	0.2%	30	4.3%
Total Nonroad	5,275	39%	3,635	48%	26,838	35%	420	60%
Total Highway	7,981	59%	3,811	50%	49,811	64%	240	34%
Aircraft	178	1%	183	2%	1,017	1%	39	6%
Total Mobile Sources	13,434	100%	7,629	100%	77,666	100%	699	100%
Total Man-Made Sources	24,538	--	18,575	--	99,745	--	3,095	--
Mobile Source percent of Total Man-Made Sources	55%	--	41%	--	78%	--	23%	–

Table II.C-2
Modeled Annual Emission Levels for
Mobile-Source Categories in 2020 (thousand short tons)

Category	NOx		HC		CO		PM	
	tons	percent of mobile source	tons	percent of mobile source	tons	percent of mobile source	tons	percent of mobile source
Total for engines subject to proposed standards	**552**	**8.9%**	**2,055**	**33.4%**	**8,404**	**9.4%**	**11.4**	**1.8%**
Highway Motorcycles	14	0.2%	144	2.3%	569	0.6%	0.8	0.1%
Nonroad Industrial SI > 19 kW	486	7.8%	348	5.7%	2,991	3.3%	2.4	0.4%
Recreational SI	27	0.4%	1,706	27.7%	5,407	3.3%	7.5	1.2%
Recreation Marine CI	39	0.6%	1	0.0%	6	0.0%	1.5	0.2%
Marine SI Evap	0	0.0%	102	1.4%	0	0.0%	0	0.0%
Marine SI Exhaust	58	0.9%	284	4.6%	1,985	2.2%	28	4.4%
Nonroad SI < 19 kW	106	1.7%	986	16.0%	27,352	30.5%	77	12.2%
Nonroad CI	1,791	28.8%	142	2.3%	1,462	1.6%	261	41.3%
Commercial Marine CI	819	13.2%	35	0.6%	160	0.2%	46	7.3%
Locomotive	611	9.8%	35	0.6%	119	0.1%	21	3.3%
Total Nonroad	3,937	63%	3,639	59%	39,482	44%	444	70%
Total Highway	2,050	33%	2,278	37%	48,903	54%	145	23%
Aircraft	232	4%	238	4%	1,387	2%	43	7%
Total Mobile Sources	6,219	100%	6,155	100%	89,772	100%	632	100%
Total Man-Made Sources	16,195	--	16,215	--	113,440	--	3,016	--
Mobile Source percent of Total Man-Made Sources	38%	--	38%	--	79%	--	21%	–

D. Regional and Local-Scale Public Health and Welfare Effects

The previous section describes national-scale adverse public health effects associated with the nonroad engines and vehicles covered by this proposal. This section describes significant adverse health and welfare effects arising from the usage patterns of snowmobiles, Large SI engines, and gasoline marine engines on the regional and local scale. Studies suggest that emissions from these engines can be concentrated in specific areas, leading to elevated ambient concentrations of particular pollutants and associated elevated personal exposures to operators and by-standers. Recreational vehicles, and particularly snowmobiles, are typically operating in rural areas such as national parks and wilderness areas, and emissions from these vehicles contribute to ambient particulate matter which is a leading component of visibility impairment.

1. Health and Welfare Effects Related to Snowmobiles

In this section, we describe more localized human health and welfare effects associated with snowmobile emissions: visibility impairment and personal exposure to air toxics and CO. We describe the contribution of snowmobile HC emissions to secondary formation of fine particles, which are the leading component of visibility impairment and adverse health effects related to ambient PM2.5 concentrations greater than 16 μg/m3. We also discuss personal exposure to CO emissions and air toxics. Gaseous air toxics are components of hydrocarbons, and CO personal exposure measurements suggest that snowmobile riders and bystanders are exposed to unhealthy levels of gaseous air toxics (e.g., benzene) and CO.

a. Nonroad Engines and Regional Haze

The Clean Air Act established 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 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 that rule, EPA also encouraged the States to work together in developing and implementing their air quality plans. The regional haze program is designed to improve visibility and air quality in our most treasured natural areas. At the same time, control strategies designed to improve visibility in the national parks and wilderness areas will improve visibility over broad geographic areas.

Regional haze is caused by the emission from numerous sources located over a wide geographic area. Such sources include, but are not limited to, major and minor stationary sources, mobile sources, and area sources. 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.

Some fine particles are formed when gases emitted to the air form particles as they are carried downwind (examples include sulfates, formed from sulfur dioxide, and nitrates, formed from nitrogen oxides). These activities generally span broad geographic areas and fine particles can be transported great distances, sometimes hundreds or thousands of miles. Consequently, visibility impairment is a national problem. Without the effects of pollution a natural visual range is approximately 140 miles in the West and 90 miles in the East. However, fine particles have significantly reduced the range that people can see and in the West the current range is 33-90 miles and in the East it is only 14 to 24 miles.

Because of evidence that fine particles are frequently transported hundreds of miles, all 50 states, including those that do not have Class I areas, will have to 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. The rule requires states to develop long-term strategies including enforceable measures designed to meet reasonable progress goals. 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.

Nonroad engines (including construction equipment, farm tractors, boats, planes, locomotives, recreational vehicles, and marine engines) contribute significantly to regional haze. This is because there are nonroad engines in all of the states, and their emissions contain precursors of fine PM and organic carbon that are transported and contribute to the formation of regional haze throughout the country and in Class I areas specifically. As illustrated in Table II.D-1, nonroad engines are expected to contribute 15 percent of national VOC emissions, 23 percent of national NOx emissions, 6 percent of national SOx emissions, and 14 percent of national PM10 emissions. Snowmobiles alone are estimated to emit 208,926 tons of total hydrocarbons (THC), 1,461 tons of NOx, 2,145 tons of SOx, and 5,082 tons of PM in 2007.

Table II.D-1
National Emissions of Various Pollutants - 2007
(Thousands Short Tons)

Source	VOC		NOx		SOx		PM_{10}	
	Tons	Percent	Tons	Percent	Tons	Percent	Tons	Percent
Heavy-Duty Highway	413	3	2,969	14	24	0	115	4
Light-Duty Highway	2,596	18	2,948	14	24	0	82	3
Nonroad	2,115	15	4,710	23	1,027	6	407	14
Electric Gen.	35	0	4,254	21	10,780	63	328	12
Point	1,639	11	3,147	15	3,796	22	1,007	36
Area	7,466	52	2,487	12	1,368	8	874	31
TOTAL	14,265		20,516		17,019		2,814	

b. Snowmobiles and Visibility Impairment

As noted above, EPA issued regulations in 1980 to address Class I area visibility impairment that is "reasonably attributable" to a single source or small group of sources. In 40 CFR Part 51.301 of the visibility regulations, visibility impairment is defined as "any humanly perceptible change in visibility (light extinction, visual range, contrast, coloration) from that which would have existed under natural conditions." States are required to develop implementation plans that include long-term strategies for improving visibility in each class I area. The long-term strategies under the 1980 regulations should consist of measures to reduce impacts from local sources and groups of sources that contribute to poor air quality days in the class I area. Types of impairment covered by these regulations includes layered hazes and visible plumes. While these kinds of visibility impairment can be caused by the same pollutants and processes as those that cause regional haze, they generally are attributed to a smaller number of sources located across a smaller area. The Clean Air Act and associated regulations call for protection of visibility impairment in class I areas from localized impacts as well as broader impacts associated with regional haze.

Visibility and particle monitoring data are available for 8 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.[103] Visibility and

[103] 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

fine particle data for these parks are set out in Table II.D-2. This table shows the number of monitored days in the winter that fell within the 20-percent haziest days for each of these eight parks. Monitors collect data two 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 haziest days during a year which are tracked as the primary focus of regulatory efforts.[104] 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. The Agency would be interested in comments from the public on the start and end dates for the typical snowmobile season at each of these national parks.

Table II.D-2
Winter Days That Fall Within the 20 Percent Haziest Days
At National Parks Used by Snowmobiles

NPS Unit	State(s)	Number of Sampled Wintertime Days Within 20 Percent Haziest Days (maximum of 21 sampled 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.

The information presented in Table II.D-2 shows that visibility data support a conclusion

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Roosevelt, ND, and Zion, UT.

[104]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.

that there are at least eight Class I Areas (7 in National Parks and one in a Wilderness Area) frequented by snowmobiles with one or more wintertime days within the 20-percent haziest days of the year. 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 haziest monitored days, two (2) of those days occurred during the wintertime when snowmobile emissions such as hydrocarbons contributed to visibility impairment. 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."[105]

Ambient concentrations of fine particles are the primary pollutant responsible for visibility impairment. Five pollutants are largely responsible for the chemical composition of fine particles: 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.[106]

The contribution of snowmobiles to elemental carbon and nitrates is small. Their contribution to sulfates is a function of fuel sulfur and is small and will decrease even more as the sulfur content of their fuel decreases due to our recently finalized fuel sulfur requirements. In the winter months, however, hydrocarbon emissions from snowmobiles can be significant, as indicated in Table II.D-3, and these HC emissions can contribute significantly to the organic carbon fraction of fine particles which are largely responsible for visibility impairment. This is because they are typically powered by two-stroke engines that emit large amounts of hydrocarbons. In Yellowstone, a park with high snowmobile usage during the winter months, snowmobile hydrocarbon emissions can exceed 500 tons per year, as much as several large stationary sources. Other parks with less snowmobile traffic are less impacted by these hydrocarbon emissions.[107]

Table II.D-3 shows modeled 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

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[105]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.

[106]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.

[107]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.

engaged in subsistence uses (36 CFR Part 13). Emission calculations are based on an assumed 2 hours of use per snowmobile visit at 16 hp with the exception of Yellowstone where 4 hours of use at 16 hp was assumed. The emission factors used to estimate these emissions are identical to those used by the NONROAD model. Two-stroke snowmobile emission factors are: 111 g/hp-hr HC, 296 g/hp-hr CO, 0.86 g/hp-hr NOx, and 2.7 g/hp-hr PM. These emission factors are based on several engine tests performed by the International Snowmobile Manufacturers Association (ISMA) and the Southwest Research Institute (SwRI). These emission factors are still under review, and the emissions estimates may change pending the outcome of that review.

Table II.D-3
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	492.0	1,311.9	3.8	12.0

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 can be a significant source of total annual mobile source emissions for the park year round. Table II.D-4 shows that in the 1998 winter season snowmobiles contributed 64 percent, 39 percent, and 30 percent of HC, CO, and PM emissions.[108] It should be noted that the snowmobile emission factors used to estimate these contributions are currently under review, and the snowmobile emissions may be revised down. However, when the emission factors used by EPA in its NONROAD model are used, the contribution of snowmobiles to total emissions in Yellowstone remains significant: 59 percent, 33 percent, and 45 percent of HC, CO and PM emissions. The University of Denver used remote-sensing equipment to estimate snowmobile HC emissions at Yellowstone during the winter of 1998-1999, and estimated that snowmobiles contribute 77% of annual hydrocarbon emissions at the park.[109] The portion of wintertime emissions attributable to snowmobiles is even higher, since all snowmobile emissions occur during the winter months.

[108] National Park Service, February 2000. Air Quality Concerns Related to Snowmobile Usage in National Parks. Air Docket A-2000-01, Document No. II-A-44.

[109] G. Bishop, et al., Snowmobile Contributions to Mobile Source Emissions in Yellowstone National Park, Environmental Science and Technology, Vol. 35, No. 14, at 2873. Docket No. A-2000-01, Document No. II-A-47.

Table II.D-4
1998 Annual HC Emissions (tpy), Yellowstone National Park

Source	HC		CO		NOx		PM	
Coaches	2.69	0%	24.29	1%	0.42	0%	0.01	0%
Autos	307.17	33%	2,242.12	54%	285.51	88%	12.20	60%
RVs	15.37	2%	269.61	6%	24.33	7%	0.90	4%
Snowmobile s	596.22	64%	1,636.44	39%	1.79	1%	6.07	30%
Buses	4.96	1%	18.00	0%	13.03	4%	1.07	5%
TOTAL	926.4		4190.46		325.08		20.25	

Source: National Park Service, February 2000. Air Quality Concerns Related to Snowmobile Usage in National Parks. Air Docket A-2000-01, Document No. II-A-44.

The information presented in this discussion indicates that snowmobiles are significant emitters of pollutants that are known to contribute to visibility impairment in some Class I areas. Annual and particularly wintertime hydrocarbon emissions from snowmobiles are high in the five parks considered in Table II.D-4, with two parks having HC emissions nearly as high as Yellowstone (Rocky Mountain and Voyageurs). 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.

c. Snowmobiles and personal exposure to air toxics and CO

Snowmobile users can be exposed to high air toxic and CO emissions, both because they sit very close to the vehicle's exhaust port and because it is common for them to ride their vehicles on groomed trails where they travel fairly close behind other snowmobiles. Because of these riding patterns, snowmobilers breathe exhaust emissions from their own vehicle, the vehicle directly in front, as well as those farther up the trail. This can lead to relatively high personal exposure levels of harmful pollutants. A study of snowmobile rider CO exposure conducted at Grand Teton National Park showed that a snowmobiler riding at distances of 25 to 125 feet behind another snowmobiler and traveling at speeds from 10 to 40 mph can be exposed to average CO levels ranging from 0.5 to 23 ppm, depending on speed and distance. The highest CO level measured in this study was 45 ppm, as compared to the current 1-hour NAAQS for CO of 35 ppm.[110] While exposure levels can be less if a snowmobile drives 15 feet off the centerline of the lead snowmobile, the exposure levels are still of concern. This study led to the development of an empirical model for predicting CO exposures from riding behind snowmobiles.

[110] Snook and Davis, 1997, "An Investigation of Driver Exposure to Carbon Monoxide While Traveling Behind Another Snowmobile." Docket No. A-2000-01, Document Number II-A-35.

Hydrocarbon speciation for snowmobile emissions was performed for the State of Montana in a 1997 report.[111] Using the empirical model for CO from the Grand Teton exposure study with benzene emission rates from the State of Montana's emission study, benzene exposures for riders driving behind a single snowmobile were predicted to range from 1.2E+02 to 1.4E+03 μg/m3. Using the same model to predict exposures when riding at the end of a line of six snowmobiles spaced 25 feet apart yielded exposure predictions of 3.5E+03, 1.9E+03, 1.3E+03, and 1.2E+03 μg/m3 benzene. at 10, 20, 30, and 40 mph, respectively.

The cancer risk posed to those exposed to benzene emissions from snowmobiles must be viewed within the broader context of expected lifetime benzene exposure. Observed monitoring data and predicted modeled values demonstrate that a significant cancer risk already exists from ambient concentrations of benzene for a large portion of the US population. The Agency's 1996 National-Scale Air Toxics Assessment of personal exposure to ambient concentrations of air toxic compounds emitted by outside sources (e.g. cars and trucks, power plants) found that benzene was among the five air toxics that appear to pose the greatest risk to people nationwide. This national assessment found that for approximately 50% of the US population in 1996, the inhalation cancer risks associated with benzene exceeded 10 in one million. Modeled predictions for ambient benzene from this assessment correlated well with observed monitored concentrations of benzene ambient concentrations.

Specifically, the draft National-Scale Assessment predicted nationwide annual average benzene exposures from outdoor sources to be 1.4 μg/m3.[112] In comparison, snowmobile riders and those directly exposed to snowmobile exhaust emissions had predicted benzene levels two to three orders of magnitude greater than the 1996 national average benzene concentrations.[113] These elevated levels are also known as air toxic "hot spots," which are of particular concern to the Agency. Thus, total annual average exposures to typical ambient benzene concentrations combined with elevated short-term exposures to benzene from snowmobiles may pose a significant risk of adverse public health effects to snowmobile riders and those exposed on a frequent basis to exhaust benzene emissions from snowmobiles. We request comment on this issue.

Since snowmobile riders often travel in large groups, the riders towards the back of the group are exposed to the accumulated exhaust of those riding ahead. These exposure levels can continue for hours at a time. An additional consideration is that the risk to health from CO exposure increases with altitude, especially for unacclimated individuals. Therefore, a park visitor who lives at sea level and then rides his or her snowmobile on trails at high-altitude is

[111] Emissions from Snowmobile Engines Using Bio-based Fuels and Lubricants, Southwest Research Institute, August, 1997, at 22. Docket No. A-2000-01, Document Number II-A-50.

[112] National-Scale Air Toxics Assessment for 1996, EPA-453/R-01-003, Draft, January 2001.

[113] Technical Memorandum, Chad Bailey, Predicted benzene exposures and ambient concentrations on and near snowmobile trails, August 17, 2001. Air Docket A-2000-01, Document No. II-B-27.

more susceptible to the effects of CO than local residents.

In addition to snowmobilers themselves, people who are active in proximity to the areas where snowmobilers congregate may also be exposed to high CO levels. An OSHA industrial hygiene survey reported a peak CO exposure of 268 ppm for a Yellowstone employee working at an entrance kiosk where snowmobiles enter the park. This level is greater than the NIOSH peak recommended exposure limit of 200 ppm. OSHA's survey also measured employees' exposures to several air toxics. Benzene exposures in Yellowstone employees ranged from 67-600 μg/m3, with the same individual experiencing highest CO and benzene exposures. The highest benzene exposure concentrations exceeded the NIOSH Recommended Exposure Limit of 0.1 ppm for 8-hour exposures.[114]

d. Summary

For all of the reasons described in this section, we continue to believe it is appropriate to set emission standards for snowmobiles. At the national level, these engines contribute to CO levels in several nonattainment areas. Snowmobiles contribute significantly to hydrocarbon emissions that are known to contribute to visibility impairment in Class I areas. In addition, snowmobilers riding in a trail formation, as well as park attendants and other bystanders can experience very high levels of CO and benzene for relatively long periods of time. The proposed standards will help reduce these emissions and help alleviate these concerns.

2. Recreational marine

As with snowmobiles, the usage patterns of recreational marine engine can lead to high personal exposure levels, particularly for CO emissions. The U.S. Coast Guard reported cases of CO poisoning caused by recreational boat usage.[115] These Coast Guard investigations into recreational boating accident reports between 1989 to1998 show that 57 accidents were reported, totaling 87 injuries and 32 fatalities, that involved CO poisoning. An article in the Journal of the American Medical Association also discusses CO poisoning among recreational boat users.[116] This study reports 21 incidences of CO poisoning from sterndrive and inboard engines; two-thirds of these incidences occurred when the boat was cruising.

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[114]U.S. Department of Labor, OSHA, Billings Area Office, "Industrial Hygiene Survey of Park Employee Exposures During Winter Use at Yellowstone National Park, February 19 through February 24, 2000. Docket No. A-2000-01, Document Number II-A-37; see also Industrial Hygiene Consultation Report prepared for Yellowstone National Park by Tim Radtke, CIH, Industrial Hygienist, June 1997. Docket A-2000-01, Document No. A-II-41.

[115] Summarized in an e-mail from Phil Cappel of the U.S. Coast Guard to Mike Samulski of the U.S. Environmental Protection Agency, October 19, 2000. Docket A-2000-01, Document No. II-A-46.

[116] Silvers, S., Hampton, N., "Carbon Monoxide Poisoning Among Recreational Boaters," JAM, November 22/29, 1995, Vol 274, No. 20. Docket A-2000-01, Document No. II-A-45

The CO exposure to boaters comes from three general sources. First, CO may enter the engine compartment and cabin spaces from leaks in the exhaust system. Second, boaters may be exposed to CO if they are near the engine when it is idling such as swimming behind the boat. Third, CO may be drawn into the boat when it is cruising due to a back draft of air into the boat known as the "station wagon effect."[117]

3. Large SI engines

Exhaust emissions from applications with significant indoor use can expose individual operators or bystanders to dangerous levels of pollution. Forklifts, ice-surfacing machines, sweepers, and carpet cleaning equipment are examples of large industrial spark-ignition engines that often operate indoors or in other confined spaces. Forklifts alone account for over half of the engines in this category. Indoor use may include extensive operation in a temperature-controlled environment where ventilation is kept to a minimum (for example, for storing, processing, and shipping produce).

The principal concern for human exposure relates to CO emissions. One study showed several forklifts operating on liquefied petroleum gas (LPG) with measured CO emissions ranging from 10,000 to 90,000 ppm (1 to 9 percent).[118] The threshold limit value for a time-weighted average 8-hour workplace exposure set by the American Conference of Governmental Industrial Hygienists is 25 ppm. The recommended limit adopted by the National Institute for Occupational Safety and Health is 35 ppm for 8-hour exposure and maximum instantaneous exposure of 200 ppm. While these lower numbers refer to ambient concentrations, the very high documented exhaust concentrations would quickly exceed the ambient levels in any operation in enclosed areas without extraordinary ventilation.

Large SI engines operating on any fuel can have very high CO emission levels. While our emission modeling estimates a significantly lower emission rate for engines fueled by LPG relative to gasoline, the study described above shows clearly that individual engines that should have low CO emissions can, through maladjustment or normal degradation, reach dangerous emission levels.

Additional exposure concerns occur at ice rinks. Numerous papers have identified ice-surfacing machines with spark-ignition engines as the source of dangerous levels of CO and NO_2, both for skaters and for spectators.[119] This is especially problematic for skaters, who breathe air

[117] United States Coast Guard, "Boating Safety Circular 64," December 1986. Docket A-2000-01, Document No. II-A-43.

[118] "Warehouse Workers' Headache, Carbon Monoxide Poisoning from Propane-Fueled Forklifts," Thomas A. Fawcett, et al, *Journal of Occupational Medicine*, January 1992, p. 12. Docket A-2000-01, Document No. II-A-36.

[119] "Summary of Medical Papers Related to Exhaust Emission Exposure at Ice Rinks," EPA Memorandum from Alan Stout to Docket A-2000-01. Docket A-2000-01, Document No. II-A-

in the area where pollutant concentration is highest, with higher respiration rates resulting from their high level of physical activity. This problem has received significant attention from the medical community.

In addition to CO emissions, HC emissions from all Large SI engines can lead to increased exposure to harmful pollutants, particularly air toxic emissions. Since many gasoline or dual-fuel engines are in forklifts that operate indoors, reducing evaporative emissions could have additional health benefits to operators and other personnel. Fuel vapors can also cause odor problems.

38.

III. Nonroad: General Concepts

This section describes general concepts concerning the proposed emission standards and the ways in which a manufacturer would show compliance with these standards. Clean Air Act Section 213 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. In addition to emission standards, this document describes a variety of proposed requirements such as applying for certification, labeling engines, and meeting warranty requirements to define a process for implementing the proposed emission-control program in an effective way.

The discussions in this section are general and are meant to cover all the nonroad engines and vehicles that would be subject to the proposed standards. Refer to the discussions of specific engine programs, contained in Sections IV through VI, for more information about specific requirements for different categories of nonroad engines and vehicles. We request comment on all aspects of these general program provisions.

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

A. Scope of Application

As noted in Section I.C.1, this proposal covers recreational marine diesel engines, nonroad industrial SI engines rated over 19 kW, and recreational vehicles introduced into commerce in the United States. The following sections describe generally when emission standards apply to these products. Refer to the specific program discussion below for more information about the scope of application and timing of the proposed standards.

1. Do the standards apply to all engines and vehicles or only to new engines and vehicles?

The scope of this proposal is broadly set by Clean Air Act section 213(a)(3), which instructs us to set emission standards for *new* nonroad engines and *new* nonroad vehicles. Generally speaking, the proposed rule is intended to cover all new engines and vehicles in the categories listed above (including any associated equipment or vessels).[120] Once the emission standards apply to a group of engines or vehicles, manufacturers must get a certificate of

[120]For some categories, we are proposing vehicle-based or vessel-based standards. In these cases, the term "engine" in this document applies equally to the vehicles or vessels.

conformity from us before selling them in the United States.[121] This includes importation and any other means of introducing engines and vehicles into commerce. We also require equipment manufacturers that install engines from other companies to install only certified engines once emission standards apply. The certificate of conformity (and corresponding engine label) provide 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 proposing to define "new" consistent with previous rulemakings. Under the proposed definition, a nonroad engine (or nonroad equipment) is considered new until its title has been transferred to the ultimate purchaser or the engine has been placed into service. This proposed definition would apply 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 would be considered new until their title has been transferred to an ultimate buyer. In Section III.B.1 we describe how to determine the model year of individual engines and vehicles.

To further clarify the proposed definition of new nonroad engine, we are proposing to specify that a nonroad engine, vehicle, or equipment is placed into service when it is used for its intended purpose. We are therefore proposing that an engine subject to the proposed standards is used for its functional purpose when it is installed on 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 this is a reasonable approach because the practice of adapting used highway or land-based nonroad engines may become more common if these engines are not subject to the standards in this proposal.

In summary, an engine would be subject to the proposed 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 a car or a category of nonroad equipment subject to different emission standards
- Installed in new nonroad equipment, regardless of the age of the engine
- Imported (new or used)

[121] The term "manufacturer" includes any individual or company introducing engines into commerce in the United States.

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

The proposed emission standards would apply to all new engines that are used in the United States. According to Clean Air Act section 216, "new" includes engines that are imported by any person, whether freshly manufactured or used. Thus, the proposed program would 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 would need an EPA-issued certificate of conformity to clear customs, with limited exemptions (as described below).

If an engine or marine vessel, recreational vehicle, or other piece of nonroad equipment that was built after emission standards take effect is imported without a currently valid certificate of conformity, we would still consider it to be a new engine, vehicle, or vessel. This means it would need 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 piece of equipment 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 abroad, transferring their title, and then importing them as used vessels.

With regard to recreational vehicles, the United States Customs Service currently allows foreign nationals traveling with their personal automobiles, trailers, aircraft, motorcycles, or boats to import such vehicles without having to pay a tariff, so long as they are used in the United States only for the transportation of such person.[122] We propose to use this approach in our regulation of emissions from recreational vehicles (snowmobiles, off-highway motorcycles, and all-terrain vehicles). We propose to allow noncompliant recreational vehicles that are the personal property of foreign nationals to be imported into the United States as long as the foreign national bringing them into the country intends to use them only for his or her recreational purposes and they are not left here when the person leaves the country (they are either taken back or destroyed). In other words, such recreational vehicles would not be considered "new" for the purpose of determining whether they must comply with the proposed emission limits. We propose that a time limit of one year on this exemption so that recreational vehicles imported for more than that period of time would be considered imported, and therefore "new" and subject to the proposed emission limits. We are also proposing that this time period cannot be extended. This time limit is designed to prevent a person from using the exemption to effectively circumvent the standards.

This exemption generally would not apply to any commercial engines that would be subject to emission standards. To import noncomplying engines for commercial applications, the importer would have to meet the requirements for a different exemption, as described in Section VII.

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[122]Harmonized Tariff Schedule of the United States (2001)(Rev. 1), subheading 9804.00.35. A copy of this document is included in Air Docket A-2000-01, at Document No. II-A-82.

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

Engines or vehicles intended for export would generally not be subject to the requirements of the proposed emission-control program. However, engines that are exported and subsequently re-imported into the United States would be need to be certified. For example, this would be the case 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 of the modification. 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.

5. Are there any new engines or vehicles that would not be covered?

We are proposing to extend our basic nonroad exemptions to the engines and vehicles covered by this proposal. 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 proposed emission standards do not apply to them. Refer to the program discussions below for a discussion of how these exclusions apply for different categories of engines.

B. Emission Standards and Testing

1. How does EPA determine the emission standards?

Our general goal in designing the proposed standards is to develop a program that will achieve significant emission reductions. We are guided by Clean Air Act section 213(a)(3), which instructs us to "achieve the greatest degree of emission reduction achievable through the application of technology the Administrator determines will be available for the engines or vehicles to which such standards apply, giving appropriate consideration to the cost of applying such technology within the period of time available to manufacturers and to noise, energy, and safety factors associated with the application of such technology." The Act also instructs us to first consider standards equivalent in stringency to standards for comparable motor vehicles or engines (if any) regulated under section 202, taking into consideration technological feasibility, costs, and other factors.

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

The proposed emission standards would be effective on a model-year basis. We are proposing to define model year much like we do for passenger cars. It would generally mean either the calendar year or some other annual production period based on the manufacturer's production practices. 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 would have to meet emission standards for that model year. For example, manufacturers producing new engines in the 2006 model year would need to comply with the 2006 standards. 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 would apply to crankcase and evaporative emissions?

Due to blow-by of combustion gases and the reciprocating action of the piston, exhaust emissions can 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 these pollutants. We have long required that automotive engines prevent emissions from the their crankcases. Manufacturers generally do this by routing crankcase vapors through a valve into the engine's air intake system. We are proposing to require that engines prevent crankcase emissions. We request comment on this proposed requirement for individual types of engines, as described in the those sections below.

For industrial spark-ignition engines, we are proposing standards to limit evaporative emissions. Evaporative emissions result from heating gasoline (or other volatile fuels) in a tank that is vented to the atmosphere. See Section IV for additional information.

3. What duty cycles is EPA proposing 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 simulates operation in the field, is critical in evaluating the likely emissions performance of engines designed to emission standards.

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.

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 recognizes the need for this practice, we are also concerned that engines maintain a consistent level of emission control for the whole range of adjustability. We are therefore proposing to require manufacturers to show that their engines meet emission standards over the full adjustment range.

Manufacturers would also have to provide a physical stop to prevent adjustment outside the established range. Operators would then be prohibited by the anti-tampering provisions from adjusting engines outside this range. Refer to the proposed regulatory text for more information about adjustable engine parameters. See especially the proposed sections 40 CFR 1048.115 for industrial SI engines and 40 CFR 1051.115 for recreational vehicles.

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 the use of 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 in several of our other nonroad rules, including commercial marine diesel. The general purposes of such programs are to provide incentives to manfuacturers to produce clean products as well as create market choices and opportunities for environmental information for consumers regarding such products. The voluntary aspects of these programs, which in part provides an incentive for manufacturers willing to certify their products to more stringent standards than necessary, is an important part of the overall application of “Blue Sky Series” programs.

We are proposing voluntary Blue Sky Series standards for many of the engines subject to this proposal. 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. For the program to be most effective, however, incentives should be in place to motivate the production and sale of these engines. We solicit ideas that could encourage the creation of these incentive programs by users and state and local governments. We also request comment on additional measures we could take to encourage development and introduction of these engines. Finally, we request comment on the Blue Sky Series approach in general as it would apply to the engines covered by this proposed rule.

C. Demonstrating Compliance

We are proposing a compliance program to accompany emission standards. This consists first of a process for certifying engine models. In addition to certification testing, we are proposing several provisions to ensure that emission-control systems continue to function over long-term operation in the field. Most of these certification and durability 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 would I certify my engines?

We are proposing a certification process similar to that already adopted for other 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, then the manufacturer's Certificate of Conformity allows the manufacturer to produce and sell the engines described in the application in the U.S.

We are proposing that manufacturers certify their engine models by grouping them into engine families. Under this approach, engines expected to have similar emission characteristics would be classified in the same engine family. The engine family definition is fundamental to the certification process and to a large degree determines the amount of testing required for certification. The proposed 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 generally 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. 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 would generally consider this useful life value in amount of operation to be a minimum value and would require manufacturers to comply for a longer period in those cases where they design their engines to operate longer than the minimum useful life. As proposed, manufacturers would be required to estimate the rate of deterioration for each engine family over its useful life. Manufacturers would show that each engine family meets the emission standards after incorporating the estimated deterioration in emission control.

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, we are proposing that manufacturers 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 would 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 ensures that all engines within the engine family are complying with emission standards.

We are proposing to require manufacturers to include in their application for certification the results of all emission tests 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 that form the basis of the manufacturer's application are a robust indicator of emission-control performance, rather than a spurious or incidental test result. We request comment on these data-reporting requirements.

Clean Air Act section 206(h) specifies that test procedures for certifying engines (including the test fuel) should adequately represent in-use operation. We are proposing test fuel specifications intended to represent in-use fuels. Engines would have to meet the standards on fuels with properties anywhere in the range of proposed test fuel specifications. The test fuel is generally to be used for all testing associated with the regulations proposed in this document, including certification, production-line testing, and in-use testing. Refer to the program discussions below for a discussion of the test fuel proposed for different categories of engines.

We are proposing to 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 would 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 would not limit the maintenance an operator could perform. It would merely limit the maintenance that operators would 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 would require every engine a manufacturer produces from the engine family to have an engine label with basic identifying information. We request comment on the proposed requirements for the design and content of engine labels, which are detailed in §1048.135 and §1051.135 of the proposed regulation text.

2. What warranty requirements apply to certified engines?

Consistent with our current emission-control programs, we are proposing that manufacturers provide a design and defect warranty covering emission-related components. As required by the Clean Air Act, the proposed regulations would require that the warranty period must be longer than the minimum period we specify 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. See the proposed regulation language for a description of which components are 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 if the operator failed to do prescribed maintenance that contributed to the warranty claim.

We are also proposing 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 meet standards with emission credits?

Many of our emission-control programs have a voluntary emission-credit program 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 reduce the cost and improve the technological feasibility of achieving standards, helping to ensure the attainment of the standards earlier than would otherwise be possible. Manufacturers gain flexibility in product planning and the opportunity for a more cost-effective 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 would allow a manufacturer to certify one or more engine families at emission levels above the applicable emission standards, as long as the increased emissions are offset by one or more engine families certified below the applicable standards. The over-complying engines generate credits that are used by the under-complying engines. Compliance is determined on a total mass emissions basis to account for differences in production volume, power and useful life among engine families. The average of all emissions for a particular manufacturer's production must be at or below that level of the applicable emission standards. This calculation generally factors in sales-weighted average power, production volume, useful life, and load factor. Banking and trading would allow a manufacturer to generate emission credits and bank them for future use in its own averaging program in later years or sell them to another company.

In general, a manufacturer choosing to participate in an emission-credit program would certify each participating engine family to a Family Emission Limit. In its certification application, a manufacturer would determine 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 that engine family. Emission credits are based on the difference between the emission standard that applies and the Family Emission Limit. We would expect the manufacturer to meet the Family Emission Limit for all emission testing. At the end of the model year, manufacturers would generally need to 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 could 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.

An alternative approach to requiring manufacturers to choose Family Emission Limits would be for us to create a discrete number of emission levels or "bins" above and below the proposed standard that manufacturers could certify to. These bin levels would then replace the Family Emission Levels in the credit calculations. We request comment on whether we should consider this approach for the engines covered by this proposal. The advantage of bins are that they can be defined by step changes in technology, which gives more assurance of emission reduction than Family Emission Limits which can change slightly with only marginal changes to the engine.

Refer to the program discussions below for more information about emission-credit provisions for individual engine categories. We request comment on all aspects of the emission-credit programs discussed in this proposal. In particular, we request comment on the structure of the proposed emission-credit programs and how the various provisions may affect manufacturers' ability to utilize averaging, banking, or trading to achieve the desired emission-reductions in the most efficient and economical way.

4. What are the proposed production-line testing requirements?

We are proposing production-line testing for recreational marine diesel engines, recreational vehicles, and Large SI engines. According to these requirements, manufacturers would 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 production-line engines in a particular engine family (see Section VII.E). Production-line testing requirements are already common to several categories of engines as part of their emission-control program.

A manufacturer's liability under the production-line testing program is limited to the test engine and any future production. If an engine fails to meet an emission standard, the manufacturer must modify it to bring that specific engine into compliance. If too many engines exceed emission standards, the engine family is determined to be in noncompliance and the manufacturer will need to correct the problem for future production. This correction 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.

The proposed production-line testing programs would depend on the Cumulative Sum (CumSum) statistical process for determining the number of engines a manufacturer needs to test (see the proposed regulations for the specific calculation methodology). Each manufacturer selects engines randomly at the beginning of a new sampling period. 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. A sampling period may be a quarter or a calendar year, depending generally on the size of the engine family. The Cumulative Sum program uses the emission results to calculate the number of tests required for the remainder of the sampling period to reach a pass or fail determination. If tested engines have relatively high emissions, the statistical sampling method calls for an increased number of tests to show that the engine family meets emission standards. 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.

Under the Cumulative Sum approach, individual engines can exceed the emission standards without bringing the whole engine family into noncompliance. Note, however, that we propose to require manufacturers to 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.

We are proposing to further reduce the testing requirements for engine families that consistently meet emission standards. For engine families with no production-line tests exceeding emission standards 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 would apply only for a single model year.

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. We therefore propose to allow a manufacturer to 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 approved the plan, we would use these criteria to determine when an engine family would become noncompliant. 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 the proposed emission-related installation instructions?

For manufacturers selling loose engines to equipment manufacturers, we are proposing to require the engine manufacturer to develop a set of emission-related installation instructions. This would include anything that the installer would need 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 emissions. We would approve the installation instructions as part of the certification process. If equipment manufacturers fail to follow the established emission-related installation instructions, we would consider this tampering, which could subject them to significant civil penalties. Refer to the program discussions below for more information about specific provisions related to installation instructions.

2. What is consumer-choice labeling?

California ARB has recently proposed consumer/environmental label requirements for outboard and personal-watercraft engines. Under this concept, manufacturers would label their engines or vehicles based on their certified emission level. California has proposed three different labels to differentiate varying degrees of emission control—one for meeting the EPA 2006 standard, one for being 20 percent lower, and one for being 65 percent below. More detail on this concept is provided in the docket.[123]

We are considering a similar approach to labeling the engines subject to this proposal. This would apply especially to consumer products. Consumer-choice labeling would give people the opportunity to consider varying emission levels as a factor in choosing specific models. This may also give the manufacturer an incentive to produce more of their cleaner engine models. A difficulty in designing a labeling program is in creating a scheme that communicates information clearly and simply to consumers. Given the very different emission levels expected from the various engines, it would be difficult to create a consistent set of labels for different engines. Also, we are concerned that other organizations could use the labeling provisions to mandate certain levels of emission control, rather than relying on consumer choice as a market-based incentive. We request comment on this approach for recreational marine engines and vessels and for recreational vehicles.

An alternative to the promotional-type label adopted by California ARB would be an approach that simply identifies an engine's certified emission levels on the emission-control label. This "informational label" could be used with or without defining voluntary emission standards. This would not provide a standardized way for manufacturers to promote their cleanest products, but it would give interested consumers the ability to make informed choices based on a vehicle's certified emission levels. We are proposing this approach of requiring an

[123] "Public Hearing to Consider Amendments to the Spark-Ignition Marine Engine Regulations," Mail Out #MSC 99-15, June 22, 1999 (Docket A-2000-01, Document II-A-27).

engine’s certified emission levels to be on the emission-control label for engines and vehicles certified to voluntary low emission or Blue Sky standards. We request comment on this approach and whether we should extend this requirement to all vehicles and engines, not just those complying with voluntary low emission standards. Also, we request comment on the relative advantages of the different approaches to consumer-choice labeling just discussed.

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

The Regulatory Flexibility Act, 5 U.S.C. 601-12, was amended by the Small Business Regulatory Enforcement Act of 1996 (SBREFA), Public Law 104-121, to ensure that concerns regarding small entities are adequately considered during the development of new regulations that affect them. The scope of this proposal includes many engine and vehicle manufacturers that have not been subject to our regulations or certification process. Many of these manufacturers are small businesses for which a typical regulatory program may be very burdensome. The sections describing the proposed emission-control program include discussion of proposed special compliance provisions designed to address this for the different engine categories. Section XI.B gives an overview of the inter-agency process in which we developed these small-volume provisions.

IV. Large SI Engines

A. Overview

This section applies to most nonroad spark-ignition engines rated over 19 kW ("Large SI engines"). The companies producing Large SI engines are typically subsidiaries of automotive companies. In most cases, these companies modify car and truck engines for industrial applications. However, the Large SI industry has historically taken a much less centralized approach to designing and producing engines. Engine manufacturers often sell dressed engine blocks without manifolds or fuel systems. Fuel system suppliers have played a big role in designing and calibrating nonroad engines, sometimes participating directly in engine assembly. Several equipment manufacturers, mostly forklift producers, also play the role of an engine manufacturer by calibrating engine models and completing engine assembly.

The proposed emission standards would achieve emission reductions of about 90 percent for CO, 85 percent for NOx, and 70 percent for 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 be especially valuable to individuals operating these engines in enclosed areas.

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. The large estimated fuel and maintenance savings relative to the estimated incremental cost of producing low-emitting engines raise the question of why normal market forces have failed to induce manufacturers to design and sell engines with emission-control technologies on the basis of the expected performance improvements. As described in Chapter 5 of the Draft Regulatory Support Document, we believe this is largely accounted for by the difficulty of equipment purchasers to justify increased capital spending on industrial machines, even with the potential for net savings over the lifetime of the equipment. This in turn prevents manufacturers from developing or implementing technologies in light of the uncertain demand. We request comment on the market dynamics that would prevent the development of and demand for cost-saving technologies.

This section describes the proposed requirements that would apply to engine manufacturers. See Section III 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 proposed requirements for engine manufacturers, equipment manufacturers, and others.

B. Large SI Engines Covered by this Proposal

Large SI engines covered in this section power nonroad equipment such as forklifts, sweepers, pumps, and generators. This would include 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.

Even though some aircraft use engines similar to the Large SI engines described in this proposal, we are not proposing emission standards for aircraft. Aircraft are covered under a separate part of the Clean Air Act. EPA's current aircraft regulations define aircraft as needing airworthiness certification from the Federal Aviation Administration. However, neither ultra-light airplanes nor blimps are governed by emission standards under our aircraft regulations. Ultra-light airplanes are exempt from the airworthiness-certification requirements in 14 CFR part 91. In contrast, blimps are subject to airworthiness certification, but EPA's emission standards for aircraft do not apply to them. Blimps are very likely to be able to use conventional land-based engines for propulsion and navigation. Our proposed definition of aircraft in these regulations would exclude all aircraft from emission standards, including aircraft that do not receive an airworthiness certificate from FAA. We may address this issue in a separate Federal Register notice.

This proposal applies only to spark-ignition engines. Our most recent rulemaking for nonroad diesel engines finalized a definition of "compression-ignition" that was intended to address the status of alternative-fuel engines (63 FR 56968, October 23, 1998). We are proposing to adopt 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. We request comment on whether we should revise the definitions that differentiate between these types of engines.

Several types of engines are excluded or exempted from the proposed requirements. 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, we do not treat stationary engines as nonroad engines, so the proposed emission standards would not apply to engines used in stationary applications. In general, an engine is considered stationary if it will be either installed in a fixed position or if it will be a portable (or transportable) engine operating in a single location for at least one year. We are proposing a requirement that these stationary engines have an engine label identifying their excluded status. This would be especially valuable for importing excluded engines without complication from U.S. Customs officials. It would also help us ensure that such engines are legitimately excluded from the emission standards proposed in this document.

2. Exclusion for engines used solely for competition

The Clean Air Act also does not consider engines used solely for competition to be nonroad engines. We would normally include this exclusion directly in the regulations. For Large SI engines, however, it seems unlikely that there would be any need for an explicit treatment of competition engines in the regulations. Any applications involving competition with spark-ignition engines would likely fall under the proposed program for recreational vehicles, which has an extensive treatment of competition engines. We request comment on the need for more detailed consideration of Large SI engines that may be used solely for competition.

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 propose to allow for this, as long as the manufacturer makes no changes to the engine that could affect its exhaust or evaporative emissions. We propose to require annual reporting for companies that use this exemption, including a list of engine models from each company. Manufacturers 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 proposed regulations describes the qualifying criteria and responsibilities in greater detail.

In addition, a vehicle manufacturer may want to produce vehicles certified to highway emission standards for nonroad use. We propose to allow this, as long as there is no change in the vehicle's exhaust or evaporative emission-control systems.

4. Lawn and garden engine exemption

Most Large SI engines 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, we propose that 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). These engines would then be exempt from the requirements proposed in this document. This approach would allow 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 would also be consistent with the provisions adopted by California ARB.

We are proposing the 30-kW cap to address our concern that treating all engines under one liter as Small SI engines may be inadequate. For example, lawn and garden engines generally don't use turbochargers or other technologies to achieve very high power levels. However, it may be possible for someone to design an engine under one liter with unusually high power, which would more appropriately be grouped with other Large SI engines with similar power capability rather than with Small SI engines. Motorcycles, for example, may produce 120 kW from a 750 cc (0.75 liter) engine. The 30-kW maximum power rating to qualify for treatment as Small SI engines represents a reasonable maximum power output that is possible from SI engines under one liter with technologies typical of lawn and garden engines. We request comment on the suggested power threshold and on any other approaches to addressing the issue of which standards should apply to engines in this intermediate size and power range.

We are proposing a temporary expansion of the lawn and garden exemption for small-volume manufacturers, as described in Section IV.E.

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 Small Nonroad SI engines. This proposal 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), we propose to allow any engine rated under 19 kW to certify to the more stringent Large SI emission standards. Such an engine would then be exempt from the requirements of 40 CFR part 90. Since manufacturers exercising this option would be voluntarily meeting a more stringent emission standard, this does not affect our earlier conclusions about the appropriate standards for engines rated under 19 kW.

We may also consider applying the Large SI emission standards to these smaller engines on a mandatory basis when engines above and below 19 kW share fundamental design features. We request comment on the need for, and appropriateness of, such an approach.

5. Special provisions for non-integrated engine manufacturers

We are aware that several Large SI engine manufacturers rely on other companies to supply engine blocks or partially assembled engines that are then modified for the final application. A similar situation occurs for some marine diesel engine manufacturers. To address this for the marine engines, we defined these companies as post-manufacture marinizers and created a variety of provisions to address their particular concerns (64 FR 73300; December 29, 1999).

The most important concern for these companies is the possibility that the company supplying the base engines may discontinue production with minimal notice. Once emission standards are in place, this would leave the manufacturer with a need to quickly design and certify a different engine to meet emission standards. One company has reported that two or three months are required to apply closed-loop catalyst systems to a new engine. With some additional time to complete the certification, a manufacturer in this situation would face a possible shutdown in engine assembly until the new engine is ready for production. For marine engines, we allow post-manufacture marinizers in this situation to request permission to produce uncertified engines for up to one year. The post-manufacture marinizer must show that it is not at fault and that it would face serious economic hardship without the exemption. We request comment on the need for such a provision for Large SI engines and on how to limit such a provision to companies that rely on partially assembled engines from unrelated companies. If we adopt provisions to address this concern, they would likely be similar to those adopted for marine diesel engines (see 40 CFR 94.209(b)). We also request comment on the potential for the proposed hardship provisions to address this concern (see Section VII.C and the proposed regulatory language in 40 CFR part 1068, subpart C).

C. Proposed Standards

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

An important element of the proposed control program is the attempted harmonization with the requirements adopted by California ARB. We are aware that inconsistent or conflicting requirements could lead to additional costs. Cooperation between agencies has allowed a great degree of harmonization, as reflected in this proposed rule. 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 proposed requirements in greater detail.

1. What are the proposed standards and compliance dates?

We propose to adopt 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 g/kW-hr (3 g/hp-hr) for HC+NOx emissions and 50 g/kW-hr (37 g/hp-hr) for CO emissions. See Section IV.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 would be similar to those used for many years in highway applications, but not necessarily with the same degree of sophistication.

Proposing emission standards for these engines starting in 2004 allows less than the usual lead time for meeting EPA requirements. We believe, however, that 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. We request comment on manufacturers' ability to produce EPA-compliant engines nationwide in 2004. Any comments should address whether there are issues related to production capacity as opposed to additional design or testing needs. As proposed, the emission standards would allow us to set near-term requirements to introduce the low-emission technologies for substantial emission reductions with minimal lead time. We request comment on adopting these standards for 2004 model year engines.

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. Starting with the 2007 model year, we propose to apply emission standards of 3.4 g/kW-hr (2.5 g/hp-hr) for HC+NOx emissions and 3.4 g/kW-hr (2.5 g/hp-hr) for CO emissions. These standards would apply to emission measurements during duty-cycle testing under both steady-state and transient operation.[124] As described in Chapter 4 of the Draft Regulatory Support Document, we believe manufacturers can achieve these proposed emission standards by optimizing currently available three-way catalysts and electronically controlled fuel systems. As described in Section IV.D.5, we propose to apply field-testing standards of 4.7 g/kW-hr (3.5 g/hp-hr) for HC+NOx emissions and 5.0 g/kW-hr (3.8 g/hp-hr) for CO emissions for 2007 and later model year engines.

The proposed 2007 standards described above reflect the importance of adopting standards that protect human health when regulating engines that often operate in enclosed areas, but also include numerous applications that operate predominantly outdoors. Emission-control technologies for Large SI engines generally pose a tradeoff between controlling NOx and CO emissions. Chapter 4 of the Regulatory Support Document presents multiple scenarios of emission standards with a comparison of calculated ambient NO, NO_2, and CO levels. We request comment on a combination of emission standards that would shift to increase or decrease the emphasis on controlling CO emissions. To increase the relative control of CO emissions, we would consider emission standards of 4.0 g/kW-hr (3.0 g/hp-hr) HC+NOx and 2.5 g/kW-hr (1.9 g/hp-hr). To focus more on reducing HC+NOx emissions, we would consider emission standards of 2.6 g/kW-hr (2.0 g/hp-hr) HC+NOx and 4.4 g/kW-hr (3.3 g/hp-hr) CO. We have narrowed this range of alternative standards to a relatively narrow range to account for the concern for individuals who may be exposed to exhaust emissions in enclosed spaces or other areas with limited airflow. We request comment on the appropriate emission standards for Large SI engines and our analysis of CO vs. HC + NOx tradeoffs found in the RIA. We also request comment on the potential for manufacturers to take further steps to adopt automotive-type technologies that would reduce emissions beyond than the levels proposed in this document, either starting in 2007 or in a subsequent phase of standards.

Gasoline-fueled engines, which must generally operate with rich air-fuel ratios at heavy loads to avoid premature engine wear from overheating components, are further constrained in their ability to simultaneously control CO and HC+NOx emissions. Furthermore, these engines are more likely to be used outdoors, where there is less concern for elevated exposure levels. We are therefore proposing to adopt alternate 2007 standards of 1.3 g/kW-hr (1.0 g/hp-hr) for HC+NOx emissions and 27 g/kW-hr (20 g/hp-hr) for CO emissions. These alternate standards are based on preliminary emission measurements with optimized gasoline-fueled engines showing the tradeoff of increasing CO emissions at very low NC+NOx levels. We are not proposing any restriction on manufacturers' use of the alternate standards (for example, for

[124] See Section IV.D for a discussion of duty cycles.

specific fuels or applications). Rather, we expect the marketplace to ensure that low-CO engines are selected for applications involving significant operation in enclosed or partially enclosed areas. We believe this approach will maximize HC+NO emission reductions from engines where that is the most important emission contribution.

Except for these alternate standards, the proposed emission standards would apply uniformly to all Large SI engines. As described in the Draft Regulatory Support Document, based on our current information, we do not believe variations among engines significantly affect their potential to reduce emissions or their cost of meeting emission standards. We request comment on whether it is appropriate to differentiate between subclasses of engines to more closely tailor emission standards to the capabilities of individual engines or based on other relevant criteria, including cost. Also, Large SI engines power a wide range of equipment. We request comment on the ability of Large SI engines in various applications to incorporate emission-control technologies and maintain control of emissions over the full useful life. We currently have no information indicating that application-specific emission standards are appropriate for this class of engines, but we request comment on whether there are relevant distinctions with respect to different applications. We further request comment on whether application-specific standards may be relevant for Large SI engines and, if so, what those standards should be. Commenters should suggest an appropriate way of addressing any such distinctions in the regulations. Finally, we have developed this proposal based on the view that it is appropriate to set standards without regard to fuel type to prevent incentives for manufacturers to design engines to be fueled by fuels subject to less stringent standards. We have proposed standards based on this approach, but request comment on whether there are advantages to setting separate emission standards for engines powered by different fuels, and in particular, on the appropriate levels for such standards. A further discussion of the feasibility, estimated cost, and emission reductions are in the Draft Regulatory Support Document.

We believe that 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 proposed 2004 emission standards should be capable of meeting the proposed 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 proposed 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 IV.D.5, since engines will not be following a prescribed duty cycle. EPA requests comment on the timing of the second phase of emission standards. Commenters should address the need to design and certify engines, distinguishing between time needed for developing new technology, recalibration of existing technology, development of test facilities, and the time needed to conduct testing. We also request comment on the air quality implications of adjusting the date of the long-term standards.

For gasoline and LPG engines, we are proposing the emission standard based on total hydrocarbon measurements, while California ARB standards are based on nonmethane hydrocarbons. We believe that switching to measurement based on total hydrocarbons should simplify testing, especially for field testing of in-use engines with portable devices (See Section

IV.D.5). To maintain consistency with California ARB standards in the near term, we propose to allow manufacturers to base their certification through 2006 on either nonmethane or total hydrocarbons (see 40 CFR 1048.145 of the proposed regulations). Methane emissions from controlled engines operating on gasoline or LPG are about 0.1 g/kW-hr. We request comment on this approach.

Most of the emission data on which we base the proposed emission standards were generated from engines using liquefied petroleum gas (LPG). 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 therefore propose to use nonmethane hydrocarbon emissions for comparison with the standard for natural gas engines. While the proposed emission standards based on measuring emissions in the field depend on total hydrocarbons, this is inconsistent with the nonmethane hydrocarbon measurements for certifying natural gas engines. We therefore propose to set a NOx-only field-testing standard for natural gas engines instead of a NOx+HC standard. Since control of NOx emissions poses a significantly greater challenge for natural gas engines, certification testing should provide adequate assurance that these engines have sufficiently low nonmethane hydrocarbon emissions. We request comment on this proposed arrangement of emission standards and testing requirements to account for methane.

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

As described in Section III, we often give manufacturers the option of showing they meet emission standards using an emission-credit program that allows them to introduce a mix of technologies with average emission levels below the standards. The emission standards for Large SI engines proposed above are based on full compliance by all engine families without averaging, banking and trading at certification. (Note the separate discussion of averaging, banking, and trading that applies to testing in-use engines in Section IV.D.4.) In determining whether we should adopt an averaging, banking, and trading program in connection with promulgating a standard, we need to consider whether the adoption of such a program would affect the determination of what emission standards would "achieve the greatest degree of emission reduction achievable through [available technology]... giving appropriate consideration to the cost of applying such technology within the period of time available to manufacturers and to noise, energy, and safety factors associated with the application of such technology". The standards we are proposing for Large SI engines reflect our assessment of these statutory factors in the absence of an ABT program for these engines. If, after notice and comment, we decide that an ABT program is appropriate, we will need to reassess the appropriate level of these standards considering the statutory factors. The emission data described in the Draft Regulatory Support Document show that while all engines in this category are likely to be able to meet the proposed standard, some engines in this category are likely to be capable of operating at a level below the level of the proposed emission standards. Incorporating an emission-credit program without adjusting the emission standards would allow manufacturers to produce some engines that have emissions that are higher than the levels we believe are capable of being met by all engines in the category. Given the emission data supporting the proposed emission standards, we believe that we would therefore need to set more stringent emission standards with averaging, banking, and trading provisions to achieve the "greatest degree of emission reduction" from these engines.

We request comment on including provisions to average, bank, and trade emission credits. We believe the appropriate standards with an emission-credit program would be 2.7 g/kW-hr (2.0 g/hp-hr) for HC+NOx emissions and 2.7 g/kW-hr (2.0 g/hp-hr) for CO emissions. See the Draft Regulatory Support Document for further discussion of this issue. Making the comparable adjustments to the field-testing measurements described in Section IV.D.5 leads to field-testing standards under an emission-credit program of 3.8 g/kW-hr (2.8 g/hp-hr) for HC+NOx emissions and 4.0 g/kW-hr (3.0 g/hp-hr) for CO emissions.

In addition, considering the frequent use of Large SI engines in enclosed areas, we may need to cap Family Emission Levels sufficiently to address concerns for exposure to elevated concentrations of CO, NO, and NO2 emissions. The Draft Regulatory Support Document shows that emission levels of 3.4 g/kW-hr for HC+NOx and for CO appear to be appropriate limits related to a scenario of exposure in enclosed or other limited-air flow areas. We also believe that there is no type of engine or application in the Large SI field that cannot accommodate the basic technologies associated with these emission levels, so this emission level would serve as an appropriate cap on Family Emission Levels in an emission-credit program for both HC+NOx and CO emissions. We request comment on these issues.

For additional, general provisions of an emission-credit program, see the proposed regulation language in part 1051, subpart H for recreational vehicles. We request comment on all aspects of averaging, banking, and trading for Large SI engines. Commenters should address appropriate emission levels for the potential mix of technologies under consideration. This should include a discussion of any technology or market constraints (or incentives) that would lead manufacturers to differentiate their engines with varying degrees of emission control. In addition, we request comment on the possibility that small-volume manufacturers with a limited product offering will be disadvantaged by an emission-credit program that may give larger companies a competitive advantage in selected markets.

As an alternative to a program of calculating emission credits for averaging, banking, and trading, we are proposing a simpler approach to help manufacturers transition to the proposed 2007 emission standards (see 40 CFR 1048.145 of the proposed regulations). Under this "family banking'" concept, we would allow manufacturers to certify an engine family early. For each year of certifying an engine family early, the manufacturer would be able to delay certification of a smaller engine family by one year. This would be based on the actual sales of the early family and the projected sales volumes of the late family; this would require no calculation or accounting of emission credits. The manufacturer would verify that actual sales are consistent with projected sales at the end of the model year.

3. Is EPA proposing Blue Sky standards for these engines?

We are proposing a staggered Blue Sky approach aligned with the introduction of new emission standards. In the 2003 model year, manufacturers could 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 would be available to customers outside of California desiring emission reductions or fuel-economy improvements. We request comment on whether we should make this available to 2002 model year engines. Similarly, for 2003 through 2006 model years, manufacturers could certify their engines to the requirements that start to apply in 2007. Finally, we propose to set a target of 1.3 g/kW-hr (1.0 g/hp-hr) HC+NOx and 3.4 g/kW-hr (2.5 g/hp-hr) CO as a qualifying level for Blue Sky Series engines for all model years. The corresponding field-testing standards for Blue Sky Series engines would be 1.8 g/kW-hr (1.4 g/hp-hr) HC+NOx and 5.0 g/kW-hr (3.8 g/hp-hr) CO. We request comment on the level of the voluntary standards starting in 2007. We also request comment on the advantages of additional labeling provisions that would advertise or promote these low-emission products.

4. What durability provisions apply?

a. Useful life

We propose to set a minimum useful life period of seven years or until the engine accumulates at least 5,000 operating hours, whichever occurs first. This figure, which California ARB also 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. In a previous rulemaking, we adopted a provision for a manufacturer to ask us to approve a useful life shorter than the minimum period that would otherwise apply. This shortened useful life would be based on information from manufacturers showing how long their engines typically operated. Extending that provision to Large SI engines would depend on a manufacturer including only engines from severe-duty applications in a given engine family. The likely practical benefits of segregating severe-duty engines would be to shorten the period for establishing deterioration factors and to avoid in-use testing on engines that are no longer meeting emission standards. We request comment on the appropriate approach to useful life values for severe-duty and other Large SI engines. We also request comment on any other limitations on manufacturers' ability to meet the proposed requirements that may be particular to severe-duty engines.

b. Warranty

We are proposing that manufacturers provide an emission-related warranty for at least the first half of an engine's useful life (in operating hours) or 3 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. In addition, we are proposing the warranty provisions adopted by California ARB for high-cost parts. For emission-related components whose replacement cost is more than about $400, we are proposing 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. We request comment on these proposed warranty provisions.

c. Maintenance instructions

We are proposing to apply 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. We propose to allow manufacturers to schedule maintenance on the following components after 4,500 hours of use: catalysts, fuel injectors, electronic controls and sensors, and turbochargers.

There are two areas of maintenance for which we are especially concerned. The first is related to the durability of oxygen sensors. We recognize that if an oxygen sensor degrades or fails, emissions can increase significantly. It is important to create a strong incentive to use the most durable oxygen sensors available. That is why we are proposing to apply the 4,500-hour minimum interval to scheduled maintenance of oxygen sensors. We are also proposing diagnostic requirement to ensure that prematurely failing oxygen sensors are detected and replaced on an as-needed basis. If operators would fail to replace oxygen sensors after a fault signal, we would not consider that engine to be properly maintained. This would invalidate the emission-related warranty and make the engine ineligible for manufacturer in-use testing. We request comment on this approach.

Our second area of concern is related to the potential need to clean LPG fuel mixers. We are aware that for some existing designs, fuel mixers can become fouled to the point that they are unable to achieve proper control of air-fuel ratios. When this occurs, it can usually be remedied by simply removing the mixer and cleaning it. Chapter 4 of the Draft Regulatory Support Document describes this in further detail, including emission test data showing that fuel systems can be quite tolerant of deposits from fuel impurities. We request comment on (1) additional test data showing an effect of mixer fouling on emissions, (2) whether we should add mixer cleaning as a possible scheduled-maintenance item, and (3) how manufacturers could ensure that operators of in-use engines would do this cleaning.

d. Deterioration factors

We are proposing an approach that gives manufacturers wide discretion to establish deterioration factors for Large SI engines. The general expectation is that manufacturers will rely on emission measurements from engines 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. We expect to review deterioration factors to ensure that the projected deterioration is consistent with any engine testing under in-use testing program. In the first two or three years of certification, we would rely on manufacturers' technical judgment (instead of results from in-use testing) to appropriately estimate deterioration factors to protect themselves from the risk of noncompliance.

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 fuel quality for LPG. As a result, LPG composition can vary widely. Limited testing data show that this varying fuel quality has a relatively 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. In any case, a routine cleaning step should remove deposits and restore the engine to proper functioning. We are aware of no systematic study of the effect of these deposits on in-use emissions, either from highway or from nonroad engines.

We request comment on the following things with respect to the quality of in-use LPG:

- The degree to which fuel quality affects emission durability, with supporting data.
- The ability of the proposed diagnostic requirements to alert the operator to the need for maintenance when the engine is no longer able to control air-fuel ratios at stoichiometry.
- The need for manufacturers to specify cleaning of fuel systems as part of critical emission-related maintenance, as described above.
- The possibility of applying engine technology to prevent fuel-related deposits.
- The potential to develop an industry-wide specification for in-use LPG motor fuels.
- The costs and benefits of fuel additives designed to prevent fuel-related deposits and how we could ensure that in-use fuels consistently include any appropriate additives.

5. 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 can accumulate in the crankcase. Uncontrolled engine designs route these vapors directly to the atmosphere. We have long required that automotive engines prevent emissions from the engine's crankcase. Manufacturers generally do this by routing crankcase vapors through a valve into the engine's air intake system. We propose to require manufacturers to prevent crankcase emissions from Large SI engines. Since automotive engine blocks are already tooled for closed crankcases, the cost of adding a valve for positive-crankcase ventilation is very small. See the Draft Regulatory Support Document for further discussion of the costs and emission reductions associated with crankcase emissions.

b. Diagnosing malfunctions

We propose to require that Large SI engines 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.[125] 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.

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

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 false failures as much as possible. The proposed diagnostic requirements therefore focus on detecting inappropriate air-fuel ratios, which is the most likely failure mode for three-way catalyst systems. We propose to specify that the malfunction-indicator light should go on when an engine operates for a full minute without reaching a stoichiometric air-fuel ratio. If this specified time is too long, we could be allowing extended open-loop operation with increased emission levels. We request comment on whether this approach is appropriate and whether this one-minute period should be longer or shorter to provide timely detection without causing false failures. In addition, we request comment on the appropriateness of other malfunction indicators, such as a measuring the frequency of crossing stoichiometry or monitoring the voltage range of oxygen sensors.

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

[125] 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.

air-fuel ratios, catalyst conversion is not as sensitive to air-fuel ratio as with stoichiometric designs. We request comment on whether these engines should show a malfunction condition when departing from a targeted air-fuel ratio, or whether some other parameters would more appropriately detect for any possible failure modes.

For cars and light-duty trucks, our diagnostic system requirements call for monitoring of misfire and reduction in catalyst conversion efficiency. We are not proposing these additional diagnostic features for nonroad Large SI engines. Requiring misfire and catalyst conversion monitoring, which are more difficult to detect, would require extensive development effort to define appropriate failure thresholds and for manufacturers to design systems to avoid false failures and false positive detection. In the context of this rulemaking, which proposes initial standards for nonroad Large SI engines, we believe it is important for manufacturers to design engines for low emissions before taking the step of designing a thorough, complex diagnostic system. We believe that monitoring air-fuel ratio will achieve the majority of the benefit available from diagnostic systems at a reasonable cost. Moreover, without a corresponding inspection-and-maintenance program, operators are most likely to respond to diagnostic warnings with a system that is clear and simple.

An example illustrates a typical scenario. One forklift operator driving an LPG-powered lift truck with three-way catalyst and closed-loop electronic controls noticed that he was able to run two hours shorter than usual on a standard tank of fuel. Since power characteristics were not noticeably affected, the operator had done no maintenance or investigation to correct the problem. Simply replacing the defective oxygen sensor restored the engine to its original level of performance (for fuel consumption and emission control). A diagnostic light would serve to alert operators that the engine needs attention and would provide help in identifying any specific parts causing the problem. Since the basic function of a three-way catalyst system is generally consistent with power and fuel-economy considerations, operators would have good reason to respond to a diagnostic light.

The automotive industry has developed a standardized protocol for diagnostic systems, including hardware specifications, and uniform trouble codes. Some of these will apply to nonroad engines, but some will not. In the proposed regulations we reference standards adopted by the International Organization for Standardization (ISO) for automotive systems. If these standards do not apply to the simpler diagnostic design proposed 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.

As described in the proposed regulatory text, the malfunction light should go on when the system detects a malfunction and must stay on until the engine is serviced or until the engine returns to consistent, normal operation. Stored diagnostic trouble codes would identify as closely as possible the cause of the malfunction, which could then be read by any qualified technician.

We request comment on these proposed diagnostic system requirements.

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. 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.[126] This study did not take into account the possibility of unusually high fuel temperatures during engine operation, as described further below.

We are proposing to require basic measures to reduce evaporative emissions from gasoline-fueled Large SI engines. The usual approach to regulating emissions from nonroad and other mobile engines is to define a measurement procedure and adopt numerical limit values (or standards) that together determine a minimum required level of performance. Manufacturers are then free to use any kind of technology to meet these performance standards.

Since the Act directs us to first consider regulating nonroad engines with standards similar to those that apply to motor vehicles, we must consider test-based evaporative emission standards that would be comparable to those for automobiles. However, we have practical concerns with requiring that approach as the only option for manufacturers. These concerns relate primarily to the nonintegrated nature of these industries and the wide variety of applications in which the engines are used. Some manufacturers could face difficulties certifying to specific numerical emission levels because of the large variation in fuel system components needed to fit the many varied kinds of equipment. While a test-based standard may be feasible,

[126] "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.

we believe we should allow the use of other cost-effective approaches that could be more appropriate for this industry.

We propose to adopt an evaporative emission standard of 0.2 grams per gallon of fuel tank capacity for heating a fuel tank from 72° to 96° F. We further propose that manufacturers can rely on a design-based certification instead of measuring emissions by adopting one of the designs described in this paragraph. We have identified four technologies that would adequately prevent evaporative emissions to show compliance with the proposed evaporative emission standard. First, 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 psi or for vacuum pressures of at least 1.5 psi.[127] Any Large SI engines or vehicles operating with these pressures would satisfy the certification requirements. Second, for applications where such high fuel tank pressures are undesirable, manufacturers could instead rely on an air bladder inside the fuel tank that changes in volume to keep the system in equilibrium at atmospheric pressure.[128] Third, an automotive-type system that stores fuel tank vapors for burning in the engine would be another alternative technology. Finally, collapsible bladder tanks, which change in volume to prevent generation of a vapor space or vapor emissions, are also commercially available. Also, similar to the Underwriters Laboratories' requirement, we are proposing 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. Section 1048.105 of the proposed regulations describes these design specifications in greater detail. We request comment on these approaches and on whether we should consider tank insulation as an alternative or complementary strategy for meeting the proposed requirements on a design basis.

In addition, we propose to require that engine manufacturers 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.[129] 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.

Finally, manufacturers can take steps to reduce fuel temperatures during operation. The use of fuel injection and the associated recirculating fuel lines and in-tank fuel pumps may even

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[127] "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.E for our consideration of incorporating the UL requirements into our regulations by reference.

[128] "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.

[129] SAE J2260 "Nonmetallic Fuel System Tubing with One or More Layers," November 1996.

increase the heat load into the fuel tank, which would tend to increase emission rates generally and may increase the occurrence of 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.[130] We are proposing a standard that prohibits fuel boiling during continuous operation at 30° C (86° F). Engine manufacturers would have to 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 proposed exhaust emission standards. While we are not proposing to 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 would eliminate most hot soak emissions. We request comment on whether the procedure described in the previous paragraphs would require fuel injection. In addition, we request comment on the possibility of meeting the 2007 exhaust emission standards with carbureted engines.

Engine manufacturers using design-based certification would 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 would include emission-related installation instructions that the engine manufacturer would give to equipment manufacturers.

With the ready availability of automotive technology and the development effort already in place to meet Underwriters Laboratories' requirements, we believe the proposed evaporative-control provisions would not pose a major development burden in most cases. We expect manufacturers generally to meet the proposed evaporative requirements with low-cost, off-the-shelf technologies. Individual engines may need somewhat more development effort to ensure compliance, but the hardware and testing costs would be minimal. We estimate an average cost of about $10 per engine for those engines that would be subject to evaporative-emission standards. Once this program is fully phased in, we estimate over 7,500 tons of HC reductions annually. See the Draft Regulatory Support Document for further information about the estimated costs and benefits of evaporative emission controls.

Reducing evaporative losses would not only provide health and safety advantages, but would contribute to overall fuel savings from Large SI engines. We request comment on the proposed measures to control evaporative emissions, including the potential cost and

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

effectiveness of (1) an evaporative emission standard at 0.2 g/gal of fuel, (2) the optional design standards, and (3) the proposed fuel-line and fuel-temperature requirements. We also request comment on any additional or complementary approaches.

D. Proposed Testing Requirements and Supplemental Emission Standards

1. What duty cycles would be used to measure emissions?

For 2004 through 2006 model years, we are proposing to use the same steady-state duty cycles adopted by California ARB. For most engines this involves the testing based on the ISO C2 duty cycle, with a separate duty cycle for constant-speed applications based on the ISO D2 duty cycle. These duty cycles are described further below.

Starting in 2007, we are proposing an expanded set of duty cycles, again with separate treatment for variable-speed and constant-speed applications. These duty-cycles are each 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 emission standards that apply. In general, the proposed duty-cycles are intended to include representative 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. Chapter 4 of the Draft Regulatory Support Document describes the duty cycles in greater detail. We request comment on the proposed duty cycles.

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 IV.D.5.

The warm-up segment begins with a cold-start. This means that the engine should be very near room temperature before the test cycle begins. Once the engine is started, it would be operated 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. The 3-minute 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.

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. 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. The principal duty cycle is based on the ISO C2 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. 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.

Engines such as generators, welders, compressors, and pumps are governed to operate only at a single speed with varying loads. We are proposing a combination of transient and steady-state testing that applies specifically to constant-speed engines. The transient duty-cycle segment includes 20 minutes of engine operation based on measured welder operation. We expect to propose this same transient duty cycle for constant-speed nonroad diesel engines. Manufacturers would also test constant-speed Large SI engines with steady-state operation 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 selling engines for both constant-speed and variable-speed applications would omit the constant-speed transient test, since that operation is included in the general transient test.

We are concerned that engines certified with the C2 duty cycle may be installed in constant-speed applications; or, similarly that engines certified with the D2 duty cycle may be installed in variable-speed applications. 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. To address this, we are proposing that manufacturers routinely test engines on both the C2 and D2 duty cycles.[131] Manufacturers selling only a variable-speed or only constant-speed engines in an engine family would be allowed to omit testing with the duty cycle that would not apply. With a more limited certification, however, we would require the manufacturer to add information to the engine label and any emission-related installation instructions to clarify that the engine has a

[131] It would not be necessary to repeat the warm-up and transient segments for additional steady-state duty cycles.

limited certification. We request comment on this approach to variable- and constant-speed engines.

Some diesel-derived engines operating on natural gas with power ratings up to 1,500 or 2,000 kW may be covered by the proposed emission standards. Engine dynamometers with transient-control capabilities are generally limited to testing engines up to 500 or 600 kW. We propose at this time to waive emission standards and testing requirements related to transient duty cycles for engines above 560 kW. We would likely review this provision for Large SI engines once we have reached a conclusion on the same issue for nonroad diesel engines. We would expect to treat both types of engines the same way. Note that the field-testing emission standards still apply to engines that don’t certify to transient duty-cycle standards.

2. What fuels would be used during emission testing?

For gasoline-fueled Large SI engines, we are proposing to use the same specifications we have adopted 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).

For LPG and natural gas, we are proposing to use the same specifications adopted by California ARB. We understand that in-use fuel quality for LPG and natural gas 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 Draft 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.

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

We request comment on appropriate fuel specifications for all types of engine testing.

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

The provisions described in Section III.C.4 apply to Large SI engines. These proposed 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 propose to 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 are not proposing to require routine transient testing of production-line engines. We believe that steady-state emission measurements will give a good indication of manufacturers' ability to build engines consistent with the prototypes on which their certification data are based. We also propose, however, to reserve the right 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 would recommend doing transient tests to better ensure that in-use tests will not reveal problems in controlling emissions during transient operation. Manufacturers would not need to make any measurements to show that production-line engines can meet field-testing emission standards.

We request comment on all aspects of the proposed production-line testing requirements, including engine sampling rates and options for using alternative testing methods.

4. Are there proposed 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 proposing to require engine manufacturers to conduct emission tests on a small number of field-aged engines to show they meet emission standards.

Under the proposed program, 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 (see Table IV.D-1). Most companies would 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. We request comment on this maximum rate of testing engines under the proposed in-use testing program.

Table IV.D-1
Maximum In-Use Testing Rate

Number of Engine Families for a Manufacturer	Maximum Number of Families Subject to In-Use Testing Each Year
1	1
2	1
3	1
4	1
5	1
6	1
7	1
8	2
9	2
10	2
11	2
12	3

We are also proposing that manufacturers in unusual circumstances have the ability to 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. We request comment on these provisions.

While this flexibility for alternate measurements would be available to small-volume manufacturers, we also request comment on applying in-use testing requirements to very small-volume engine families in general. While the proposed regulations would allow us to select an engine family every year from an engine manufacturer, there are several reasons why small volume manufacturers could 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 could provide adequate data to show compliance for that engine family for a number of years, provided the manufacturer continues to produce those engines without significantly redesigning them in a way that could affect their in-use emissions performance and that we do not have other reason to suspect noncompliance. Also, where we had comfort that a manufacturer's engines were likely in good in-use compliance, we would 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 could expect that we would select their engine families less frequently, especially if other available data pointed toward clear in-use compliance.

We are also proposing that manufacturers in unusual circumstances have the ability to develop an alternate plan to fulfill any in-use testing obligations. These include total sales for an engine family below 200 per year, installation only in applications where testing is not possible without irreparable damage, or any other unique feature that prevents full emission measurements. We request comment on these provisions. While this flexibility would be available to small-volume manufacturers, we also request comment on applying in-use testing requirements to these companies in general. While the proposed regulations would allow us select an engine family every year from an engine manufacturer, there are reasons why these companies could expect a less demanding approach. First, to avoid unfair treatment of individual manufacturers, we would 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 could expect that we would select their engine families less frequently. 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 would be 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.

Second, manufacturers may use the proposed equipment and procedures for testing engines without removing them from the equipment (referred to in this document as field-testing). See Section IV.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 would be demonstrated by comparing the measured emission levels to the proposed field-testing emission standards, which would 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 would not be eligible to participate in the in-use averaging, banking, and trading program (described below).

We could give directions to include specific types of normal operation to confirm that engines are controlling emissions in real operation. For example, for testing to show compliance with field-testing emission standards, we may identify specific types of operation on specific days or times to sample emissions, as long as these fall within the range of normal operation for the application. Dynamometer testing might include operation over a torque-speed trace measured from any appropriate equipment. If we don’t provide specific direction, manufacturers would use their discretion to show that engines comply with the field-testing standards, much like for certification (see Section IV.D.5).

Along with the in-use testing program, we are proposing an in-use credit program designed to reduce compliance cost without reducing environmental benefits. The program would provide manufacturers with flexibility in addressing potential in-use noncompliance in a way that we agree would avoid the need for a determination of nonconformity under Clean Air Act section 207(c), and thereby avoid a recall. Participation in this program would be voluntary.

The flexibility of the proposed in-use credit program is appropriate given the particular circumstances of the Large SI engine industry. For an engine family failing in-use testing, we believe recalling the nonconforming engines may be particularly burdensome and impractical for this industry, mainly due to the difficulty of tracking the nonconforming engines. Recalling the engines would therefore require substantial resources, yet may not be highly effective in remedying the excess emissions.

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). Once we make this determination, recall would be necessary to remedy the nonconformity. However, under these circumstances, where it is expected that recall would be impractical and largely ineffective, it is appropriate not to make a determination of substantial nonconformity where a manufacturer uses emission credits to offset in-use noncompliance. Thus, under the Clean Air Act, we may choose to make no section 207(c) determination of substantial nonconformity where an engine manufacturer uses emission credits to offset any noncompliance with the statute's in-use performance requirements. Though the language of section 213(d) is silent on the issue of emission credits, it generally allows considerable discretion in determining what modifications to the highway regulatory scheme are appropriate for nonroad engines.

In-use credits would be based on in-use testing conducted by the manufacturer. For a given engine family, the in-use compliance level would be determined by averaging the results from in-use testing performed for that engine family. If the in-use compliance level is below the applicable standard, the manufacturer would generate in-use credits for that engine family. If the in-use compliance level is above the standard, the engine family would experience a credit deficit. Manufacturers calculate credits based on the measured emission levels (when compared with applicable emission standards) and several additional variables, such as rated power, useful life, and engine family population. To ensure that emission credits show a real degree of emission control relative to the emission standard, we are proposing that emission credits must be based on transient duty-cycle operation on a dynamometer. An exception would apply for averaging emission levels from 2004 through 2006 model year engines, where we would allow for emission credits based on steady-state emission testing.

While we are proposing the in-use credit program adopted by California ARB, an additional concern relates to the status of emission credits over the long term. This would be our first step in setting emission standards for this category of engines, which increases the uncertainty of setting standards requiring the "greatest degree of emission reduction achievable," as called for in the Clean Air Act. If manufacturers are able to use the projected technologies to consistently achieve emission levels even lower than we require, in-use testing over several years can lead to a large pool of in-use emission credits. To avoid making the in-use testing program meaningless for some engines, especially in the context of a transition to a next tier of emission standards , we would not intend to use credits older than three model years in deciding whether to take administrative action under section 207(c). This should address the concern for accumulating credits without taking away EPA and the manufacturers' substantial flexibility to use credits to offset marginally noncompliant engines.

We request comment on all aspects of the proposed in-use testing requirements.

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

To enable field-testing of Large SI engines and to address concerns for controlling emissions outside of the specific duty cycles proposed to measure emissions for certification, we are proposing 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, this provides a low-cost method of testing in-use engines. Second, testing has shown that emissions can vary dramatically under certain modes of operation. 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 manufacturers with a framework for showing that their engines will 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 proposing supplemental emission standards that apply more broadly than the duty-cycle standard. These standards would apply to all regulated pollutants (NOx, HC, and CO) under all normal operation (steady-state or transient). We propose to exclude abnormal operation (such as very low average power and extended idling time), but not restrict operation to any specific combination of speeds and loads. In addition, we are proposing that the field-testing standards would 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. What are the field-testing emission standards?

Starting with the 2007 model year, we propose to apply field-testing emission standards of 4.7 g/kW-hr (3.5 g/hp-hr) for HC+NOx emissions and 6.7 g/kW-hr (5.0 g/hp-hr) for CO emissions. As described above for the duty-cycle standards, we believe manufacturers will be able to use the additional time beyond 2004 to optimize their designs to control emissions under the full range of normal in-use operation. As described in Chapter 4 of the Draft Regulatory Support Document, we believe manufacturers can achieve these proposed emission standards using currently available three-way catalysts and electronically controlled fuel systems.

As described above, we are proposing alternate emission standards for those engines operating predominantly outdoors. The corresponding proposed field-testing standards are 1.8 g/kW-hr (1.3 g/hp-hr) for HC+NOx emissions and 41 g/kW-hr (31 g/hp-hr) for CO emissions.

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 proposing specific field-testing standards for 2004 through 2006 model year engines, we are proposing to allow this as an option. In this case, manufacturers would conduct the field testing as described here to show that their engines meet the 4 g/kW-hr HC+NOx standard and the 50 g/kW-hr CO standard. This could 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 would expect any additional variability in field-testing measurements not to affect manufacturers' ability to meet the same emission standards. We request comment on the need for and appropriateness of this provision. We also request comment on whether there should be a separate field-testing standard, higher or lower than the proposed duty-cycle standards, to provide adequate assurance that the engines operate with the required level of emission control.

These proposed field-testing standards are based on emission data measured with the same emission-control technology used to establish the duty-cycle standards. The higher numerical standard for field testing reflects the observed variation in emissions for varying engine operation, the projected effects of ambient conditions on the projected technology, and the accuracy limitations of in-use testing equipment and procedures. 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).

EPA generally requires manufacturers to show at certification that they are capable of meeting requirements that apply for any in-use testing. 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, we are proposing that manufacturers show in their application for certification that they meet the field-testing standards. Manufacturers would 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. The manufacturer would provide a detailed description of any testing, engineering analysis, and other information that forms the basis for the statement. This would 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 is 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. We are proposing to require manufacturers to design their engines to broadcast instantaneous speed and torque values to the onboard computer. We are also proposing a requirement to add an emission sampling port downstream of the catalyst.

The 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 could use the field-testing equipment and procedures to get a low-cost, valid emission measurement at the production line. Manufacturers may 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 III.C.4 for more information.

c. What limits are placed on field testing?

The field-testing standards would apply to all normal operation. This could 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 proposing several parameters that would narrow the range of engine operation that would be subject to the field-testing standards. For example, emission sampling for field testing would not include engine starting.

Engines can often operate at extreme engine conditions (summer, winter, high altitude, etc.). To narrow the range of conditions for the design engineer, we are proposing to limit 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.

We are proposing some additional limits to define “normal” operation that could be included in 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 proposed field-testing standards would be feasible. These restrictions would apply to both variable-speed and constant-speed engine applications.

First, measurements with more than 2 minutes of continuous idle would be excluded. This means that an emission measurement from a forklift while it idled for 5 minutes would not be considered valid. On the other hand, an emission measurement from a forklift that idled for 1 minute (continuous or intermittent) 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 should therefore 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 rates decrease significantly. 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, we are proposing that the 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.

Third, gasoline-fueled 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 accordingly proposing for gasoline-fueled engines that operation at 90 percent or more of maximum power must be less than 10 percent of the total sampling time. We would 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 could 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. We propose to allow manufacturers to request a different threshold to allow more open-loop operation. Before we could approve such a request, the engine manufacturer would need to have a plan for ensuring that the engines in their final installation would not routinely operate at loads above the specified threshold.

Fourth, as a part of the "normal operation" limitation, we are considering a limit on the frequency of accelerations. Very frequent acceleration events can make it difficult to consistently get enough air for combustion. Engine dynamometers also place a practical limit on the degree of transient operation that can be simulated in the laboratory. It would not be appropriate to exclude normal driving patterns, but drawing a line at the upper end of what happens in the field may be an appropriate constraint for field testing. This would likely take the form of a maximum frequency of acceleration events during the emission sampling period. We request comment on defining the most severe accelerations that we should include in field-testing as normal operation.

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 proposing 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 are not proposing a maximum sampling time. We would expect manufacturers testing in-use engines to select an approximate sampling time before measuring emissions. When selecting an engine family for the in-use testing program, we may add further direction related to the emission-sampling effort, such as sampling time or specific types of engine operation.

We request comment on whether these are appropriate constraints on sampling emissions using field-testing procedures. In particular, we request comment on whether the limitations described are necessary or sufficient to target the whole range of normal operation that should be subject to emission standards.

d. How do I test engines in the field?

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

Small analyzers and other equipment are already available that could be adapted for measuring emissions from field equipment. A portable flame ionization detector could measure total hydrocarbon concentrations. Methane measurement currently requires more expensive laboratory equipment that is impractical for field measurements. Field-testing standards would therefore be based on total hydrocarbon emissions. A portable analyzer based on zirconia technology measures NOx emissions. A nondispersive infrared (NDIR) unit could measure CO. Emission samples could best be drawn from the exhaust flow directly downstream of the catalyst material to avoid diluting effects from the end of the tailpipe. For this reason we request comment on a requirement for manufacturers to produce all their engines with this kind of sampling port in the exhaust pipe or at the end of the catalytic converter. Mass flow rates would also factor into the torque calculation; this could 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. We therefore propose to require that manufacturers design their engines to continuously monitor engine speed and torque. The proposed tolerance for speed measurements,, which is relatively straightforward is ±5 percent. For torque, the onboard computer would need to convert measured engine parameters into useful units. The manufacturer would probably 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, we are proposing that manufacturers 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 Draft Regulatory Support Document. We request comment on this approach to measuring in-use emissions and on any alternate approaches.

We request comment on all aspects of field-testing standards and procedures.

E. Special Compliance Provisions

We are proposing a variety of provisions to address the particular concerns of small-volume manufacturers of Large SI engines. These provisions are generally designed to address the limited capital and engineering resources of companies that produce very few engines.

As described in Section IV.B.4, we are proposing a provision to allow manufacturers to certify Large SI engines to emission standards for engines below 19 kW if they have displacement below 1 liter and rated power between 19 and 30 kW. We are proposing to expand this flexibility to include a limited number of engines up to 2.5 liters. This provision would be available for manufacturers producing 300 or fewer Large SI engines annually nationwide for the 2004 through 2006 model years. We request comment on this arrangement, especially in three areas. First, we request comment on the possible need to adjust the 30 kW cap for these engines to ensure that we include the appropriate engines. Second, we request comment on the sales threshold and whether a greater allowance would be necessary to accommodate the sales levels of small-volume manufacturers. Finally, since many of these engines may be used in places where individual exposure to CO emissions is a concern, we request comment on adopting an intermediate CO emission standard for these engines. The CO emission standard for engines rated below 19 kW is currently about 600 g/kW-hr. Engines with displacement between 1 and 2.5 liters generally have much lower CO emissions than small lawn and garden engines. Baseline emission levels on small automotive-type engines shows that uncontrolled emission levels are about 130 g/kW-hr. We request comment on adopting this as a CO standard for engines that use the provision described in this paragraph.

Starting in 2007, we propose to discontinue the provisions described above for engines between 1 and 2.5 liters. In their place, we propose to adopt for three model years the standards that would otherwise apply in 2004 (4 g/kW-hr HC+NOx and 50 g/kW-hr CO with steady-state duty cycles). Starting in 2010, there would no longer be separate emission standards for small-volume manufacturers. Since upgrading to the anticipated emission-control technology substantially improves performance, we expect that small-volume manufacturers may find it advantageous to introduce these technologies ahead of the schedule described here.

We are proposing several additional provisions to reduce the burden of complying with emission standards; we propose to apply these provisions to all manufacturers. These include (1) reduced production-line testing rates after consistent testing with good emission results, (2) allowance for alternative, low-cost testing methods to test production-line engines, (3) a flexible approach to developing deterioration factors, which gives the manufacturer broad discretion to develop appropriate emission-durability estimates.

We are also proposing provisions to address hardship circumstances, as described in Section VII.C. For Large SI engines, we are proposing a longer available extension of the deadline for meeting emission standards for small-volume manufacturers. Under this provision, we would extend the deadline by three years for companies that qualify for special treatment under the hardship provisions. We would, however, not extend the deadline for compliance beyond the three-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.

F. Technological Feasibility of the Standards

Our general goal in designing the proposed standards is to develop a program with technologically feasible standards that will achieve significant emission reductions. Our standards must comply with Clean Air Act section 213(a)(3), as described in Section III.B. The Act also instructs us to first consider standards equivalent in stringency to standards for comparable motor vehicles or engines (if any) regulated under section 202 of the Act, taking into consideration technological feasibility, costs, and other factors (the relevant engines regulated under section 202 are automotive and highway truck engines). We are proposing 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 would not be 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. On the other hand, the proposed emission standards for Large SI align well with standards we have adopted for the next tier of heavy-duty highway gasoline engines (64 FR 58472, October 29, 1999). We have also adopted long-term standards for these engines that require significant further reductions with more sophisticated technologies (66 FR 5002, January 18, 2001).

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 Draft 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 the proposed standards nationwide in 2004 would therefore require manufacturers only to produce greater numbers of the engines complying with the California standards.

Chapter 4 of the Draft Regulatory Support Document further describes data and rationale showing why we believe that the proposed 2007 model year emission standards under the steady-state and transient duty-cycles and field-testing procedures are feasible. In summary, SwRI testing 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 proposed 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 would not allow manufacturers enough stability between introduction of different phases of emission standards to amortize their fixed costs and prepare for complying with the full set of requirements proposed in this notice. 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 proposed standards. The proposed provisions to allow “family banking” for early compliance should provide an additional tool for companies that choose to spread out their design and certification efforts.

The proposed emission standards would either have no impact or a positive impact with respect to noise, energy, and safety, as described in Chapter 4 of the Draft Regulatory Support Document. In particular, the anticipated fuel savings associated with the expected emission-control technologies would 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 proposed interim and final emission standards allows manufacturers enough time to optimize these designs to most effectively reduce emissions from the wide range of Large SI equipment applications.

V. Recreational Marine Diesel Engines

This section describes the new provisions proposed for 40 CFR part 94, which would apply to engine manufacturers and other certificate holders. This section also discusses proposed test equipment and procedures for anyone who tests engines to show they meet emission standards. We are proposing the same general compliance provisions from 40 CFR part 94 for engine manufacturers, equipment manufacturers, operators, rebuilders, and others. Similar general compliance provisions are described for the other engines included in this proposal in Section VII. See Section III for a description of our general approach to regulating nonroad engines and how manufacturers show that they meet emission standards.

A. Overview

We are proposing exhaust and crankcase emission standards for recreational marine diesel engines with power ratings greater than or equal to 37 kW. We are proposing emission standards for hydrocarbons (HC), oxides of nitrogen (NOx), carbon monoxide (CO), and particulate matter (PM) beginning in 2006. We believe manufacturers will be able to use technology developed for use on land-based nonroad and commercial marine diesel engines. To encourage the introduction of low-emission technology, we are also proposing voluntary "Blue Sky" standards which are 40 percent lower than the proposed standards. We also recognize that there are many small businesses that manufacture recreational marine diesel engines; we are therefore proposing several regulatory flexibility options for small businesses that should help minimize any unique burdens caused by emission regulation. A history of environmental regulation for marine engines is presented in Section I.

We have determined there are at least 16 companies manufacturing marine diesel engines for recreational vessels. Six of the identified companies are considered small businesses as defined by the Small Business Administration (fewer than 1000 employees). Nearly 75 percent of diesel engines sales for recreational vessels in 2000 can be attributed to three large companies. Based on sales estimates for 2000, the six small businesses represent approximately 4 percent of recreational marine diesel engine sales. The remaining companies each comprise between two and seven percent of sales for 2000.

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 Proposal

The standards we are proposing in this section apply to recreational marine diesel engines. These engines were excluded from our final standards for commercial marine diesel engines finalized in 1999 because we thought their operation in planing mode might impose design requirements on recreational boat builders (64 CFR 73300, December 29, 1999). Commercial marine vessels tend to be displacement-hull vessels, designed and built for a unique commercial application (e.g., towing, fishing, general cargo). Power ratings for engines used on these vessels are analogous to land-based applications, and these engines are generally warranted for 2,000 to 5,000 hours of use. Recreational vessels, on the other hand, tend to be planing vessels, and 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; recreational marine engines are therefore warranted for fewer hours of operation than their commercial counterparts. In our previous rulemaking, recreational engine industry representatives raised concerns about the ability of these engines to meet the standards without substantial changes in the size and weight of the engine. Such changes could 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 on fiberglass molds, this could be a significant burden for recreational vessel builders.

Since we finalized the commercial marine diesel engine standards, we determined that recreational marine diesel engines can achieve those same emission standards without significant impacts on engine size and weight. Section V.G of this document and Chapters 3 and 4 of the Draft Regulatory Support Document 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 nevertheless proposing to establish a separate program for recreational marine diesel engines in this rule. This will allow us to tailor certain aspects of the program to these applications, notably the not-to-exceed requirements. We seek comment on whether this approach is appropriate or if we should remove the distinction and apply identical emission-control requirements to both commercial and recreational marine diesel engines.

To distinguish between commercial and recreational marine diesel engines for the purpose of emission controls, it is necessary to define "recreational marine diesel engine." According to the definition we finalized in our commercial marine diesel engine rule, recreational marine engine means 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 also including in the proposed definition that a recreational marine engine must be a Category 1 marine engine (have a displacement of less than 5 liters per cylinder). One manufacturer commented after the ANPRM that only engines less than 2.5 liters per cylinder in displacement should be considered recreational. We request comment on this size cut-off and we request comment on allowing manufacturers flexibility in defining the upper limit of their recreational product line provided that it is between 2.5 and 5 liters per cylinder.

For the purpose of the recreational marine diesel engine definition, 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." To put some boundaries on that definition, since certain vessels that are used for pleasure may have operating characteristics that are more similar to commercial marine vessels (e.g., 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" would 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 than 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 response to the ANPRM on these definitions. Engine manufacturers were concerned that the definitions may be unworkable for engine manufacturers, since 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 planing, power density and performance requirements that go along with that use.

We responded to similar concerns in the Summary and Analysis of Comments for the commercial marine diesel engine rule, explaining that a vessel would be considered a recreational vessel if the boat builder intends that the customer will operate the boat consistent with the recreational-vessel definition.[132] Relying on the boat builder's intent is necessary since 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.

We are proposing to retain our existing definition of recreational marine vessel. We request comment on all aspects of this definition. We are also requesting comment on how to verify the validity of the vessel manufacturer's original intent. One option, as noted in the Summary and Analysis of Comments for the previous rule, would be written assurance from the buyer.

We are also requesting comment on two alternative approaches for the definition of recreational marine vessel that were suggested by ANPRM commenters. The first recommends that we follow the definition in 46 U.S.C. 2101(25), which defines a recreational vessel as one "being manufactured or operated primarily for pleasure, or leased, rented, or chartered to another

[132] Summary and Analysis of Comments: Control of Emissions from Marine Diesel Engines. EPA420-R-99-028, November 1999, Docket A-97-50, document V-C-1.

for the latter's pleasure."[133] The second recommends that we define recreational vessel as one (1) which by design and construction is intended by the manufacturer to be operated primarily for pleasure, or to be leased, rented, or chartered to another for the latter's pleasure; and (2) whose major structural components are fabricated and assembled in an indoor production-line manufacturing plant or similar land-side operation and not in a dry dock, graving dock, or marine railway on the navigable waters of the United States.[134] We request comment on whether either of these definitions is preferable to the existing definition and, more specifically, on whether either of these alternative definitions would be sufficient to ensure that recreational marine diesel engines are installed on vessels that will be used only for recreational purposes.

C. Proposed Standards for Marine Diesel Engines

We are proposing technology-forcing emission standards for new recreational marine diesel engines with rated power greater than or equal to 37 kW. This section describes the proposed standards and implementation dates and gives an outline of the technology that can be used to achieve these levels. We request comment on these standards and dates. In particular, commenters should address whether the dates provide sufficient lead time. The technological feasibility discussion below (Section V.G) describes our technical rationale in more detail.

1. What are the proposed standards and compliance dates?

To propose emission standards for recreational marine diesel engines, we first considered the Tier 2 standards for commercial marine diesel engines. Recreational marine diesel engines can use all the technologies projected for Tier 2 and 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.

We are proposing to implement the commercial marine engine standards for recreational marine diesel engines, allowing two years beyond the dates that standards apply for the commercial engines. This would provide engine manufacturers with additional lead time in

[133] Statement of the Engine Manufacturers Association, Docket A-2000-01, Document No. II-D-33.

[134] Comments of the National Marine Manufacturers Association, Docket A-2000-01, Document II-D-27.

adapting technology to their recreational marine diesel engines. The proposed standards and implementation dates for recreational marine diesel engines are presented in Table V.C-1. The subcategories refer to engine displacement in liters per cylinder.

Table V.C-1
Proposed Recreational CI Marine
Emission Standards and Implementation Dates

Subcategory	HC+NOx g/kW-hr	PM g/kW-hr	CO g/kW-hr	Implementation Date
power ≥ 37 kW 0.5 ≤ 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

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

Section III.C.3 gives an overview of the proposed emission-credit program, which is consistent with what we adopted for Category 1 commercial marine diesel engines. We are proposing that the emission-credit program be limited to HC+NOx and PM emissions.

Consistent with our land-based nonroad and commercial marine diesel engine regulations, we are proposing to disallow simultaneous generation of HC+NOx credits and use of 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 request comment on whether an engine should be allowed to generate credits on one pollutant while using credits on another, and whether allowing such an additional flexibility would necessitate a reconsideration of the stringency of the proposed emission limits.

We are proposing 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 proposed 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 could result in emission increases in areas such as ports that may have a need for PM or NOx emission reductions. Balancing this concern is the fact that recreational marine diesel engines constitute a small fraction of PM and HC + NOx emissions in nonattainment areas. Thus, if a few engine families have higher emissions then our proposed FEL cap, the incremental emissions in these areas may not be significant. Also, if we do not promulgate FEL caps for this category, manufacturers will need to offset high emitting engines with low-emitting engines to meet the average standard. We are interested in comments on these issues, on the degree to which FEL caps would hinder manufacturer flexibility and impose costs, and the environmental impact of FEL caps. We ask commenters to address whether we should promulgate FEL caps.

As an alternative, we are requesting comment on whether we should consider using the MARPOL Annex VI NOx standard as the appropriate NOx FEL upper limit. Under this approach we would continue to use the land-based Tier 1 PM standard as the recreational marine diesel engine FEL upper limit. As part of this approach we would have to accommodate the fact that the MARPOL Annex VI standard is for NOx only and these proposed standards are HC+NOx. We further request comment under this approach as to how best to deal with this inconsistency.

We are proposing that 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 greater flexibility in implementing their engine designs. However, if we were to revisit the standards proposed today at a later date, we would have to reevaluate this issue in the context of spillover of credits in the new program.

Consistent with the land-based nonroad diesel rule, we are also proposing to disallow using credits generated on land-based engines for demonstrating compliance with marine diesel engines. In addition, we propose that credits may not be exchanged between recreational and commercial marine engines. We are concerned that manufacturers producing land-based and/or commercial marine engines in addition to recreational marine engines could effectively trade out of the recreational marine portion of the program, thereby potentially obtaining a competitive advantage over small companies selling only recreational marine engines. In addition, there are two differences in the way that land-based, commercial marine, and recreational marine credits are calculated that make the credits somewhat incompatible. The first is that the difference in test duty cycles means there is an difference in calculated load factors for each of these categories of engines. The second is that there are significant differences in the useful lives. EPA seeks comment on the need for these restrictions and on the degree to which imposing them may create barriers to low-cost emission reductions.

We are proposing to allow early banking of emission credits once this rule is finalized. We believe that early banking of emission credits will allow for a smoother implementation of the recreational marine standards. These credits are generated relative to the proposed standards and are undiscounted. We are aware that there are already some marine diesel engines that meet the proposed standards, and we are concerned about windfall credits from engines that generate early credits without any modifications to reduce emissions. We request comment on whether or not these engines should be able to generate credits.

We also propose that manufacturers have the option of generating credits relative to their pre-control emission levels. If manufacturers choose this option they will have to develop engine family-specific baseline emission levels. 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 meet the proposed standards to generate credits, but the credits will be calculated relative to the generated baseline rather than the standards. However, 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. We request comment on all aspects of the proposed emission-credit program.

One engine manufacturer commented after the ANPRM that all their recreational engine product lines fall into the per-cylinder displacement range with the proposed implementation date of 2006. This manufacturer expressed concern that it would be burdensome to introduce all their product lines at one time and presented the idea of phasing in their product lines from 2005 through 2007 instead. An alternative to early banking or a revised phase-in would be “family-banking.” Under the “family-banking” concept, we would allow manufacturers to certify an engine family early. For each year of certifying an engine family early, the manufacturer would be able to delay certification of a smaller engine family by one year. This would be based on the actual sales of the early family and the projected sales volumes of the late family; this would require no calculation or accounting of emission credits. We request comment on this approach or any other approach that would help manufacturers bring the product lines into compliance to the proposed standards without compromising emissions reductions (see §1048.145 of the proposed regulations).

3. Is EPA proposing voluntary standards for these engines?

a. Blue Sky

Section III.B.5 gives an overview of Blue Sky voluntary standards. We are proposing to target about a 45-percent reduction beyond the mandatory standards as a qualifying level for Blue Sky Series engines to match the voluntary standards already adopted for commercial marine diesel engines (see Table V.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 proposed for this category of engines, including allowable maintenance, warranty, useful life, rebuild, and deterioration factor provisions. This program would become effective immediately once we finalize this rule. We request comment on the Blue Sky Series approach as it would apply to recreational marine diesel engines.

Table V.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 discussed above in Section I.F.3 for marine diesel engines rated above 130 kW. We are not proposing to adopt the MARPOL Annex VI NOx emission limits as Clean Air Act standards at this time. However, we encourage engine manufacturers to make Annex VI-compliant engines available and boat builders to purchase and install them prior to the implementation of our proposed standards. If the international standards are ratified in the U.S., they 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.

To encourage boat manufacturers to purchase MARPOL Annex VI-compliant engines prior to the date the Annex goes into force for the United States, we are proposing a voluntary certification program that will allow engine manufacturers to obtain a Statement of Voluntary Compliance to the MARPOL Annex VI NOx limits. This voluntary approach to the MARPOL Annex VI emission limits depends on the assumption that manufacturers will produce MARPOL-compliant engines before the emission limits go into effect internationally. Engine manufacturers can use this voluntary certification program to obtain a Statement of Voluntary Compliance to the MARPOL NOx limits.[135]

We request comment on whether or not we should apply the MARPOL Annex VI standards as a first Tier to this proposed regulation. We also request comment on reasons for whether or not the MARPOL Annex VI standards should apply to recreational marine at all.

[135] For more information about our voluntary certification program, see “guidance for Certifying to MARPOL Annex VI,” VPCD-99-02. This letter is available on our website: http://www.epa.gov/otaq/regs/nonroad/marine/ci/imolettr.pdf.

4. What durability provisions apply?

There are several related provisions that would be needed to ensure that emission control would be maintained throughout the life of the engine. Section III gives a general overview of durability provisions associated with emissions certification. This section discusses these proposed provisions specifically for recreational marine diesel engines.

a. How long would my engine have to comply?

We propose to require that manufacturers produce engines that comply over the full useful life of ten years or until the engine accumulates 1,000 operating hours, whichever occurs first. We would consider the hours requirement to be a minimum value for useful life, and would require manufacturers to 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 proposed hour limit, we would look for evidence that the engines continue to reliably deliver the necessary power output without an unacceptable increase in fuel consumption.

b. How would I demonstrate emission durability?

We are proposing the same durability demonstration requirements for recreational marine diesel engines as already exist for commercial marine diesel engines. This means that recreational marine engine manufacturers, using good engineering judgment, would generally need to test one or more engines for emissions before and after accumulating 1,000 operating hours (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 would be allowed to 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 are also proposing the same provisions from the commercial marine rulemaking for how durability data are to be collected and how deterioration factors are to be generated. 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.

c. What maintenance would be allowed during service accumulation?

For engines certified to a 1,000-hour useful life, the only maintenance that would be allowed is regularly scheduled maintenance unrelated to emissions that is technologically necessary. This could typically include changing engine oil, oil filter, fuel filter, and air filter. We request comment on the allowable maintenance during service accumulation.

d. Would production-line testing be required?

We are proposing to apply the production-line testing requirements for commercial marine engines to recreational marine diesel engines, with the additional provisions described in Section III.C.4. A manufacturer would have to test one percent of its total projected annual sales of Category 1 engines each year to meet production-line testing requirements. We are proposing that manufacturers combine recreational and commercial engine families in calculating their sample sizes for production-line testing. We are not proposing a minimum number of tests, so a manufacturer could produce up to 100 marine diesel engines without doing any production-line testing.

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

These proposed 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 engines that are currently being sold into the U.S. market, we are proposing alternate forms of the hydrocarbon standards to address the potential for natural gas-fueled and alcohol-fueled engines. In our regulation of highway vehicles and engines, we determined it is not appropriate to apply total hydrocarbon standards to engines fueled with natural gas (which is comprised primarily of methane), but rather that nonmethane hydrocarbon (NMHC) standards should be used (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 determined that alcohol-fueled highway engines and vehicles should be subject to HC-equivalent (HCE) standards instead of HC standards (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. Thus, we are proposing that alcohol-fueled recreational marine engines comply with total hydrocarbon equivalent (THCE) plus NOx standards instead of THC plus NOx standards.

6. Is EPA controlling crankcase emissions?

We are proposing to require manufacturers to prevent crankcase emissions from recreational marine diesel engines, with one exception. We are proposing to allow turbocharged recreational marine diesel engines to be built with open crankcases, as long as the crankcase ventilation system allows 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 would 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. This proposal is 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 proposing 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 the PM standards proposed here for diesel engines will have the effect of limiting smoke emissions as well. We request comment on this position and, specifically, on whether there is a need at this time for additional control of smoke emissions from recreational marine diesel engines, and if so, what the appropriate limits should be.

We also request comment on an appropriate test procedure for measuring smoke emissions, in case we choose to pursue smoke limits. There is currently no established test procedure for a marine engine to measure compliance with a smoke limit. Most propulsion marine engines operate over a torque curve governed by the propellor. Consequently, a vessel with an engine operating at a given speed will have a narrow range of torque levels. Some large propulsion marine engines have variable-pitch propellers, in which case the engine operates much like constant-speed engines. Note that the International Organization for Standardization (ISO) is working on a proposed test procedures for marine diesel engines.[136] As this procedure is finalized by ISO and emission data become available, we may review the issue of smoke requirements for all marine diesel engines. We request comment on this overall approach to smoke emissions from marine diesel engines, as well as comment on the draft ISO procedures.

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

We are proposing not-to-exceed requirements similar to those finalized for commercial marine diesel engines. At the time of certification, manufactures would have to 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 would provide a detailed description of all testing, engineering analysis, and other information that forms the basis for the statement. This certification could be based on testing or on other research which could be used to support such a statement that is consistent with good engineering judgment. We request comment on applying the proposed NTE requirements to recreational marine diesel engines. and on the application of the requirements to these engines.

[136] International Standards Organization, 8178-4, "Reciprocating internal combustion engines—Exhaust emission measurement—Part 4: Test cycles for different engine applications," Docket A-2000-01, Document II-A-19.

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 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 proposing to apply 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 when the engine is being tested for emissions and adjust the emissions from the engine would be an example of a defeat device, regardless of the emissions performance of the engine.

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, using a standardized test procedure alone 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 to characterize marine engine operation, we are concerned that an engine designed to the duty cycle would not necessarily perform the same way over the range of speed and load combinations seen on a boat. These duty cycles are based on average propeller curves, but a propulsion marine engine may never be fitted with an “average propeller.” For instance, 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 seen on boats, we propose to establish a zone under the engine’s power curve where the engine may not exceed a specified emission limit. This limit would apply to all of the regulated pollutants under steady-state operation. In addition, we propose that the whole range of real ambient conditions be included in this “not-to-exceed” (NTE) zone testing. The NTE zone, limit, and ambient conditions are described below.

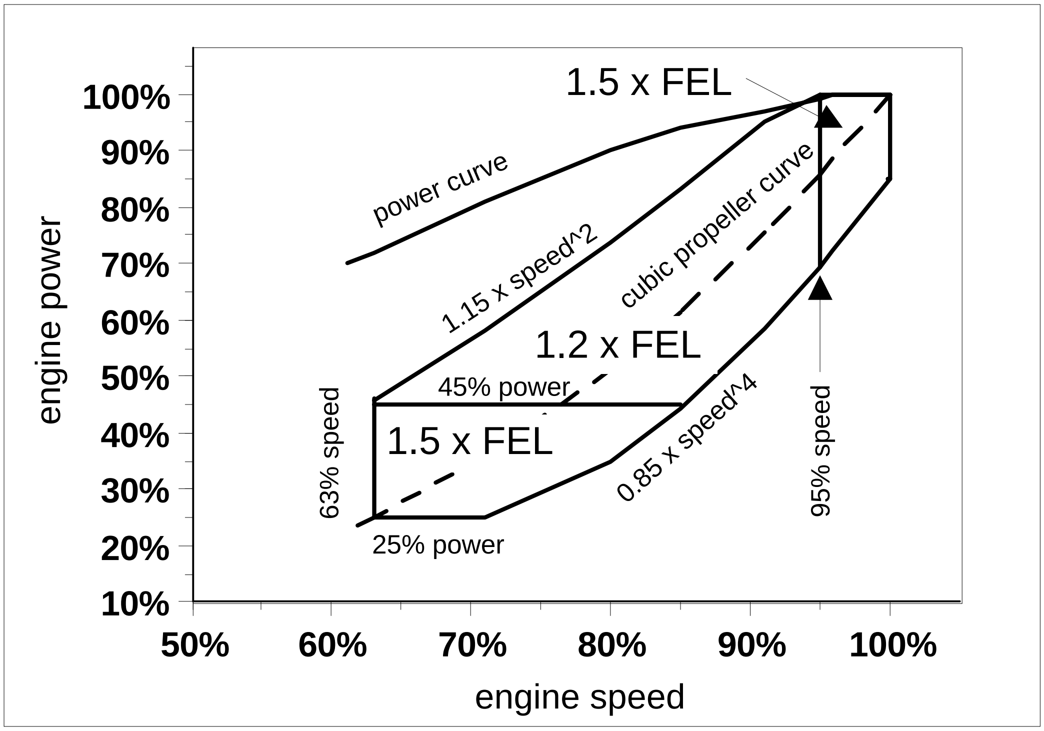
We believe there are significant advantages to taking this approach. The test procedure is very flexible so it can represent the majority of in-use engine operation and ambient conditions. Therefore, the NTE approach takes all of the benefits of a numerical standard and test procedure and expands it to cover a broad range of conditions. Also, laboratory testing makes it harder to perform in-use testing because either the engines would have to be removed from the vessel or care would have to be taken that laboratory-type conditions can be achieved on the vessel. With the NTE approach, in-use testing and compliance become much easier 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 of what is expected in use versus over a fixed laboratory test procedure.

Even with the NTE requirements, we believe it is still 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 and should not require additional technology beyond what is used to meet the proposed standards. We believe basing the emission standards on a distinct cycle and using the NTE zone to 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.

b. Shape of the NTE zone

Figure V-C-1 illustrates our proposed NTE zone for recreational marine diesel engines. We based this zone on the range of conditions that these engines could typically see in use. Also, we propose to divide the zone into subzones of operation which have different limits as described below. Chapter 4 of the Draft Regulatory Support Document describes the development of the boundaries and conditions associated with the proposed NTE zone. We request comment on the proposed NTE zone.

Figure V.C-1: Proposed NTE Zone for Recreational CI Marine Engines



We propose to allow manufacturers to petition to adjust the size and shape of the NTE zone for certain engines if they can certify that the engine will not see operation outside of the revised NTE zone in use. This way, manufacturers could avoid having to test their engines under operation that they would never see in use. However, manufacturers would still be responsible for all operation of an engine on a vessel that would reasonably be expected to be seen in use and would be responsible for ensuring that their specified operation is indicative of real-world operation. In addition, if a manufacturer designs an engine for operation at speeds and loads outside of the proposed NTE zone (i.e., variable-speed engines used with variable-pitch propellers), the manufacturer would be responsible for notifying us so their NTE zone can be modified appropriately to include this operation.

c. Transient operation

We are proposing that only steady-state operation be included in the NTE testing. We are basing the test for determining certification emissions levels on the ISO E5 steady-state duty cycles. The goal of the NTE, for this proposal, is to cover the operation away from the five modes 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 would likely be 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. We are aware that the high-load transient operation seen when a boat comes to plane would not be included in the NTE zone as defined, even if we would require compliance with NTE standards during transient operation. We are also aware that these speed and load points could not be achieved under steady-state operation for a properly loaded boat in use.

Our proposal to exclude transient operation from NTE testing is consistent with the commercial marine diesel requirements. Also, the proposed standards are technology-forcing and are for a previously unregulated industry. We believe excluding transient operation will simplify the requirements on this industry while still maintaining proportional emission reductions due to the technology-forcing nature of this proposal. We intend to study marine operation to understand better the effects of transient operation on emissions. 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. We request comment on the appropriateness of excluding transient operation from NTE requirements.

d. Emission standards

We are proposing emission standards for an NTE zone representing a multiplier times the weighted test result used for certification. Because an emission level is an average of various points over a test procedure, a multiplier of is inconsistent with the idea of a Federal Test Procedure standard as an average. This is consistent with the concept of a weighted modal emission test, such as the steady-state tests included in this proposal.

Consistent with the requirements for commercial marine engines, we propose that recreational marine diesel engines must meet a cap of 1.5 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 1.2 times the certified levels at or above 45 percent of rated power. However, we are proposing an additional subzone, when compared to the commercial NTE zone, at speeds greater than 95 percent of rated. We are proposing a cap of 1.5 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.

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. We are not proposing that engine starting be included in the NTE testing. In addition, manufacturers would 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 proposing to apply the commercial marine engine ranges for these variables. Chapter 4 of the Draft 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 proposed 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.

D. Proposed Testing Requirements

40 CFR part 94 details specifications for test equipment and procedures that apply generally to commercial marine engines. We propose to base the recreational marine diesel engine test procedures on this part. Section VIII gives a general discussion of the proposed 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 Technical Support Document describes these duty cycles in greater detail.

1. Which duty cycles are used to measure emissions?

For recreational marine diesel engines, we are proposing to use 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 propose to 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 Draft Regulatory Support Document provides further detail on the ISO E5 duty cycle. We request comment on the appropriateness of this duty cycle.

2. What fuels will be used during emission testing?

We are proposing to use the same specifications for recreational marine diesel engines as we have used previously 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 standard 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 would in-use testing be performed?

We have the authority to perform in-use testing on marine engines 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 request comments on the proposed in-use testing provisions described below.

We propose to use field-testing data in two ways. First, we would use it as a screening tool, with follow-up laboratory testing over the ISO E5 duty cycle where appropriate. Second, we would use the data directly as a basis for compliance determinations provided that field testing equipment and procedures are capable of providing reliable information from which conclusions can be drawn regarding what emission levels would be in laboratory-based measurements.

For marine engines that expel exhaust gases underwater or mix their exhaust with water, we propose to require manufacturers to 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. The purpose of this proposed provision is to simplify in-use testing.

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.

E. Special Compliance Provisions

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

1. What are the proposed 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 would 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 (i.e., 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 proposed requirements.

To clarify the responsibilities of engine dressers under this rule, we propose to exempt them from the requirement to certify engines to the proposed emission standards, as long as they meet the following seven proposed conditions.

(1) The engine being dressed (the “base” engine) must be a highway, land-based nonroad, or locomotive engine, certified pursuant to 40 CFR 86, 40 CFR 89, or 40 CFR 92,

respectively, or a marine diesel engine certified pursuant to this part.

(2) The base engine's emissions, for all pollutants, must be at least as good as 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 would 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 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.

We propose that any engine dresser not meeting all these conditions be considered an engine manufacturer and would accordingly need to certify that new engines comply with this rule's provisions.

Under this proposal, 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.

2. What was the Small Business Advocacy Review Panel?

As described in Section XI.B, the August 1999 report of the Small Business Advocacy Review Panel addresses the concerns of sterndrive and inboard engine marinizers, compression-ignition recreational marine engine marinizers, and boat builders that use these engines.

To identify representatives of small businesses for this process, we used the definitions provided by the Small Business Administration for engine manufacturers and boat builders. We then contacted companies manufacturing internal-combustion engines employing fewer than 1,000 people to be small-entity representatives for the Panel. Companies selling or installing such engines in boats and employing fewer than 500 people were also considered small businesses for the Panel. Based on this information, we asked 16 small businesses to serve as small-entity representatives. These companies represented a cross-section of both gasoline and diesel engine marinizers, as well as boat builders.

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 proposed rule. The Panel's recommended flexibility options are described in the following sections.

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

We are proposing several flexibility 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 propose to define a small-volume engine manufacturer based on annual U.S. sales of engines. This production count would include all engines (automotive, other nonroad, etc.) and not just recreational marine engines. We propose to consider small businesses to be those that produce fewer than 1000 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 1000 engines as a limit because it groups together all the marinizers most needing the proposed burden reduction approaches, while still allowing for reasonable sales growth.

The proposed flexibility options for small-volume marinizers are discussed below and would be used at the manufacturers' discretion. We request comment on the appropriateness of these flexibility options or other options.

a. Broaden engine families

We propose to allow 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 flexibility 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 certify a single engine in the first year to represent their whole product line. As for large companies, the small-volume manufacturers would then be able carry-over data from year to year until engine design changes occur that would significantly affect emissions.

We understand that this flexibility alone may not be able to reduce the burden enough for all small-volume manufactures because it would still require a certification test. 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.

b. Minimize compliance requirements

We propose to waive production-line and deterioration testing for small-volume marinizers. We would 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.

There are also some disadvantages of this approach, because there would be no testing assurance of engine emissions at the production line. This is especially a concern without a manufacturer-run in-use testing program. Also, assigned deterioration factors would not be as accurate as deterioration factors determined by the manufacturer through testing. We request comment on appropriate deterioration factors for the technology discussed in this proposal.

c. Expand engine dresser flexibility

We propose to expand 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.

There would be some potential for adverse emissions impacts because emissions are sensitive to turbo-matching; however, if the goal of the marinizer is to match the performance of the original turbocharger, this risk should be small. We recognize that this option would not likely benefit all diesel marinizers because changes to fuel management for power would not qualify under engine dressing.

d. Streamlined certification

We are requesting comment on allowing small-volume marinizers to certify to a performance standard by showing their engines meet design criteria rather than by certification testing. The goal would be to reduce the costs of certification testing. We are concerned that this approach must be implemented carefully to work effectively. This would put us in the undesirable position of specifying engine designs for marinizers, which we have historically avoided by setting performance standards.

We are not clear on how to set meaningful design criteria for marine diesel engines. We expect that emission reductions in diesel engines will be achieved through careful calibration of the engine fuel and air management systems using strategies such as timing retard and charge-air cooling. It may not be feasible to specify criteria for ignition timing, charge-air temperatures, and injection pressures that would ensure that every engine can achieve the targeted level of emission control. While we do not believe design criteria can be set to provide sufficient assurance of emission control from these engines, we ask for comment on any possible approaches.

We propose to allow small-volume marinizers to certify to the proposed not-to-exceed (NTE) requirements with a streamlined approach. We believe small-volume marinizers could make a satisfactory showing that they meet NTE standards with limited test data. Once these manufacturers test engines over the proposed five-mode certification duty cycle (E5), they could use those or other test points to extrapolate the results to the rest of the NTE zone. For example, an engineering analysis could 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, we propose that keeping all four test modes of the E5 cycle within the NTE standards would 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. We request comment on this approach.

e. Delay standards for five years

We propose that small-volume marinizers not have to comply with the standards for five years after they take effect for larger companies. Under this plan the proposed standards would take effect from 2011 to 2014 for small-volume marinizers, depending on engine size. We propose that marinizers would be able to apply this delay to all or just a portion of their production. They could 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.

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 the proposed emission standards. This additional time will allow small-volume marinizers to obtain and implement proven, cost-effective emission-control technology. Some small-volume marinizers have expressed concern to the Small Business Advocacy Panel that large manufacturers could have competitive advantage if they market their engines as cleaner than the small-business engines. Other small-volume manufacturers commented that this provision would be useful to them.

We are also requesting comment on limited exemptions for small-volume marinizers. Under this sort of flexibility, upon request from a small-volume marinizer, we would exempt a small number of engines per year for 8 to 10 years. An example of a small-volume exemptions would be 50 marine diesel engines per year. We are concerned, however, that this approach may not be appropriate given our goal of reducing burden on small businesses without significant loss in emission control.

f. Hardship provisions

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

Second, we propose that small-volume marinizers could 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 would have a major impact on the company's solvency. We would consider this relief mechanism as a option to be used only as a last resort. We believe this provision would protect small-volume marinizers from circumstances outside their control.

g. Use of emission credits

We request comment on the appropriateness of allowing small-volume manufacturers to purchase credits under the streamlined certification approach described above. Under this approach, the engine's emission performance for purposes of certification is determined on the basis of design features rather than emission test results alone. Certification would therefore depend on engineering analysis and design criteria. Without a full set of emission test data, however, it would not be possible for these manufacturers to participate in an emission-credit program.

We believe the level of credits necessary to offset emissions from uncontrolled engines could be established conservatively to maximize assurance of compliance. For this reason, the baseline emissions of the uncontrolled engine could be based on the worst-case baseline data we are aware of, which would currently be 20 g/kW-hr HC+NOx and 1 g/kW-hr PM. The credits needed would then be calculated using the proposed standards and the usage assumptions presented in Chapter 6 of the Draft Regulatory Support Document.

Under this limited emission-credit program, we propose that the participating manufacturer would be able to buy credits offered for sale by recreational marine diesel engine manufacturers certifying only on the basis of emission tests (not using the streamlined certification described above). We propose that cross-trading outside of recreational marine not be allowed, because it could prevent emission reductions from being achieved in areas where boats contribute most significantly to local air pollution and it could prevent new technology from being applied to recreational marine engines. However, we request comment on whether or not small-volume marinizers should be able to use credits generated from other sectors such as land-based nonroad engines.

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

The SBAR Panel Report recommends that we propose burden reduction approaches for small-volume boat builders. This recommendation was based on the concern that, although boat builders would not be directly regulated under the proposed engine standards, they may need to redesign engine compartments on some boats if engine designs were to change significantly. Based on comments from industry, we believe these flexibility options may be appropriate; however, they may also turn out to be unnecessary.

We are proposing four flexibility options for small-volume vessel manufacturers using recreational marine diesel engines. The purpose of these options is to reduce the burden on companies for which fixed costs cannot be distributed over a large number of vessels. For this reason, we propose to define a small-volume boat builder as one that produces fewer than 100 boats for sale in the U.S. in one year and meets the Small Business Administration definition of a small business (fewer than 500 employees). The production count would include all engine-powered recreational boats. We propose that these flexibility options be used at the manufacturer's discretion. The proposed flexibility options for small-volume boat builders are discussed below. We request comment on the appropriateness of these or other flexibility options.

a. Percent-of-production delay

This proposed flexibility would allow manufacturers, with written request from a small-volume boat builder and prior approval from us, to produce a limited number of uncertified recreational marine engines. We propose that, over a period of five years (2006-2010), small-volume boat builders would be able to 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 should give small boat builders flexibility to delay using new engine designs for a portion of business.

We currently believe this flexibility is appropriate, however, it is possible that this flexibility could turn out to be unnecessary if the standards do not result in significant changes in engine size, power-to-weight ratio, or other parameters that would affect boat design. Moreover, custom boat builders may not need this flexibility if they design each boat from the ground up. We are also concerned that this flexibility could reduce the market for the certified engines produced by the engine manufacturers and could make it difficult for customs inspectors to know which uncertified engines can be imported. We therefore propose that engines produced under this flexibility would have to be labeled as such.

b. Small-volume allowance

This proposed flexibility 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 flexibility would be that the 80-percent allowance described above could be exceeded as long as sales do not exceed either 10 engines per year or 20 engines over five years (2006-2010). This proposed flexibility would apply only to engines less than or equal to 2.5 liters per cylinder.

c. *Existing inventory and replacement engine allowance*

We propose that small-volume boat builders be allowed to sell their existing inventory after the implementation date of the new standards. However, no purposeful stockpiling of uncertified engines would be permitted. This provision is intended to allow small boat builders flexibility to turn over engine designs.

d. *Hardship relief provision*

We propose that small boat builders could 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 would have a major impact on the company's solvency. This relief would allow the boat builder to use an uncertified engine and would be 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 proposed 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

We have identified three principal amendments to the requirements for outboard and personal watercraft engines. First, we are proposing to add a definition of United States. 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. Finally, we are proposing 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. We are proposing to clarify that for manufacturers with fewer than four engine families, the maximum testing rate should be one family per year in place of the percentage calculation. We request comment on these amendments. Specifically, we request comment on whether there is a need to delay the effectiveness of any of these amendments to allow manufacturers time to comply with new requirements.

2. 40 CFR part 94

We are proposing several regulatory amendments to the program for commercial marine diesel engines. Several of these are straightforward edits for correct grammar and cross references.

We propose to change the definition of United States, as described in the previous section.

We are proposing to add a definition for spark-ignition, consistent with the existing definition for compression-ignition. This would allow us to define compression-ignition as any engine that is not spark-ignition. This would help ensure that marine emission standards for the different types of engines fit together appropriately. We do not expect this change to affect any current engines.

The discussion of production-line testing in Section III includes a proposal to reduce testing rates after two years of consistent good performance. We propose to extend 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 proposing to adopt a range of 13° to 30° C (55° to 86° F) for emission testing.

We request comment on modifying the language prohibiting emission controls that increase unregulated pollutants. The existing language states:

> An engine with an emission-control system may not emit any noxious or toxic substance which would not be emitted in the operation of the engine in the absence of such a system, except as specifically permitted by regulation.

Amended regulatory language would focus on preventing emissions that would endanger public welfare, rather than setting a standard that allows no tradeoff between pollutants. We are considering this also in emission-control programs for other types of engines, since various prospective engine technologies require more careful consideration of this issue.

> You may not design your engines with emission-control devices, systems, or elements of design that cause or contribute to an unreasonable risk to public health, welfare, or safety while operating. This applies especially if the engine emits any noxious or toxic substance it would otherwise not emit.

After completing the final rule for commercial marine diesel engines, manufacturers expressed a concern about the phase-in schedule for engine models under 2.5 liters per cylinder. Some of these engine models include ratings above 560 kW (750 hp). When we proposed emission standards for these engines, we suggested that the larger engines could certify according to an earlier schedule, since the lower-power engines from those product lines would need to meet emission standards for marine and land-based nonroad engines earlier. We received no comment on this position. We request comment on the need to accommodate manufacturers' calibration, certification, and production schedules in aligning the marine and land-based nonroad diesel engine emission standards and on what offsets are appropriate.

G. Technological Feasibility

We believe 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. 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 Draft Regulatory Support Document discuss this process in more detail. Also, we have collected emission data demonstrating the feasibility of the not-to-exceed requirements. These data are presented in Chapter 4 of the Draft Regulatory Support Document.

1. Implementation schedule

For recreational marine diesel engines, the proposed implementation schedule allows an additional two years of delay beyond the commercial marine diesel standards. This represents up to a five-year delay in standards relative to the implementation dates of the land-based nonroad standards. This should reduce the burden of complying with the proposed regulatory scheme by allowing time for carryover of technology from land-based nonroad and commercial marine diesel engines. In addition, the proposed implementation dates represent four or more years of lead time beyond the planned date for our 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 make more use of the water they operate in as a cooling medium compared with commercial marine, because they are able to make use of 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.

3. Technological approaches

We anticipate that manufacturers will meet the proposed 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 Draft Regulatory Support Document for this proposed rule and is summarized here. We request comment on the applicability of the technology discussed below for CI recreational marine engines.

Our cost analysis is based on the technology package which we believe most manufacturers will apply and is described in Chapter 5 of the Draft Regulatory Support Document. Our estimated costs of control are an “average” based on this technology package. This assumes that reductions from the package are all necessary and that the performance in the area of emission reductions is linear. While we believe this is a reasonable approach for estimating the overall costs of compliance, we are also seeking comment on whether there are different technologies or different application of the technologies in our package which could affect the marginal costs of compliance. That is to say, is there an incremental difference in technology which would reduce (or increase) costs significantly, and thus significantly affect the costs of control for a small given margin of additional emission reduction.

By proposing 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 shown some initiative in producing limited numbers of low-NOx marine diesel engines. More than 80 of these engines have been placed into service in California through demonstration programs. The Draft Regulatory Support Document further discusses these engines and their emission results. Through the demonstration programs, we were able to gain some insight into what technologies can be used to meet the proposed emission standards.

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 moving to a separate circuit, marine engine manufacturers would be able to achieve further reductions in the charge-air temperature. This separate circuit could result in even lower temperatures by using 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 achieve the reductions in NOx emissions for this proposal through the use of aftercooling.

Electronic controls also offer great potential for improved control of engine parameters for better performance and lower emissions. Unit pumps or injectors would 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 should be able to 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.

4. Our conclusions

The proposed standards for recreational marine diesel engines reasonably reflect what manufacturers can achieve through the application of available technology. Recreational marine diesel 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 CI 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. The proposed standards clearly represent significant reductions compared with baseline emission levels.

Emission-control technology for diesel engines is in a period of rapid development in response to the range of emission standards in place (and under consideration) for highway and land-based nonroad engines in the years ahead. This development effort will automatically transfer to some extent to marine engines, because marine engines are often derivatives of highway and land-based nonroad engines. Regardless, this development effort would need to expand to meet the proposed standards. Because the technology development for highway and land-based nonroad engines will largely constitute basic research of diesel engine combustion, the results should generally find direct application to marine engines.

Based on information currently available, we believe it is feasible for recreational marine diesel engine manufacturers to meet the proposed standards using combinations of technological approaches discussed above and in Chapters 3 and 4 of the Draft Regulatory Support Document. To the extent that the technologies described above may not yield the full degree of emission reduction anticipated, manufacturers could still rely on a modest degree of fuel-injection timing retard as a strategy for complying with the proposed emission standards.

In addition, we believe the flexibilities incorporated into this proposal 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.

VI. Recreational Vehicles and Engines

A. Overview

This section applies to recreational vehicles. We are proposing to set new 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.[137] In our program to set standards for nonroad SI 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 tested differently than Small SI engines. In the same way, we are proposing to treat snowmobiles, off-highway motorcycles, and ATVs separately from our Large SI engine program, which is described in Section IV. For recreational vehicles that are not snowmobiles, off-highway motorcycles, or ATVs, we propose to apply the standards otherwise applicable to nonroad SI engines (see Section VI.B.2).

We are proposing emission standards for hydrocarbons (HC), and carbon monoxide (CO) from all recreational vehicles and NOx from off-highway motorcycles and ATVs. Many of these vehicles use two-stroke engines which emit high levels of HC and CO. 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 near-term standards. To encourage the introduction of low-emission technology such as catalytic control and the conversion from two-stroke to four-stroke engines, we are also proposing a Voluntary Low Emission Standards program. We also recognize that there are many small businesses that manufacture recreational vehicles; we are therefore proposing several regulatory special compliance provisions to reduce the burden of emission regulations on small businesses.

1. What are recreational vehicles and who makes them?

We are proposing to adopt new emission standards for off-highway motorcycles, all-terrain vehicles (ATVs), and snowmobiles. Eight manufacturers dominate the sales of these recreational vehicles. Of these eight manufacturers, seven of them manufacture a combination of 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.

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

a. *Off-highway motorcycles*

Motorcycles come in a variety of configurations and styles. For the most part, however, they are two-wheeled, self-powered vehicles. 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. 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 ranging from 48 to 650 cubic centimeters (cc). 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 racing or competition machines.

b. *All-terrain vehicles*

ATVs have been in existence for a long time, but have become increasingly popular over the last 25 years. Some of the earliest and most popular ATVs were three-wheeled off-highway models with large balloon tires. 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 controlled by a steering system. The ATV steering system uses motorcycle handlebars, but otherwise looks and operates like an automotive design. 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 recreational use but have the ability to perform many utility functions, such as plowing snow, tilling gardens, and mowing lawns. They are typically heavier and equipped with relatively large four-stroke engines and automatic transmissions with a reverse gear. Sport quads are smaller and designed primarily for recreational purposes. They are equipped with two- or four-stroke engines and manual transmissions.

There are two other less common types of ATVs, both of which are six-wheeled models. One looks similar to a large golf cart with a bed for hauling cargo, much like a pick-up truck. These ATVs are typically manufactured by the same companies that make quad runners and use similar engines. The other can operate both in water and on land. These amphibious ATVs typically have small gasoline-powered engines similar to those found in lawn and garden tractors, rather than the motorcycle engines used in quads, though some use automotive-based Large SI engines.

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 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.

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 proposed 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. We request comment on this definition and on any other approaches to differentiate these products.

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 expensive, 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 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 scooters and skateboards that are powered by 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 proposing to revise the Small SI rules to cover these engines under the Small SI regulations. To avoid any problems in transitioning to meet emission standards, we propose to apply these standards in 2006. We request comments on these issues.

2. What is the regulatory history for recreational vehicles?

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 VI.A-1, are based on the highway motorcycle chassis test procedures. Manufacturers may certify ATVs to optional standards, also shown in Table VI.A-1, which are based on the utility engine test procedure.[138] 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 4-stroke engines and advanced 2-stroke engines with a catalytic converter. California ARB anticipated that the standards would be met initially through the use of high performance 4-stroke engines.

Table VI.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 product from manufacturers was reportedly creating economic hardship for dealerships. The number of certified off-highway

[138] 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).

motorcycle models was particularly inadequate.[139] In 1998, California revised the program, allowing the use of 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 4-stroke engines.

B. Engines Covered by this Proposal

We are proposing new emission standards for all new off-highway motorcycles, all-terrain vehicles (ATVs), and snowmobiles. We are also proposing to apply existing Small SI emission standards to other recreational vehicles, as described above. The engines used in these vehicles tend to be small, air- or liquid-cooled, reciprocating Otto-cycle engines that operate on gasoline.[140] With the exception of what we define as "other recreational vehicles," these engines are designed to be used in vehicles, where engine performance is characterized by highly transient operation, with a wide range of engine speed and load capability. Maximum engine speed is 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.[141]

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 hydrocarbons (HC) and particulate matter (PM) than four-stroke engines of similar size and power. 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 advantages, combined with a simple design and lower manufacturing costs, tend to make two-stroke engines popular as a power unit for recreational vehicles. With the exception of a few youth 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

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[139] 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).

[140] Otto cycle is another name for a spark-ignition engine which utilizes a piston with homogeneous external or internal air and fuel mixture formation and spark ignition.

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

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 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 would typically be covered by the Small SI standards because they don't operate above 5000 rpm. Similarly, engines used in golf carts are also included in the Small SI program. As discussed above, we are proposing to revise the Small SI regulations to include all recreational engines except those in off-highway motorcycles, ATVs, snowmobiles, and hobby engines. We are proposing to remove the 5,000 rpm and speed governor criteria from the applicability provisions of the Small SI regulations.

There may, however, be instances where an ATV, off-road motorcycle, or snowmobile manufacturer currently uses a certified small utility engine in their vehicle, and could be required to recertify that engine to the recreational vehicle standards in the future. Relatively slow-moving amphibious ATVs would be one example where certified small utility engines may be used. We request comment on whether or not we should allow off-road motorcycles, ATVs, and snowmobiles to be certified to the Small SI standards in cases where a manufacturer has chosen to use a certified small utility engine. We also request comment on retaining the 5,000-rpm rated speed criteria for determining the applicability of the Small SI standards for snowmobiles, ATVs, and off-road motorcycles. Further, we request comment and information on any vehicles that currently have an engine certified to Small SI standards which would be required to certify to the recreational vehicle standards due to this regulatory change.

3. Hobby Engines

The Small SI rule categorized SI engines used in model cars, boats, and airplanes as recreational engines and exempted them from the Small SI program.[142] We continue to believe that it would be inappropriate to include hobby engines in the Small SI program because of significant engine design and use differences. At this time, we also believe that hobby engines are substantially different than engines used in recreational vehicles and, as discussed below, we are not proposing to include SI hobby engines in this proposal.

There are about 8,000 spark-ignition engines sold per year for use in scale-model aircraft, cars, and boats.[143] This is a very small subsection of the overall model engine market, most of which are glow-plug engines that run on a mix of castor oil, methyl alcohol, and nitro methane.[144] A typical SI hobby engine is approximately 25 cc with a horsepower rating of about 1-3 hp, though larger engines are available. These SI 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 more 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.

[142] 80 FR 24292, April 25, 2000.

[143] 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.

[144] Glow plug hobby engines are considered compression ignition engines (diesel) because they lack a spark ignition system and throttle (see definition of compression ignition, 40 CFR §89.2). The nonroad diesel engine regulations (40 CFR §89.2) do not apply to hobby engines and therefore these engines are unregulated.

The average annual hours of operation has been estimated to be about 12.2 hours per year.[145] 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.

SI 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 the similar, the materials, airflow, cooling, and fuel delivery systems are considerably different.[146, 147] Some SI model engines are scale replicas of multi-cylinder aircraft or automobile engines and are fundamentally different than SI 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 proposing to include SI hobby engines in the recreational vehicles program at this time. The engines differ significantly from the recreational engines included in the proposal 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 4-stroke engine, a catalyst, or fuel injection all would involve increases in weight, which would be particularly problematic for model airplanes. The feasibility of 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, SI 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 SI hobby engines as a whole account for less than 30 tons of HC

145 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.

146 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.

147 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.

nationally per year, much less than 0.01% of Mobile Source HC emissions).[148] Thus, the cost per ton associated with regulating such engines would be well above any regulations previously adopted under the mobile source program (we estimate potential cost per ton for HC to over $200,000 per ton compared to less than $2,500 per ton for most other mobile source programs).

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 SI engine applications would be sufficiently representative for hobby engines. We are not aware of any efforts to develop an emission test cycle or conduct any emission testing of these engines. In addition, 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.

For all the above reasons, we do not have adequate information and are not able to propose emission standards and test procedures for SI hobby engines at this time. We request comment on the above points, including feasibility, cost, and benefits associated with potential control technologies for these engines. We also request comment on any other information or unique characteristics of hobby engines that should be taken into consideration.

4. Competition 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 competition use.[149,150] These high-performance

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[148] 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.

[149] 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.

[150] 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.

motorcycles are largely powered by 2-stroke engines, though some 4-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 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 our 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.

If retained for the recreational vehicles program, the above definition may be useful for identifying certain models that are clearly used only for competition. For example, there are motorcycles identified as "observed trials" motorcycles which are designed without a standard seat because the rider does not sit down during competition. This feature would make recreational use unlikely:)

Most motorcycles marketed for competition do not appear to have obvious physical characteristics that constrain their use to competition. Upon closer inspection, however, there are several features and characteristics for many competition motorcycles that would 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 (e.g., roads, parks, state land, federal land, etc.).[151] Vehicle performance of modern motocross bikes are so advanced (e.g., extremely high power-to-weight ratios and advanced suspension systems) that it is highly unlikely that these machines would be used for recreational purposes. In addition, motocross and other competition off-highway motorcycles typically do not come with a warranty, which would further deter the purchase and use of competition bikes for recreational operation.[152] We believe

[151] 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.

[152] 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

these features should be sufficient in distinguishing competition motorcycles from recreational motorcycles. We are specifically proposing 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; and an engine displacement greater than 50 cc.*

Vehicles not meeting the applicable criteria listed above would be excluded 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 could be technical rationale explaining the differences between a competition and non-competition motorcycle, marketing and/or sales information indicating the intent of the motorcycle for competition purposes, or survey data from users indicating the competitive nature of the motorcycle.

Although there are several features that distinguish competition motorcycles from recreational motorcycles, several parties have commented that they believe motorcycles designed for competition use may be 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.[153] 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 proposing to exclude a high percentage of off-highway motorcycles as being competition machines, this definition is appropriate because a high percentage of these motorcycles are in fact used solely for competition.

We are very interested in receiving input on the proposed competition exclusion. We request comment on ways the program can be established to exclude motorcycles used solely for competition, consistent with the Act, without excluding vehicles that are also used for other purposes. We specifically request comment on the identifying characteristics of competition vehicles in §1051.620 of the proposed regulations. Ideally, the program can be established in a way that provides reasonable certainty at certification. However, approaches could include reasonable measures at time of sale or in-use that would ensure that the competition exclusion is applied appropriately.

conditions.

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

C . Proposed Standards

1. What are the proposed standards and compliance dates?

a. Off-highway Motorcycles and ATVs

We are proposing HC plus NOx and CO standards for off-highway motorcycles and 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 NOx standards serve only to cap NOx emissions for these engines. Comparable CO reductions can be expected from both 2-stroke and 4-stroke engines, as CO levels are similar for the two engine types. We are also proposing averaging, banking and trading provisions for off-highway motorcycles and ATVs, as discussed below.

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In the current off-highway motorcycle and ATV market, consumers can choose between two-stroke and four-stroke models in most sizes and categories. 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 and ATV applications. Eighty percent of all ATVs sold are four-stroke. In addition, 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 and ATVs, combined with our own baseline emission testing, provides ample data on the emission-control capability of four-stroke engines in off-highway motorcycles and ATV applications. 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.

In determining what standards to set for off-highway motorcycles and ATVs, we considered several approaches. One approach was to establish separate standards for two-stroke and four-stroke engines. This would take into consideration the fact that it could be expensive and difficult for two-stroke engines to meet the same emission levels as four-stroke engines. The problem with this approach is that two-stroke engines emit up to 25 times more HC emissions than four-stroke engines. Four stroke engines are currently being used on most, if not all, of the different subclasses of ATVs and off-highway motorcycles that we would be regulating, and we believe they can be used on all such subclasses. We are concerned that setting lesser standards for two-stroke engines could possibly result in the increase of two-stroke engine usage at the expense of four-stroke engines, which would result in a greater level of emissions and could miss the opportunity for a more appropriate and cost-effective standard. As a result, we proposing an approach that would require a single set of off-highway motorcycle and ATV standards for all engine types, similar to California ARB. We believe that this approach is consistent with our statutory requirement to propose standards that achieve the greatest emission reduction achievable, considering cost, noise, and safety factors.We ask for comment on this proposed approach and the rationale underlying this approach.

In 1994, California ARB adopted emission standards for off-highway motorcycles and ATVs. At the time, these standards were stringent enough that manufacturers were unable to provide performance-oriented off-highway motorcycles and ATVs that met the standards. As a result, ARB allowed manufacturers to sell non-compliant off-highway motorcycles and ATVs, resulting in approximately a third of the off-highway motorcycles and ATVs sold being compliant with the standards. Four-stroke engine technology has advanced considerably since the ARB regulations went into effect. Manufacturers are now capable of offering four-stroke engines that provide excellent performance. However, 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. However, the HC emissions from four-stroke engines even when they operate rich are significantly lower than those from two-stroke engines. The market appears to be shifting to four-stroke technology.

As discussed above in Section # B.1.4, the CAA requires us to exempt from emission standards off-highway motorcycles and ATVs used for competition. We expect several competition off-highway motorcycle models, most equipped with two-stroke engines, to continue to be available. We are concerned that setting standards as stringent as ARB's would result in a performance penalty for four-strokes which could encourage consumers who want performance-oriented off-highway motorcycles to purchase competition vehicles in lieu of purchasing compliant machines that don't provide the desired performance. That is why we are proposing emission standards that are slightly less stringent than the California ARB. We believe that our proposed emission standards would allow the continued advancement of four-stroke technology and are a good compromise between available emission-control technology, cost, and vehicle performance.

We are proposing exhaust emission standards for off-highway motorcycles and ATVs to take effect in the 2006 model year. We would allow a short 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). These emission standards would 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 would be similar to those used for many years in highway applications, but not necessarily with the same degree of sophistication.

We considered proposing several alternative sets of standards. The first alternative considered was to set the HC+NOx standard at a level higher than 2.0 g/km, since this standard could prove to be difficult for a two-stroke engine to achieve. However, since two-stroke engines emit so much higher levels of HC than four-stroke engines, and HC emission-control technology for two-stroke engines is more expensive and complicated, we would expect that such a standard would have to be considerably higher than 2.0 g/km, perhaps in the range of 10 to12 g/km. Even a standard this high would still likely require secondary air injection and a catalytic converter for most two-stroke engines to comply. We believe that the concerns over high catalyst temperatures and potential negative impacts on engine performance would most likely result in manufacturers choosing to convert two-stroke applications to four-stroke, especially since four-stroke engines are already so prevalent in off-highway motorcycle and ATV applications. In addition, we believe that the cost differential between air injection and a catalyst for a two-stroke engine and using a four-stroke engine would be minimal. We request comment on such a standard, and on the costs and emissions benefits associated with that approach. Commenters should include a recommendation for the level of the standard.

We also considered setting the HC+NOx standard at a level lower than 2.0 g/km, since it is possible to use a catalyst on a four-stroke engine and achieve lower emission levels. We decided that for off-highway motorcycles, the technologies necessary to meet emission standards lower than our proposed level of 2.0 g/km for HC+NOx could be prohibitive due to several factors such as limited catalyst locations that are considered safe to the operator and potential negative engine performance impacts (see our discussion on proposed 2009 standards for more detail). These issues are not as important for ATVs. However, it would be difficult to implement them by the 2006 model year since 20 percent of the fleet is still two-stroke and manufacturers would need time to convert their fleet to four-stroke. Therefore, we are not proposing a HC+NOx standard lower than 2.0 g/km for off-highway motorcycles and are instead proposing a second phase of standards for ATVs in the 2009 model year. We are asking for comment on this aspect of the proposal, and on such a standard.

Some youth-oriented off-highway motorcycles and ATVs with small engine displacements have engine governors limiting vehicle speeds. In the case of ATVs, the Consumer Product Safety Commission (CPSC) limit youth ATVs with engine displacements between 50 and 100 cc to a top speed of 35 mph. Similarly, ATVs with engine displacements of 50 cc and less are limited to a top speed of 15 mph. Many small off-highway motorcycles use the same governors. For vehicles with a displacement greater than 50 cc, we believe the FTP is an appropriate test cycle because of the transient capability of these vehicles. However, for the vehicles with engine displacements of 50 cc and less, the governed top speed of 15 mph restricts the operation of these vehicles to either idle or the governed wide-open throttle setting, similar to a lawn mowers. It may not make sense to require these small-displacement vehicles to be tested over the FTP. Therefore, we propose that off-highway motorcycles and ATVs with an engine displacement of 50 cc or less have the option to certify to the proposed off-highway motorcycle and ATV standards discussed above or to meet the Phase 1 Small SI emission standards for non-handheld Class I engines. We request comment on this option.

ATV manufacturers have requested that we allow them the option of certifying ATVs to the same optional exhaust emission standards as allowed by California ARB. California allows ATVs to be optionally tested using the California ARB utility engine test cycle (SAE J1088) and procedures. In California, manufacturers may use the J1088 engine test cycle to meet the California Small Off-Road Engine emission standards. Manufacturers were required 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. California allowed this option because the goal of their program was to encourage the use of four-stroke engine technology in ATVs. The lawn and garden test cycle and standards were considered stringent enough to encourage manufacturers to switch from two-stroke engines to four-stroke engines. We continue to be concerned that the J1088 test cycle doesn't represent actual ATV operation, but for our Phase 1 standards, our goal is to encourage manufacturers to switch from two-stroke to four-stroke engine technology. Therefore, to facilitate this phase-in we are proposing here that manufacturers may optionally certify ATVs using the California utility cycle and standards as shown in Table VI.C-1 instead of the FTP standards of 2.0 g/km HC+NOx and 25 g/km CO discussed above.

Table VI.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)

Some manufacturers have expressed concern about the stringency of the proposed standards for some small displacement (e.g., less than 80 cc) youth off-highway motorcycles and ATVs. They have also stated that some of these small vehicles may have a difficult time operating over the FTP cycle. Therefore, we request comment on the ability of small displacement youth off-highway motorcycles and ATVs to operate over the FTP test cycle and meet our proposed emission standards.

2009 Standards

As stated above, we expect manufacturers to meet the proposed 2006 standards by using four-stroke engines with minor modifications to fuel calibrations. Several technologies are available to further reduce emissions from off-highway motorcycles and ATVs. The most likely choices would be the use of electronic fuel injection, secondary air injection into the exhaust system, and catalytic converters. Although these technologies would be capable of further emission reductions, there are potential concerns with applying each of these technologies to off-highway motorcycles. The complexity and increased cost of electronic fuel injection makes it problematic for off-highway motorcycle applications. Off-highway motorcycle manufacturers and enthusiasts have expressed concern over possible leg burns resulting from catalysts since off-highway motorcycles have exhaust systems that run higher up on the frame. They are concerned that if a rider were to fall over with the motorcycle on top of them, the hot catalyst could burn the rider. Catalysts and secondary air also have the potential to adversely affect engine performance. Since motorcycle performance is paramount for off-highway motorcycles, any technologies that could impact performance or pose a perceived safety threat could encourage consumers to purchase high-performance competition motorcycles rather than recreational motorcycles. For ATVs, however, the design of the vehicle is more receptive to placing a catalyst on the exhaust.

Since the engine is further inside the vehicle with numerous plastic fairings around the engine, the operator's legs are far away and shielded from the exhaust pipe. ATV engines also tend to have lower power output than off-highway motorcycle engines, making the use of secondary air or catalysts more tolerable.

Since ATV design and use are more conducive to these more advanced emission-control technologies than off-highway motorcycles, we believe it is appropriate to pursue more advanced emission-control technologies for ATVs. We also note that the usage rate and population of ATVs is growing substantially compared to off-highway motorcycles. We expect that, with additional time to optimize designs to better control emissions, manufacturers of ATVs should be able to meet more stringent emission standards. Starting with the 2009 model year for ATVs only, we propose to apply emission standards of 1.0 g/km (1.6 g/mi) for HC+NOx emissions and 25 g/km (40.5 g/mi) for CO emissions. As with the Phase 1 standards, we are proposing a two-year phase-in, with 50 percent of models complying in 2009 and all models complying in 2010.

We are proposing that ATVs would be required to meet a 1.0 g/km HC+NOx standard because we believe it can be met by using four-stroke engines with secondary air injection. Secondary air injection is a common HC emission-control technology used on highway motorcycles. It's use is more transparent to the ATV operator than a catalyst and is a relatively inexpensive means of achieving significant emission reductions. Depending on several variables, some models may have a more difficult time meeting the Phase 2 standards without the use of a catalyst. Therefore, while we expect ATV manufacturers to meet the Phase 2 standards for many of their models using four-stroke engines with air injection, they may also choose to use a combination of several possible emission-control technologies, including base-engine modifications, improved fuel-system calibrations, electronic fuel injection, and catalytic converters. Off-highway motorcycles would continue to meet the 2006 standards described above.

Several ATV manufacturers have expressed concern over being able to meet tighter HC+NOx standards while still meeting the proposed CO standards. They have asked us to increase or even eliminate the CO standard for Phase 2. Therefore, we request comment on whether the CO standard for Phase 2 should be increased from the proposed level of 25 g/km.

We are proposing to discontinue the provision allowing manufacturers of ATVs the option to certify to the California utility engine test procedure and emission standards for Phase 2 ATVs. We propose to require that manufacturers test all Phase 2 ATVs with the highway motorcycle FTP test procedure. Manufacturers have expressed concerns over the cost of building emission test cells equipped with chassis dynamometers and the representativeness of the FTP relative to in-use ATV operation. They argue that the FTP is no more representative of ATV operation than the steady-state J1088 engine test cycle. While it may be true that the chassis-based FTP test cycle is not fully representative of in-use ATV operation, there is currently very limited data addressing this. California is in the process of gathering in-use operating data for ATVs. Preliminary examination of that data is too inconclusive to determine whether the FTP is adequately representative of in-use ATV operation. It does indicate that the five steady-state modes captured in the J1088 cycle are not adequately representative of ATV operation. It has long been known that ATVs experience considerable transient operation, similar to automobiles and motorcycles. The California data support this view. The chassis-based FTP used for certification of motorcycles, while possibly not ideal for ATVs, therefore appears to be more representative of ATV operation than the J1088 test cycle. With this in mind, we request comment on the possibility of developing an alternate test cycle and procedure for ATVs that would be more representative of typical ATV operation. An alternate test cycle could be chassis-based or engine-based, but would need to incorporate transient operation. If an acceptable alternative cycle is developed, we would reassess whether our proposed emission test procedure for Phase 2 would still be appropriate.

As with the 2006 proposed emission standards, we request comment on the ability of small-displacement ATVs to operate over the FTP test cycle and meet our proposed emission standards.

We request comment on whether a Phase 2 standard for ATVs is appropriate, and on the proposed level of the Phase 2 standard. We also request comment on technology, cost, and safety issues associated with a possible second phase of off-highway motorcycle emission standards.

b. *Snowmobiles*

We are proposing CO and HC standards for snowmobiles. We are requesting comment on whether we should set standards for PM and NOx emissions from snowmobiles, and what appropriate levels would be. As previously discussed, snowmobile engines are almost exclusively two-stroke. As such, they emit high levels of HC and PM.   However, we are not proposing PM standards at this time for snowmobiles, because limits on HC emissions will serve to simultaneously limit PM. We considered adding a regulatory requirement for manufacturers to measure and report PM emission rates along with their other certification data, but we did not include such a requirement in the proposed regulations. We are most concerned about the cost to manufacturers if they were required to build PM measurement capabilities into all of their test facilities. We request comment on the need for PM emission data, and whether it is necessary to put a requirement in the regulations.

We are not proposing NOx standards for snowmobiles because they are primarily operated during the winter months when ozone is not a concern. However, we are proposing that manufacturers measure NOx emission rates and report them in their applications for certification. We believe that this would provide necessary information, but would not be a significant burden for manufacturers.   We request comment on this element of the proposal.

2006 Standards

We are proposing standards for snowmobiles to take effect for all models starting in the 2006 model year: 275 g/kW-hr (205 g/hp-hr) for CO and 100 g/kW-hr (75 g/hp-hr) for HC.   As discussed below, we are proposing an emission-credit program with these standards. Thus, we expect manufacturers to meet these proposed standards using a variety of technologies and strategies across their product lines. Snowmobiles pose some unique problems 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, allowing for excellent performance. Manufacturers have stated that if snowmobile performance declines, customers will either stop purchasing snowmobiles, or will replace original equipment (e.g., emission-control technology) with uncertified aftermarket parts. The desire for low weight is perceived as a safety issue, since operators may have to drag their sleds out of deep snow. Styling, especially very low-profile hoods, has also become paramount among snowmobile enthusiasts. All these concerns mean that it may be initially more difficult for manufacturers to develop a broad range of technologies capable of significant emission reductions. Some manufacturers may aggressively pursue clean carburetion and associated engine modifications and apply those uniformly across their entire product line. Others may choose to apply more advanced technologies such as direct or semi-direct injection to some of their more expensive, high-performance sleds and be less aggressive in pursuing emission reductions from their lower-priced offerings in order to optimize the fit of different technologies (and their associated costs) to the various product offerings. We also expect some manufacturers to offer some models featuring four-stroke engines.

We are proposing to require all snowmobiles to meet the proposed first phase of emission standards beginning with the 2006 model year. We request comment on options to ease the transition to the new standards, as described in Section VI.C.2.b.

Due to the unique performance requirements for snowmobiles, we believe our proposed 2006 standards would be challenging for manufacturers and would result in cleaner snowmobiles. While some advanced technologies such as two-stroke direct injection and four-stroke engines, would be found in some models, many models would still be equipped with two-stroke engines with relatively minor engine modifications resulting in minimum emission reductions, while some models may not even have any emission controls.

2010 Standards

We have had many discussions with manufacturers about emission control technologies. We have also closely examined the certification emission results of outboard boat engines and personal watercraft (PWC) equipped with two-stroke direct injection and four-stroke engines. It is our belief that with sufficient lead time, manufacturers can successfully implement these technologies across a much broader range of their snowmobile fleet. Manufacturers have indicated to us that two-stroke engines equipped with direct fuel injection systems could reduce HC emissions by 70 to 75 percent and reduce CO emissions by 50 to 60 percent. Certification results for 1999 and 2000 model year outboard engines and PWC support the manufacturers projections. In addition, two snowmobile manufacturers plan to sell a four-stroke model next year. These manufacturers indicated that their machines are capable of HC reductions in the 70 to 95 percent range, with CO reductions of 60 to 80 percent. Therefore, we believe that with sufficient time it is feasible for snowmobile manufacturers to achieve a greater penetration of advanced emission control technologies throughout their fleets and reduce emissions further.

We are, therefore, proposing a second phase of average standards to take effect with the 2010 model year. The proposed 2010 average standards are 200 g/kW-hr (149 g/hp-hr) for CO and 75 g/kW-hr (56 g/hp-hr) for HC. These standards represent a 50% reduction in HC and CO emissions from the current average baseline levels. We believe that implementation in 2010 would provide sufficient time for advanced technologies to be more broadly available. We also believe that manufacturers will have had adequate time to make appropriate modifications to snowmobile designs (e.g., styling and packaging issues) so they can more broadly spread advanced emission-control technologies across their product lines. We expect these standards would be met through the application of direct injection two-stroke technology and, to a much lesser extent, four-stroke technology, to cover about half of overall production, with the remaining models utilizing clean carburetion and electronic fuel injection, along with the associated engine modifications. The actual mix of technologies used would be the manufacturers choice, but the data mentioned above gives us reason to believe that the basic technology exists to meet the standard based on a 50-percent reduction. We believe that the lead time provided to meet these standards is sufficient to overcome the technical hurdles discussed below in Section VI.F.2.

We request comment on our second phase of snowmobile standards. In particular, we are interested in comments on the level of the standards, our technical assessment and potential fleet mix projections, any safety, reliability, or performance considerations associated with adoption of four-stroke technology. We also request comment on the cost of adopting such standards and the effects on sales and consumer satisfaction. We are also interested in further information addressing the benefits associated with such a standard.

c. Noise Standards

The Noise Control Act (42 U.S.C. 4901 et seq.) authorizes EPA to establish noise emission standards for motorized equipment. Under this authority, we established noise emission standards for motorcycles and three-wheeled ATVs in 40 CFR Part 205 (45 FR 86708, December 31, 1980). These regulations include voluntary "Low noise emission product standards" for motorcycles ($) CFR 205.152(c)).

Prior to proposal, we received public comments requesting that we consider setting new noise standards for recreational vehicles. Noise from these vehicles in public parks or other public lands can adversely impact other activities. However, at this time we do not have funding to pursue noise standards for nonroad equipment that does not have an existing noise requirement.

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 emissions for a particular manufacturer's production must be at or below that level of the applicable emission standards. We are proposing separate emission-credit programs for snowmobiles, off-highway motorcycles, and ATVs. We are proposing an emissions credit program for the optional Phase 1 ATV engine-based standards as well as the chassis-based standards. We request comment on whether or not averaging, banking, and trading adds value to the engine-based option considering the level of the standards being proposed.

In addition to the averaging program just described, the proposed 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 proposing 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. In order to generate credits, the average emissions level must be below the standard, so the credits would be the result of reductions in excess of those required by the standards.

We are seeking comment on whether or not a credit life limit (e.g., three years) is needed to ensure that manufacturers do not have the opportunity to, in effect, postpone the Phase 2 standards for several years for one or more vehicle families. Unlimited credit life has the potential to interfere with the timely and orderly phase-in of future standards, especially if the manufacturer is able to bank large amounts of credits during intervening years. This is a concern here because the proposed level of the Phase 1 standards may provide considerable opportunity for credit generation for manufacturers that can market a significant number of relatively clean models early in the program. For example, some 4-stroke ATV models are likely to have emissions levels below the Phase 1 standards, allowing for considerable credit generation.

We also request comment on how this issue may differ for credits generated under Phase 2, where the affect on the next tier of standard is not a complicating issue. We would have the opportunity to consider and reassess such a provision if and when we were to propose a third phase of standards. In addition, we request comments on an alternative approach of not allowing credits generated in Phase 1 to be used in Phase 2.

For off-highway motorcycles and ATVs, we are proposing to allow averaging for the HC plus NOx standard. Off-highway motorcycle and ATVs would be averaged separately to avoid providing an advantage in the market to companies that offer both types of products over those that produce only one type. In addition, there are differing degrees of stringency in the standards for ATVs and off-road motorcycles long-term and we do not want off-road motorcycle credits to dilute the effectiveness of the Phase 2 ATV standards. Also, ATVs certified to the chassis-based standards and engine-based standards would be 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. We are not proposing a CO averaging, banking, and trading program because the level of the standard does not appear to add substantial technological challenge to the program, especially for Phase 1. The usefulness of CO averaging may not warrant the additional complexity of an averaging program. We request comment on the need for a CO ABT program for Phase 2, and on the proposed approach for separate ABT programs.

For the Phase 2 ATV standards, we are proposing a maximum allowable Family Emission Limit (FEL) of 2.0 g/km HC plus NOx (the Phase 1 standard). In several other ABT programs, we have established a cap at the previous emission standard to ensure a minimum level of control long term. We request comment on whether or not an FEL limit is appropriate to ensure a minimum level of control for all models. Please see the discussion on this issue in the recreational marine diesel section of this document for more information. We request comment specifically on how this approach could affect product offerings and consumer choice. We also request comment on the level of the emissions cap and alternative levels.

For snowmobiles, we are proposing an emission-credit program for both CO and HC. We are proposing that maximum allowable Family Emission Limits be set at 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. This cap ensure a minimum level of control for each snowmobile certified under the program. We believe that 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 request comment on the level of the cap for Phase 1. We also request comment on whether it would be appropriate to set more stringent maximum allowable Family Emission Limits for 2010 and later model year snowmobiles, for example, at the levels of the 2006 standards. We are interested in comment on any potential impacts a more stringent cap may have on the variety of products available to the consumer. We are proposing that manufacturers may not both generate and use credits for the different pollutants within a given engine family.

We request comment on all aspect of the proposed ABT program, including on the administrative and liability provisions provided in the proposed regulatory text.

b. Early Credits and Alternative Phase-in Schedule

We are interested in but are not specifically proposing opportunities for early credits, and other flexibilities, as discussed below. We are proposing no phase-in schedule for snowmobiles and a two-year phase-in schedule for off-road motorcycles and ATVs. While we believe adequate lead-time is provided to meet the proposed standards, we recognize that some flexibility in timing could help manufacturers transition their full product line to new standards. We are requesting comment on three specific approaches to providing additional flexibility to manufacturers, described below. We are interested in how these provisions could be established in a way that would be environmentally neutral and yet also provide manufacturers with flexibility.

We are not proposing provisions for early generation of credits, because we have not been able to resolve our concerns about substantial windfall credits (credits generated relatively easily from baseline engines). For example, there could be substantial credits available for snowmobile manufacturers that have developed four-stroke snowmobile models. Also, some baseline ATV and off-highway motorcycles could also have relatively low emission levels. However, as discussed below, we are seeking comment on approaches for early credits that could address concerns regarding windfall credits.

Under an early emission-credit approach, manufacturers could earn credits by reducing emissions earlier than required, then use those credits after the program begins. Because there is a wide variation in baseline emission levels, we would need to consider taking steps to ensure that manufacturers do not generate windfall credits. One way to address the concern for windfall credits would be to allow credits only for emission reductions below the proposed standards and limit the life of those credits to three years. We believe this approach may ensure that manufacturers would generate credits only through the use of cleaner technologies. It also ensures that the credits would not adversely impact the long-term effectiveness of the program. This approach would provide incentive for manufacturers to pull ahead significantly cleaner technologies. We request comment on early credits for CO and HC emissions for snowmobiles and HC+NOx emissions for off-road motorcycles and ATVs, and a requirement that the credit-generating engines also meet the standards for the other regulated pollutants.

Under the second approach, an alternative phase-in schedule, manufacturers would be provided with a one-for-one credit in the phase-in schedule for selling complying recreational vehicles prior to the start of the program. Manufacturers who pull ahead a percentage of their product line would get a phase-in credit to be used during the initial years of the program (i.e., 2008 and earlier). For example, if a snowmobile manufacturer phased in 10 percent of their product line early in 2005, they could then phase-in 90 percent, rather than 100 percent, of their product line in 2006. We would expect this to be a transitional provision limited to the first few years of the program (all vehicles would need to be certified by 2008). We could implement the program through a calculation based on the sum of the phase-in percentages over a series of model years. For example, for snowmobiles, the sum of the phase-in percentages over model years 2004-2008 could be required to be equal to or greater than 300% (100% each for 2006, 2007, and 2008). For off-road motorcycles and ATVs, the calculation would take into account the 50/100 percent phase-in schedule for 2006/2007, with a requirement that the sum of the phase-in be equal to or greater than 250 percent. For example, an alternative phase-in schedule of 25/50/75/100 percent in 2005 through 2008 would be acceptable. The calculation of the percentage phase-in would be the same as that for the standard program.

An alternative to early banking or a revised phase-in would be “family-banking.” Under the “family-banking” concept, we would allow manufacturers to certify an engine family early. For each year of certifying an engine family early, the manufacturer would be able to delay certification of a smaller engine family by one year. This would be based on the actual sales of the early family and the projected sales volumes of the late family; this would require no calculation or accounting of emission credits.

We request comment on the above approaches or any other approach that would help manufacturers bring the product lines into compliance to the proposed standards without compromising emissions reductions (see §1048.145 of the proposed regulations). We request comment on the merits of the various approaches noted above, and others commenter may wish to suggest. We request that commenters provide detailed comments on how the approaches should be set up, enhanced, or constrained to ensure that they serve their purpose without diminishing the overall effectiveness of the standards.

3. Is EPA proposing Voluntary Low-Emission Standards for these engines?

We are proposing a Voluntary Low-Emission Standards program for recreational vehicles. The purpose of this program is two-fold; first, to encourage new emission-control technology and second, to aid the consumer in choosing clean technologies. At the point of purchase, manufacturers could add a tag designating qualifying vehicles to inform consumers which engines are certified by this program and listing the certification levels of the vehicles. In addition, we are suggesting that manufacturers provide information about the program in the vehicle Owner's Manual. To qualify for this program, engines must meet the voluntary standards described below. Manufacturers choosing to sell engines with this designation may generate certification emission credits from these technologies.

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.[154] We believe that EPA designation of clean technologies through this voluntary program can provide useful information to consumers. We request comment on the merits and design of the program and also on additional measures we can take to encourage this program and prohibit misuse.

We are proposing Voluntary Low-Emission Standards for off-highway motorcycles and ATVs of 0.8 g/km (1.3 g/mi) HC+NOx and 12 g/km (24.3 g/mi) CO. These emission levels are consistent with the 2008 standards proposed by California ARB for highway motorcycles. We believe that off-highway motorcycles and ATVs could meet these voluntary standards by employing some of the same technologies manufacturers will use to meet the 2008 California emission standards for highway motorcycles. We request comment on the level of the standards and the need for lower voluntary standards for Phase 2 of the ATV program.

We are proposing Voluntary Low Emission Standards for snowmobiles of 200 g/kW-hr (149 g/hp-hr) for CO and 75 g/kW-hr (56 g/hp-hr) for HC through 2009 model year snowmobiles. These are the same levels as our proposed phase 2 standards. For the 2010 model year and later, the standards are 120 g/kW-hr (89 g/hp-hr) for CO and 45 g/kW-hr (34 g/hp-hr) for HC for any snowmobiles. We believe these voluntary standards could be met with either direct injection two-stroke, or four-stroke technology. Snowmobiles included in this program may generate credits for use in the proposed emission-credit program. We request comment on

[154] 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.

the level of the voluntary standards being proposed and whether we should consider more or less stringent voluntary standards for snowmobiles.

4. What durability provisions apply?

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

a. How long would my engine have to comply?

We propose to require manufacturers to produce off-highway motorcycle and ATV engines that comply over their full useful life, where useful life is the period that lasts either 5 years or until the vehicle accumulates 30,000 kilometers, whichever occurs first. We would consider this 30,000-kilometer value to be a minimum kilometer value for useful life, and would require manufacturers to comply for a longer period in those cases where they design their vehicles to be operated longer than 30,000 kilometers.

For snowmobiles, we are proposing a minimum useful life of 5 years or 300 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.[155]

We request comment on the proposed useful life values. Any comments in support of a different useful life should include documentation of typical life and operation.

b. Would I have to warrant my engine's emission controls?

We are proposing a design/defect warranty period of 3 years, with an hours or kilometers limit equal to half the useful life interval proposed above. During this time manufacturers would repair or replace free of charge emission-related components that fail. Because this warranty requirement applies only for emission-related components, manufacturers are not responsible for routine maintenance that is currently performed for uncontrolled engines (e.g., changing oil filters or carburetors).

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[155] EPA memorandum, "Emission Modeling for Recreational Vehicles," from Linc Wehrly to Docket A-98-01, November 13, 2000.

c. How would I demonstrate emission durability during certification?

For off-highway motorcycles and ATVs, we are proposing the same durability demonstration requirements that apply to highway motorcycles. This includes a requirement to run the engines long enough to test for exhaust emissions at the end of the useful life. This allows manufacturers to generate a deterioration factor that helps ensure that the engines will continue to control emissions over a lifetime of operation.

d. What maintenance would be allowed during service accumulation?

For vehicles certified to the proposed useful life, no emission-related maintenance would be allowed during service accumulation. The only maintenance that would be allowed is regularly scheduled maintenance unrelated to emissions that is technologically necessary. This could typically include changing engine oil, oil filter, fuel filter, and air filter.

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

These proposed 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 proposing extensive special provisions to address them at this time.

6. Is EPA controlling crankcase emissions?

We are proposing to require that new off-highway motorcycles and ATVs be built to prevent crankcase emissions. This means that engines would no longer emit crankcase vapors directly to the atmosphere. The typical control strategy is to route the crankcase vapors back to the engine intake. This proposal is consistent with our previous regulation of crankcase emissions from such diverse sources as highway motorcycles, outboard and personal watercraft 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.[156] We are also proposing closed crankcases on new snowmobiles. This requirement is only relevant 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 Draft Regulatory Support Document.

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[156] Memo to Docket from Linc Wehrly, dated September 10, 2001. (A-2000-1) document II-B-25.

D. Proposed Testing Requirements

1. What duty cycles are used to measure emissions?

Testing a vehicle or engine for emissions 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 off-highway motorcycles and ATVs, we propose that the current highway motorcycle test procedure be used for measuring emissions. The highway motorcycle test procedure is the same 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 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 LA4 (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.

Highway motorcycles are divided into 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 propose that this same class/cycle distinction be allowed for off-highway motorcycles and ATVs. In other words, off-highway motorcycles and ATVs with an engine displacement between at or below 169 cc would be tested over the FTP test cycle for Class I highway motorcycles. 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. Some manufacturers have expressed concern over the ability of some small-displacement (e.g., less than 80 cc) youth off-highway motorcycles and ATVs to operate over the FTP. We request comment on the ability of these small-displacement vehicles to operate over the FTP test cycle. We also request comment on whether or not it would be appropriate to allow all ATVs to be certified using the Class I cycle.

Some manufacturers have noted that they do not currently have chassis-based test facilities capable of testing ATVs. Manufacturers have noted that requiring chassis-based testing for ATVs would require them to invest in additional testing facilities that can handle ATVs, since ATVs do not fit on the same roller(s) as motorcycles used in chassis testing. Some manufacturers also have stated that low-pressure tires on ATVs would not stand up to the rigors of a chassis dynamometer test. California provides manufacturers with the option of certifying ATVs using the engine-based, utility engine test procedure (SAE J1088), and most manufacturers use this option for certifying their ATVs. Manufacturers have facilities to chassis-test motorcycles and therefore California does not provide an engine-testing certification option for motorcycles.

We have tested numerous ATVs over the FTP and have found that several methods can be used to test ATVs on chassis dynamometers. The most practical method for testing an ATV on a motorcycle dynamometer is to disconnect one of the drive wheels and test with only one drive wheel in contact with the dynamometer. For chassis dynamometers set up to test light-duty vehicles, wheel spacers or a wide axle can be utilized to make sure the drive wheels fit the width of the dynamometer. We have found that the low-pressure tires have withstood dynamometer testing without any problems.

We acknowledge that a chassis dynamometer could be very costly to purchase and difficult to put in place in the short run, especially for smaller manufacturers. Therefore, we are proposing that for the model years 2006 through 2009, ATV manufacturers would be allowed the option to certify using the J1088 engine test cycle per the California off-highway motorcycle and ATV program. After 2009, this option would end and the FTP would be the required test cycle. If an alternate transient test cycle (engine or chassis) correlates with the FTP or better represents in-use ATV operation, we would consider allowing manufacturers to use the alternative test cycle in place of the FTP.

b. Snowmobiles

We are proposing to adopt the snowmobile duty cycle developed by Southwest Research Institute (SwRI) in cooperation with the International Snowmobile Manufacturers Association (ISMA) for all snowmobile emission testing.[157] The test procedure consists of two main parts; the duty cycle that the snowmobile engine would operate 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 we are proposing was developed specifically to reflect 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

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[157] "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. (A-2000-1) document II-D-05.

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 VI.D-1.

Table VI.D-1
Proposed Snowmobile Engine Test Cycle

Mode	1	2	3	4	5
Normalized Speed	1	0.85	0.75	0.65	Idle
Normalized Torque	1	0.51	0.33	0.19	0
Relative Weighting (%)	12	27	25	31	5

We believe this duty cycle is representative of typical snowmobile operation and is therefore appropriate for demonstrating compliance with the proposed snowmobile emission standards. We request comment on this proposed duty cycle, and on any alternatives that we should consider.

The other proposed testing protocols are largely derived from our regulations for marine outboard and personal watercraft engines, as recommended in the SwRI/ISMA test cycle development work (61 FR 52088, October 4, 1996). The testing equipment and procedures from that regulation are generally appropriate for snowmobiles. Unlike snowmobiles, however, the marine engines tend to operate in fairly warm 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, we could take one of two general approaches. The first is to require testing at ambient temperatures typical of snowmobile operation, with appropriate jetting. A variation of this option is to simply require that the engine inlet air temperature be representative of typical snowmobile operation, without requiring that the entire test cell be at that temperature. The second is to allow testing at higher temperatures than typically experienced during snowmobile operation, with jetting appropriate to the warmer ambient temperatures.

We are proposing 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 believe this approach strikes an appropriate balance between the need to test at conditions that are representative of actual use, and the fact that simply cooling the inlet air would be significantly less costly than requiring a complete cold test cell.

We request comment on whether we should allow snowmobile engine testing to be done according to the test procedures developed by Southwest Research Institute. Under those procedures testing is done at warmer ambient temperatures than typical of snowmobile operation. Appropriate jetting under this approach is determined by extrapolating from the manufacturer's jet chart (if necessary).

We invite comment on all aspects of the proposed test procedures.

2. What fuels will be used during emission testing?

We are proposing to use the same fuel specifications for all recreational vehicles as we currently use for highway motorcycles and light-duty vehicles, which is representative of a summertime blend. We believe that off-highway motorcycles and ATVs use the same fuel as highway motorcycles. While snowmobiles typically operate during wintertime, we believe it is appropriate to use summertime gasoline for testing, primarily because it is the fuel that was used to for the snowmobile emission testing that supported the development of our baseline emission estimates. Also, the majority of snowmobile HC emissions are a result of scavenging losses (unburned fuel from the intake charge exiting the combustion chamber with the exhaust gases). The primary difference between summertime and wintertime gasoline blends is the volatility, which is not likely to have a significant effect on scavenging losses. However, given that snowmobiles typically operate during wintertime, we request comment on whether we should consider a unique test fuel specifically for snowmobiles, and what specifications might be appropriate for such a fuel. Also, if we were to consider a unique snowmobile test fuel based on wintertime gasoline properties, should the proposed standards be adjusted in any way to account for the fact that the baseline emission estimates were developed from test data utilizing summertime blends.

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

We are proposing that recreational vehicle or engine manufacturers 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 III.C.4 above. We are proposing that production-line testing be performed using the same test procedures as for certification testing. We request comment on all aspects of the proposed production-line testing requirements, including engine sampling rates and options for using alternative testing methods.

E. Special Compliance Provisions

As described in Section XI.B, the report of the Small Business Advocacy Review Panel addresses the concerns of small-volume manufacturers of recreational vehicles.

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 proposed emission standards for off-highway motorcycles and ATVs will likely necessitate the use of 4-stroke engines. Most small-volume off-highway motorcycle and ATV importers—and to a lesser degree, small-volume manufacturers—currently use 2-stroke engines. While 4-stroke engines are in widespread use in motorcycles and ATVs in general, their adoption by any manufacturer is still a significant business challenge. Small manufacturers of these engines could 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 could place small manufacturers at a competitive disadvantage without specific provisions to address this burden.

We are proposing to apply 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 SBAR Panel recommended these provisions to address the potentially significant adverse effects on small entities of an emission standard that will likely result in the use of 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.[158] We request comment on the appropriateness of the 5,000-unit threshold. In addition, we propose to limit use of some or all of these flexibilities to entities that are in existence or have product sales at the time of proposal 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. We request comment on any such restrictions.

We also request comment on allowing small entities with sales in excess of 5,000 units to certify using the flexible approaches described below for several engines equal to their 2000 or 2001 sales level. This would assure that all small entities currently in the market would be able to take advantage of these approaches. In addition, we request comment on when small entities must notify EPA that they intend to use the small-entity flexibilities.

During the Panel's outreach meeting with small entities on issues related to recreational ATVs and off-road motorcycles, small entities expressed particular concern that a federal emission standard requiring manufacturers to switch to four-stroke engines might increase costs to the point that many small importers and manufacturers could experience significant adverse effects. As noted above, the Panel recommendations are designed to reduce the burden on small entities without compromising the environmental benefits of the program. However, it is

[158]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.

possible that even with the broad flexibility under consideration, costs to small entities may still be too high. Also, they may not be able to recover costs without losing much or all of their business. We seek comment on the effect of the proposed standard on small entities, including any data 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 resulting from the proposed standards, more specifically from the conversion of two-stroke technology to four-stroke technology. Additionally, we seek comment on any differences in costs between small and large manufacturers. We plan to assess information received in response to this request to inform the final rule decision-making process on whether additional flexibility (beyond that proposed below) is warranted.

Snowmobiles

There are only a few small snowmobile manufacturers and they sell only a few hundred engines a year, which represents less than 0.5 percent of total annual production. Therefore, the per-unit cost of regulation could be significantly higher for these small entities because they produce very low volumes. Additionally, these companies do not have the 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). Our proposed snowmobile emission standards could 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 believe additional lead-time would be a way of reducing the burden to meet the proposed standards. This would provide extra time for technology to develop and, in the case of importers, extra time to resolve supplier issues that may arise. We propose a delay of two years beyond the date larger businesses would be required to comply. For ATVs and snowmobiles, the two-year delay would also apply to the timing of the proposed Phase 2 standards.

In addition, for small snowmobile manufacturers, we propose that the emission standards be phased in over an additional two years at a rate of 50 percent, then 100 percent. Phase 1 would be phased in at 50/50/100 percent in 2008/2009/2010 and Phase 2 would be phased in 50/50/100 percent in 2012/2013/2014. We seek comment on whether a longer time period is appropriate given the costs of compliance for small businesses and the relationship between importers and their suppliers.

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.

We propose to permit small-volume manufacturers to use design-based certification, which would allow us to issue a certificate to a small business for the emission-performance standard based on a demonstration that engines or vehicles meet design criteria rather than by emission testing. The intent is to demonstrate that an engine using a design similar to or superior than that being used by larger manufacturers to meet the proposed emission standards would ensure compliance with the proposed standards. The demonstration would be based in part on emission test data from engines of a similar design. Under a design-based certification program, a manufacturer would provide evidence in the application for certification that an engine or vehicle would meet the applicable standards for its useful life based on its design (e.g., the use a four-stroke engine, advanced fuel injection, or any other particular technology or calibration). The design criteria could 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 would submit adequate engineering and other information about their individual designs showing that they meet emission standards for the useful life. We request comment on how these provisions should be implemented. We also seek comment on whether we should allow large manufacturers to use similar provisions on a limited basis.

3. Broaden engine families

We propose an approach that would allow for relaxed criteria for what constitutes an engine or vehicle family. It would allow small businesses to put all their models into one vehicle or engine family (or more) for certification purposes if appropriate. Manufacturers would 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, we are proposing to require manufacturers to test a small sampling of production engines to ensure that production engines meet emission standards. We propose to waive production-line testing for small entities and request comment on whether limits for this waiver would be appropriate. This would eliminate or substantially limit production-line testing requirements for small businesses. It could be limited to engine/vehicle families under a given production volume or could be applied broadly to small businesses. This is likely to be important to small businesses, many of which do not have testing facilities on-site and would rely on outside contractors for testing.

5. Use of assigned deterioration factors for certification

We propose to provide small entities with the option of using assigned deterioration factors. Rather than performing a durability demonstration for each family for certification, manufacturers would 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 could 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 that have been certified to other EPA programs could be used in recreational vehicles. For example, there is a large variety of engines certified to EPA lawn and garden standards (Small SI). We propose to allow manufacturers of recreational vehicles to use engines certified to any other EPA standards for five years. Under this approach, engines certified to the Small SI standards could be used in recreational vehicles, and such engines would be subject to the Small SI standards and related provisions rather than the Recreational Vehicle program. The small business using the engine would not have to recertify the engine, provided the manufacturer does not alter the engine in such a way as to cause it to exceed the emission standards it was originally certified as meeting. Also, the recreational vehicle application may not be the primary intended application for the engine. We request comment on which of the already established standards and programs would be a useful certification option for small businesses.

Additionally, a certified snowmobile engine produced by a large snowmobile manufacturer could be used by a small snowmobile manufacturer, provided the small manufacturer did not alter the engine in such a way as to cause it to exceed the snowmobile emission standards. This would provide a reasonable degree of emission control provided all other elements of the program were met. For example, if the only change a manufacturer were to make to the certified engine was to replace the stock Y-pipes and 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 could, subject to our review, still be eligible for this flexibility option. The manufacturer could also change the carburetor to have a leaner air/fuel ratio without losing eligibility. We believe that 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 were to change the bore or stroke of the engine, the engine would no longer qualify, as emissions could increase. We propose to allow the above approach for small snowmobile manufacturers.

7. Averaging, banking, and trading

For the overall program, we are proposing corporate-average emission standards with opportunities for banking and trading of emission credits. We would 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. We request comment on how the provisions could be enhanced for small business to make them more useful.

8. Hardship provisions

We are proposing 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 propose an additional provision to allow a small snowmobile manufacturer to petition us for relaxed standards for one or more engine families. The manufacturer would have to 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 would then set an alternative standard at a level between the prescribed standard and the baseline level. Such a standard would be intended to apply until the engine family is retired, or modified in such a way as to increase emissions. These engines would be excluded from the averaging calculation. We seek comment on allowing this provision for up to 300 engines per year per manufacturer, which would ensure that it is sufficiently available for those manufacturers needing it most.

We seek comment on initial and deadline dates for submitting these petitions. While any relief would be enacted for the first year standards apply, there may be value to getting feedback early. It would seem reasonable that the first date for submittals would be during the first year of requirements for large manufacturers. The deadline for submittals might be at some time during the last year of the small-business delay.

F. Technological feasibility of the Standards

1. Off-highway motorcycles and ATVs

We believe the proposed standards are technologically feasible given the availability of emission-control technologies in the context of the proposed program, 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.[159] 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 carburetors. Two-stroke engines lubricate the piston and crankshaft by mixing oil with the air and fuel mixture. This is accomplished by most contemporary 2-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 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 would consist of modifications to the base engine, fuel system, cooling system, and recalibration of the air and fuel mixture. These could, for example, consist of changes to valve timing for four-stroke engines, changing from air- to liquid-cooling, and the use of advanced carburetion techniques or electronic fuel injection in lieu of traditional carburetion systems. Other approaches could include the use of 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 the use of 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. The use of oxidation catalysts in conjunction with direct injection could potentially reduce emissions even further. Finally, conversion of two-stroke engine technology to four-stroke engine technology would significantly reduce HC emissions.

None of these technologies should have any negative noise, safety, or energy impacts. Fuel injection can improve the combustion process which can result in lower engine noise. The

[159] 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 would range from 0.05 liters to 0.65 liters.

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. The use of fuel injection, the enleanment of the air and fuel mixture and the use of four-stroke technology all can result in significant reductions in fuel consumption.

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

2006 Standards

Four-Stroke Engines

We believe off-highway motorcycles and ATVs utilizing four-stroke engines will need only to make some minor calibration changes and improvements to the carburetor to meet our proposed emission standards for the 2006 model year. The calibration changes will most likely consist of reducing the amount of fuel in the air/fuel mixture. This is commonly referred to as enleaning 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. Thus, we do not believe the standards will significantly reduce the performance or durability of these engines. Carburetion improvements could include increased carburetor tolerances, which would ensure more precise flow of fuel and air resulting in better fuel atomization (i.e., smaller fuel droplets), better combustion and less emissions.

Since our proposed emission standards are for HC + NOx, as well as for 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 should allow manufacturers to meet our proposed standards without significantly increasing NOx levels.

Two-Stroke Engines

Off-highway motorcycles and ATVs using two-stroke engines will present a greater challenge for compliance with the proposed standards. We believe it is possible for a two-stroke engine equipped with direct injection and an oxidation catalyst to meet our proposed standards. However, there are several issues associated with direct injection, such as system durability and the need for high electrical system output, that need to be resolved before it can be successfully integrated into off-highway motorcycle and ATV applications by the 2006 model year. For example, there is concern over how durable a direct injection system would be when exposed to harsh environmental conditions such as water, mud, rocks and sand, to name a few. The typical electrical system on a two-stroke off-highway motorcycle and ATV uses a magneto system which produces between 250 and 300 watts of electrical power. A typical direct injection system needs up to 1,000 watts of electrical power, meaning a traditional low-cost magneto system would be insufficient and possibly have to be replaced with an expensive and cumbersome alternator, similar to what is used on automobiles. For these reasons, and because of the potential complexities and cost of a direct injection system, we anticipate that most manufacturers would chose to convert models using two-stroke engines to 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. In addition to converting to four-stroke technology, manufacturers will also most likely have to make some minor calibration and carburetion improvements to meet the proposed 2006 emission standards.

2009 Standards

As discussed above, the proposed 2009 standards are proposed to apply only to ATVs. To meet these standards, we believe manufacturers will need to use four-stroke engines with further advancements in carburetor calibrations and improved tolerances or possibly even switch to electronic fuel injection for some models. There is currently one manufacturer who uses electronic fuel injection in their off-highway motorcycles and ATVs. The technologies most likely be used to meet these standards are secondary air and/or an oxidation catalytic converter.

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. 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 at or below our proposed 2009 standards (further details of our secondary air testing are described in the Draft Regulatory Support Document). Thus, we believe secondary air injection alone could be a viable technology used by ATV manufacturers to meet our proposed 2010 standards.

We also tested several ATVs with oxidation catalysts. We evaluated several different catalyst configurations with varying size, loading, cell density, and washcoat. We also examined different catalyst locations in the exhaust system. We found that a relatively small oxidation catalyst located in the exhaust system produced emission levels below our proposed emission standards. Therefore, we also believe that the use of an oxidation catalyst could be another viable technology available to ATV manufacturers to meet our proposed 2009 emission standards.

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 2-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 397 g/kW-hr (296 g/hp-hr) CO and 150 g/kW-hr (111 g/hp-hr) HC.

b. What technology approaches are available to control emissions?

We believe the proposed standards would be technologically feasible. A variety of technologies are currently available or in stages of development to be available for use on 2-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 2-stroke technologies, converting to 4-stroke engines is feasible for some snowmobile types. Each of these is discussed in the following paragraphs.

There are several things that can be done to improve carburetion in snowmobile engines. First, strategies to improve fuel atomization would promote more complete combustion of the fuel/air mixture. Additionally, production tolerances could be improved for more consistent fuel metering. Both of these things would allow for more accurate control of the air/fuel ratio. In conjunction with these improvements in carburetion, the air/fuel ration could be leaned out some. Snowmobile engines are currently calibrated with rich air/fuel ratios for durability reasons. Leaner calibrations would serve to reduce CO and HC emissions. Such calibration changes could reduce snowmobile engine durability. However, there are many engine improvements that could be made to regain lost durability that occurs with leaner calibration. These include changes to the cylinder head, pistons, ports and pipes to reduce knock. In addition critical engine components could be made more robust to improve durability.

The same calibration changes to the air/fuel ratio just discussed for carbureted engines could also be employed, possibly with more accuracy, with the use of 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 watercraft engines. We believe these technologies hold promise for application to snowmobiles. 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 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, the use of 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-strokes. Four-stroke engines have a lower power to weight ratio than two-stroke engines and are heavier. Thus, they are more appropriately used in snowmobile models where extreme power and acceleration are not the primary selling points. Such models include touring and sport trail sleds, as opposed to high performance sleds such as those used for aggressive trail, cross country, mountain and lake riding.

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

2006 Standards

We expect that, in the context of an emission-credit program, manufacturers might choose to take different paths to meet the proposed 2006 model year emission standards. We expect that many of the reductions required will come from aggressive implementation of improved carburetion and enleanment strategies. Manufacturers have indicated to us that direct injection strategies can result in emission reductions of 70 to 75 percent for HC and 60 to 65 percent for CO. Certification results from 2000 model year outboard engines and PWC support such reductions. At least one manufacturer has indicated that direct injection technology will be available for snowmobiles on at least some models well in advance of 2006. 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. Finally, there are at least two snowmobile manufacturers planning on offering four-stroke models in the future, and we expect further interest in four-strokes to develop for those snowmobile categories for which four-strokes are a good fit.

2010 Standards

We expect that, in the context of an emission credit program, manufacturers would choose to apply enleanment strategies and the associated engine modification to roughly half of their production. The rest of their production would encompass primarily direct injection two stroke and to a much lesser extent, four stroke technology.

VII. General Nonroad Compliance Provisions

This section describes a wide range of compliance provisions that apply generally to all of the engines and vehicles that would be subject to the proposed standards. Several of these provisions apply not only to manufacturers, but also to equipment manufacturers installing certified engines, remanufacturing facilities, operators, and others.

The proposed regulatory text for the compliance requirements for Large SI and recreational vehicles would be contained in a new Part 1068 of title 40, entitled “General Compliance Programs for Nonroad Engines.” The compliance provisions for marine engines would be the same as those in our existing programs for commercial diesel marine engines (40 CFR 94), which are similar to the provisions proposed in 40 CFR part 1068.

The following discussion of the general nonroad provisions follows the proposed regulatory text. For ease of reference, the subpart designations are provided. We request comment on all these provisions.

A. Miscellaneous Provisions (Part 1068, subpart A)

This regulation contains some general provisions, including general applicability and the definitions that apply to Part 1068. Other provisions concern good engineering judgment, how we would 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. Section 1068.5 of the proposed regulations describes the methodology we propose to use to evaluate concerns related to manufacturers’ use of good engineering judgment in cases where the manufacturer has such discretion. If we find a problem in these areas, we would take into account the degree to which any error in judgment was deliberate or in bad faith. This subpart is consistent with provisions in the final rule for light-duty highway vehicles and commercial marine diesel engines.

B. Prohibited Acts and Related Requirements (Part 1068, subpart B)

The proposed provisions in this subpart lay out a set of prohibitions for engine manufacturers, equipment manufacturers, operators, and engine rebuilders to ensure that engines comply with the emission standards. These provisions are summarized below, but readers are encouraged to review the proposed regulatory text. 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 (§1068.100)

This proposed regulation contains several prohibitions consistent with the Clean Air Act. No one may sell 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 would consider tampering. We have generally applied the existing policies developed for tampering with highway engines and vehicles to nonroad engines.[160] 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 for certain applications (i.e., stationary or solely for competition), we generally prohibit using these engines in other applications.

These proposed 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 in 1970 dollars and should be periodically adjusted by regulation to account for inflation. The current penalty amount for each violation is $27,500.[161]

2. Equipment manufacturer provisions (§1068.105)

According to this proposed regulation, equipment manufacturers may not sell new equipment with uncertified engines once the emission standards begin to apply. We would 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 propose to require equipment manufacturers to observe the engine manufacturers emission-related installation specifications to ensure that the engine remains consistent with the application for certification. 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, we propose to require them to add a duplicate label on the equipment. Equipment manufacturers may make these labels or get them from the engine manufacturer.

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[160] "Interim Tampering Enforcement Policy," EPA memorandum from Norman D. Shulter, Office of General Counsel, June 25, 1974 (Docket A-2000–01; document II-B-20).

[161] EPA acted to adjust the maximum penalty amount in 1996 (61 FR 69364, December 31, 1996). See also 40 CFR part 19.

If equipment manufacturers don't fulfill the responsibilities we describe in this section, we would consider them to be violating one or more of the prohibited acts described above.

3. In-service engines (§1068.110)

The proposed regulations would 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 proposed regulation would also reserve our right to do testing (or require testing) to investigate potential defeat devices, as authorized by the Act.

4. Engine rebuilding (§1068.120)

We are proposing to establish rebuild provisions for all the nonroad engines subject to the proposed emission standards. 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 proposing minimal recordkeeping requirements so rebuilders can show that they comply with regulations.

In general, we propose to require that anyone who rebuilds a certified engine must restore it to its original (or a lower-emitting) configuration. We are proposing to add 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. We are also proposing that rebuilders replace an existing catalyst if there is evidence that the catalyst is not functional; for example, if a catalyst has lost its physical integrity with loose pieces rattling inside, it would need to be replaced. See §1068.65 for more detailed information.

The proposed rebuilding provisions define good rebuilding practices to help rebuilders avoid violating the prohibition on "removing or disabling" emission-control systems. We therefore propose to extend these provisions to individuals who rebuild their own engines, but without any recordkeeping requirements.

We request comment on applying these proposed requirements for engine rebuilding and maintenance to the engines and vehicles subject to this rulemaking. In addition, we request comment on the associated recordkeeping requirements.

C. Exemptions (Part 1068, subpart C)

We are proposing to include several exemptions for certain specific situations. Most of these are consistent with previous rulemakings. We highlight the new or different proposed provisions in the following paragraphs. In general, exempted engines would need to comply with the requirements only in the sections related to the exemption. Note that additional restrictions could apply to importing exempted engines (see Section VII.D). Also, we are also proposing that 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 would help ensure that imported engines clear Customs without difficulty.

1. Testing

Anyone would be allowed to 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 could be exempted from regulation if they are maintained in the manufacturers' possession and are not used for any revenue-generating service.

3. Display engines

Engine manufacturers would get an exemption without request if the engines are for display only.

4. National security

Engine manufacturers could receive an exemption for engines they can show are needed by an agency of the federal government responsible for national defense. For cases where the engines will not be used on combat applications, the manufacturer would have to request the exemption with 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 would be exempted without need for a request. This exemption would not be available if the destination country has the same emission standards as those in the United States.

6. Competition engines

New engines that are used solely for competition are excluded from regulations applicable to nonroad engines. For purposes of our certification requirements, a manufacturer would receive an exemption if it can show that it produces the engine specifically for use solely in competition. In addition, engines that have been modified for use in competition would be 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 would therefore not allow the engine to be used for anything other than competition once it has been modified. This also applies to someone who would later buy the engine, so we would 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 would be 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 would also have to meet those standards.

8. Hardship related to economic burden

There are two types of hardship provisions. The first type of hardship program would allow small businesses to petition EPA for additional lead time (e.g., up to 3 years) to comply with the standards. A small manufacturer would have to make the case that it has taken all possible business, technical, and economic steps to comply but the burden of compliance costs would have a significant impact on the company's solvency. A manufacturer would be required to provide a compliance plan detailing when and how it would achieve compliance with the standards. Hardship relief could include requirements for interim emission reductions and/or purchase and use of emission credits. The length of the hardship relief decided during review of the hardship application would be up to one year, with the potential to extend the relief as needed. The second hardship program would allow companies to apply for hardship relief if circumstances outside their control cause the failure to comply (i.e., supply contract broken by parts supplier) and if the failure to sell the subject engines would have a major impact on the company's solvency. See the proposed regulatory text in 40 CFR 1068.240 and 1068.241 for additional details.

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, we have heard of certified engines being available too late for equipment manufacturers to adequately accommodate changing engine size or performance characteristics. To address this concern, we are proposing to allow equipment manufacturers to request up to one extra year before using certified engines if they are not at fault and would face serious economic hardship without an extension. See the proposed regulatory text in 40 CFR 1068.245 for additional information.

D. Imports (Part 1068, subpart D)

In general, the same certification requirements would apply to engines and equipment whether they are produced in the U.S. or are imported. This proposed regulation also includes some additional provisions that would apply if someone wants to import an exempted or excluded engine. For example, the importer would need written approval from us to import any exempted engine; this is true even if an exemption for the same reason doesn't require approval for engines produced in the U.S.

All the proposed exemptions described above for new engines would also apply to importation, though some of these apply only on a temporary basis. If we approve a temporary exemption, it would be 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 proposed exemptions that would apply only to imported engines.

- Identical configuration: This would be 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 would apply to all the nonroad engines covered by this proposal. We did not finalize this exemption for commercial marine diesel engines, since we expected no individuals to own or import such an engine.
- Personal use: This would be a permanent exemption to allow individuals to import engines for their personal use. To prevent abuse of this exemption, we would require that importers own the exempted engines and we would generally exempt only one of each type of engine over an individual's lifetime.
- "Antique" engines: We would generally treat used engines as new if they are imported without a certificate of conformity. However, this permanent exemption would allow for importation of uncertified engines if they are more than 20 years old in their original configuration.
- Repairs or alterations: This would be a temporary exemption to allow companies to repair or modify engines. This exemption would not allow for operating the engine, except as needed to do the intended work.
- Diplomatic or military: This would be a temporary exemption to allow diplomatic or military personnel to use uncertified engines during their term of service in the U.S.

We request comment on all the proposed exemptions for domestically produced and imported engines and vehicles.

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 would 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 proposed regulation text describes the audit procedures in greater detail.

We intend generally to rely on manufacturers' testing of production-line engines to show that they comply with emission standards. However, we reserve our right to do selective enforcement auditing if we have reason to question the emission testing conducted and reported by the manufacturer.

F. Defect Reporting and Recall (Part 1068, subpart F)

We are proposing provisions for defect reporting. Specifically, we are proposing that manufacturers tell us when they learn of a defect occurring 25 times or more for engine families with annual sales up to 10,000 units. This threshold of defects would increase proportionately for larger families. For catalyst-related defects, we propose a threshold of approximately half the frequency of noncatalyst problems to trigger a defect report. While these thresholds would depend on engine family sales, counting defects would not be limited to a single engine family. For example, if a manufacturer learns that operators reported 25 cases of a short-circuit in the electronic control unit from three different low-volume engine models spread over five years, that would trigger the need to file a defect report. This information could come from warranty claims, customer complaints, product performance surveys, or anywhere else. The proposed regulation language in §1068.501 also provides information on the thresholds for triggering a further investigation for where a defect report is more likely to be necessary. We request comment on the proposed defect reporting provisions.

Under Clean Air Act section 207, if we determine that a substantial number of engines within an engine family, although properly used and maintained, do not conform to the appropriate emission standards, the manufacturer will be required to remedy the problem and conduct a recall of the noncomplying engine family. However, we also recognize the practical difficulty in implementing an effective recall program for nonroad engines. It would likely 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 is to generally 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 findings of substantial nonconformity under section 207 of the Act. We would consider alternatives nominated by a manufacturer 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 would guide us in evaluating projects to determine whether their nature and burden is appropriate to remedy the environmental impact of the nonconformity. We request comment on this approach to addressing the Clean Air Act provisions related to recall. In addition, we request comment on the proposed requirement to keep recall-related records until three years after a manufacturer completes all responsibilities under a recall order.

G. Public Hearings (Part 1068, subpart G)

According to this regulation, manufacturers would have the opportunity to challenge our decision to suspend, revoke, or void an engine family's certificate. This also applies to our decision to reject the manufacturer's use of good engineering judgment (see §1068.5). Part 1068, subpart G describes the proposed procedures for a public hearing to resolve such a dispute.

VIII. General Test Procedures

The regulatory text in part 1065 is written with the intent to apply broadly to EPA engine programs. This proposal, however, applies to anyone who tests engines to show that they meet the emission standards for Large Industrial SI engines or for recreational vehicles. 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 Large SI engines. We may later propose to apply the same provisions to other engines, with any appropriate additions and changes. Recreational marine diesel engines would use the test procedures already adopted in 40 CFR part 94.

A. General Provisions

As we have done in previous programs, we are proposing specific test procedures to define how measurements are to be made, but would allow the use of alternate procedures if they are shown to be equivalent to our specified procedures. The test procedures proposed in 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. We request comment on all aspects of these proposed test procedures. We also request comment regarding whether any additional parts of the test procedures contained in 40 CFR part 86 (for highway vehicles and engines), in other parts that apply to nonroad engines, or in ISO 8178 should be incorporated into the final test procedures.

B. Laboratory Testing Equipment

The proposed regulations do not specify the type of engine or chassis dynamometer that must be used 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. Steady-state testing calls for a minimal degree of sophistication in the dynamometer system.

Measuring emissions during transient operation calls for a greater degree of sophistication than steady-state testing. For chassis testing of recreational vehicles, we propose to use the specifications adopted 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. Furthermore, we would require any EPA confirmatory testing to meet more stringent specifications than manufacturers testing their own engines.

In addition, for transient testing with recreational vehicles and any testing with Large SI engines, the proposed regulations specify that emissions 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 would be routed into a dilution tunnel where it would be mixed with air, and then sampled using a bag sampler system. After the test, the concentrations of HC, CO, and NOx in the bag would be measured using conventional laboratory analyzers.

For industrial spark-ignition engines and snowmobiles, the proposed 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 proposed provisions for alternate testing procedures may allow for raw-sampling measurements. As specified in paragraph 1065.010(c)(3) of the proposed regulations, we would allow manufacturers to use alternate procedures that are shown to be equivalent to the proposed procedures. We request comment on this approach to emission-measurement procedures. Specifically, we request comment on the degree of equivalence that should be shown to gain approval of alternate procedures. See the final rule for 2007 heavy-duty highway engine emission standards for one approach of defining a tolerance on equivalence for alternate procedures (66 FR 5002, January, 18, 2001).

C. Laboratory Testing Procedures

We are proposing specific procedures for running the test. These procedures are outlined briefly here, with a more detailed description of the most significant aspects. Before starting the test, it would be necessary to operate the engine for some time to improve the stability of the emissions, or to make the engine 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 about 50 hours as a break-in period. This would be done for most or all emission-data engines (for certification). The second method is much longer (up to the full useful life), and is done to obtain 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 would be collected from the dilution tunnel for each test segment or test mode using sample bags. These bags would then be 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 the duty cycles for testing. 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 an objective procedure for measuring this engine parameter.[162]

We propose to 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-

[162]See the final rule for commercial marine diesel engines for a broader discussion of maximum test speed (64 FR 249, December 29, 1999)

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.

Intermediate speed for steady-state duty cycles is generally 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. We propose to use this approach, using the maximum test speed described above to calculate these percentage values.

We request comment on applying this method of determining rated speed to ATVs certified to engine-based emission standards, recreational marine diesel engines, and Large SI engines.

2. Maintenance

As described in Section III.C.1, we are proposing limits on the amount of scheduled maintenance manufacturers may prescribe for their customers to ensure that engines continue to meet emission standards. If manufacturers would specify unreasonably frequent maintenance, there would be little assurance that in-use engines would continue to operate at certified emission levels. We would also apply these minimum maintenance intervals to engines the manufacturer operates for service accumulation before testing for emissions. For example, manufacturers could 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 could not replace fuel-system components on a recreational vehicle during the course of service accumulation for establishing deterioration factors. We would not restrict scheduling of routine maintenance item 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 can significantly affect emissions.

IX. Projected Impacts

This section summarizes the projected impacts of the proposed emission standards. The anticipated environmental benefits are compared with the projected cost of the program for an assessment of the cost per ton of reducing emissions for this proposal.

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 Draft Regulatory Support Document. We request comment on all aspects of the emission inventory analysis, including the usage rates and other inputs used in the analysis.

Tables IX.A-1 and IX.A-2 contain the projected emission inventories for the years 2010 and 2020, respectively, from the engines and vehicles subject to this proposal under the base case (i.e., without the proposed standards taking effect) and assuming the proposed standards take effect. The percent reductions based on a comparison of estimated emission inventories with and without the proposed emission standards are also presented.

Table IX.A-1
2010 Projected Emissions Inventories (thousand short tons)

Category	Exhaust CO			Exhaust NOx			Exhaust HC**		
	base case	with proposed standards	percent reduction	base case	with proposed standards	percent reduction	base case	with proposed standards	percent reduction
Industrial SI >19kW	2,615	1,152	56	397	152	62	293	111	62
Snowmobiles	567	415	27	1	1	0	213	155	27
ATVs	3,901	3,380	13	21	21	0	1,098	756	31
Off-highway motorcycles	194	172	11	1	1	0	143	112	22
Recreational Marine diesel*	5	5	0	31	29	7	0.9	1.0	10
Total	7,282	5,124	30	451	204	55	1,748	1,135	35

* We also anticipate a 2 percent reduction in direct PM from a baseline of inventory of 1,184 tons in 2010 to a control inventory of 1,158 tons.
** The Industrial SI >19 kW estimate includes both exhaust and evaporative emissions.

Table IX.A-2
2020 Projected Emissions Inventories (thousand short tons)

Category	Exhaust CO			Exhaust NOx			Exhaust HC**		
	base case	with proposed standards	percent reduction	base case	with proposed standards	percent reduction	base case	with proposed standards	percent reduction
Industrial SI >19kW	2,991	231	92	486	77	84	346	50	86
Snowmobiles	609	227	63	2	2	0	229	85	63
ATVs	4,589	3,041	34	25	25	0	1,301	205	84
Off-highway motorcycles	208	154	26	1	1	0	154	77	50
Recreational Marine diesel*	6	6	0	39	32	17	1.3	1.0	25
Total	8,404	3,658	56	552	137	75	2,032	418	79

* We also anticipate a 6 percent reduction in direct PM from a baseline of inventory of 1,470 tons in 2020 to a control inventory of 1,390 tons.
** The Industrial SI >19 kW estimate includes both exhaust and evaporative emissions.

As described in Section II, we project there would 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 II.

B. Economic Impact

In assessing the economic impact of setting emission standards, we have made a best estimate of the technologies and their associated costs to meet the proposed standards. 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 Draft Regulatory Support Document. We request comment on this cost information, and the issues discussed below.

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 would 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 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.[163] (see the Draft Regulatory Support Document for additional information). The cost analysis generally incorporates this learning effect 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 costs to meet the new emission limits (retail-price equivalent). 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.

We estimate that the anticipated increase in the cost of producing new Large SI engines for the proposed 2004 standards is estimated to range from $550 to $800, depending on fuel type, with a composite estimated cost of $600. 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 $45 for the 2007 standards, which primarily involves 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 is no small change 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.[164] We request comment on whether these estimated costs associated with emission controls would affect larger or smaller engines disproportionately to the overall cost of producing the engines.

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[163]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 Emissions 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).

[164]Chapter 5 of the Draft Regulatory Support Document describes why we believe market forces haven’t already led manufacturers to add fuel-saving technologies to their products.

Projected costs for ATVs and off-highway motorcycles average between $50 and $150 per unit. Initial standards are based on the emission-control capability of engines four-stroke engines. Those models that convert from two-stroke to four-stroke technology will see substantial fuel savings in addition to greatly reduced emissions. The second phase of standards for ATVs is based on recalibrating four-stroke engines for lower emissions and adding a two-way catalyst or other device to further reduce 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 marketing constraints for their products. Fuel savings and improved performance offsets the additional cost of producing most of these vehicles.

We expect that the cost of the 2006 snowmobile standards will average $55 per snowmobile. These costs are based on manufacturers leaning out the air/fuel mixture, improving carburetors for better fuel control and less production variation, and modifying the engine to withstand higher temperatures and potential misfire episodes attributed to enleanment. We expect that the 2010 standards will be met through the application of direct injection 2-stroke technology on a significant portion of the fleet, as well as some conversion to 4-stroke engines. We project that the cost of these controls would average $216 per snowmobile, although we believe these costs would be offset by fuel savings and improved performance.

Recreational marine diesel engines would be expected to see increased costs averaging $443 per engine in the near term. We expect manufacturers to meet the proposed 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 proposed emission standards.

Table IX.B-1
Estimated Average Cost Impacts of Proposed Emission Standards

Engine Type	Standard	Increased Production Cost per Engine*	Lifetime Operating Costs per Engine (NPV)
Large SI	2004	$600	$-3,985
Large SI	2007	$45	—
Snowmobiles	2006	$55	—
Snowmobiles	2010	$216	$-509
ATVs	2006	$60	$-102
ATVs	2009	$52	—
Off-highway motorcycles	2006	$151	$-98
Marine diesel	2006	$443	—

*The estimated long-term costs decrease by about 35 percent. Costs presented for second-phase standards for Large SI and ATVs are incremental to the first-phase standards.

The above analysis presents unit cost estimates for each engine type. These costs represent the total set of costs the engine manufacturers will bear to comply with emission standards. 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 proposed standards would be effective.) 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 presents a summary of the annualized reduced operating costs as well. Overall, we project, based on information currently available to us, that the annualized net savings to the economy would be approximately $260 million per year.

Table IX.B-2
Estimated Annual Cost to Manufacturers and Annual Savings from Reduced Operating Costs of the Proposed Emission Standards

Engine Type	Annualized Cost to Manufacturers (millions/year)	Annualized Savings from Reduced Operating Costs (millions/year)
Large SI	$85	$324
Snowmobiles	$24	$28
ATVs	$59	$81
Off-highway motorcycles	$13	$10
Marine Diesel	$3	$0
Aggregate	$184	$443

C. Cost per Ton of Emissions Reduced

We calculated the cost per ton of emission reductions for the proposed standards. For snowmobiles, this calculation is on the basis of CO emissions. For all other engines, we attributed the entire cost of the proposed program to the control of ozone precursor emissions (HC or NOx or both). A separate calculation could apply to reduced CO or PM emissions in some cases. Assigning the full compliance costs to a narrow emissions basis leads to cost-per-ton values that underestimate of the value of the proposed program.

Table IX.C-1 presents the near-term discounted cost-per-ton estimates for the various engines covered by the proposal. (The aggregate cost-per-ton estimates are over the first 20 years of the proposed programs.) Reduced operating costs more than offset the increased cost of producing the cleaner engines for Phase 1 Large SI, Phase 1 ATV, and Phase 2 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 proposal, therefore show a net savings resulting from the proposed 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 the Proposed Emission Standards

Engine Type	Standard	Discounted Reductions per Engine (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 (Composite of all fuels)	2004	3.14	$220	$0	—	—
Large SI (Composite of all fuels)	2007	0.56	$80	$80	—	—
Snowmobiles	2006	1.18	—	—	$50	$50
Snowmobiles	2010	0.32	—	—	$670	$0
ATVs	2006	0.88	$70	$0	—	—
ATVs	2009	0.09	$550	$550	—	—
Off-highway motorcycles	2006	0.37	$310	$110	—	—
Marine diesel	2006	0.68	$580	$580	—	—
Aggregate	—	—	$140	$0	$100	$0

* HC+NOx reductions, except snowmobiles which are CO reductions.

D. Additional Benefits

For most of the engine categories contained in today's proposal, we expect there will be a fuel savings as manufacturers redesign their engines to comply with the proposed standards. For ATVs and off-highway motorcycles, the fuel savings will be realized as manufacturers switch from 2-stroke to 4-stroke technologies. For snowmobiles, the fuel savings will be realized as manufacturers switch some of their engines to more fuel efficient 2-stroke technologies and some of their engines to 4-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. Overall, we project the fuel savings associated with the anticipated changes in technology would be about 730 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.

The controls in this rule are a cost-effective means of obtaining reductions in NOx, NMHC and CO emissions. A related subject concerns the value of the health and welfare benefits these reductions might produce. While we have not conducted a formal benefit-cost analysis for this rule, we believe the benefits of this rule clearly will greatly outweigh any cost.

Ozone causes a range of health problems related to breathing, including chest pain, coughing, and shortness of breath. Exposure to PM (including secondary PM formed in the atmosphere from NOx and NMHC emissions) has been associated in epidemiological studies with premature death, increased emergency room visits, and increased respiratory symptoms, and exacerbation of existing cardio-pulmonary disease. Children, the elderly, and individuals with pre-existing respiratory conditions are most at risk regarding both ozone and PM. In addition, ozone and PM adversely affect the environment in various ways, including crop damage, acid rain, and visibility impairment. A discussion of the health and welfare effects from ozone and PM can be found in Section II of this preamble. Interested readers should also refer to Chapter 1 of the Draft Regulatory Support Document for this rule and Chapter 2 of EPA's "Regulatory Impact Analysis: Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements."[165]

In two recent mobile-source control rules, for light-duty vehicles (the Tier 2/Gasoline Sulfur rule) and for highway heavy-duty engines and diesel fuel, we conducted a full analysis of the expected benefits once those rules are fully implemented. These rules, which primarily reduced NOx and NMHC emissions, were seen to yield health and welfare benefits far exceeding the costs. EPA projected that besides reducing premature mortality, these rules will reduce chronic bronchitis cases, hospital admissions for respiratory and cardiovascular causes, asthma attacks and other respiratory symptoms, emergency room visits for asthma attacks, acute bronchitis, work loss days, minor restricted activity days, and decreased worker productivity.

The majority of the benefits from those recent rules were due to their NOx and NMHC emission reductions. Given the similarities in pollutants being controlled, we would expect this rule to produce similar benefits per ton of emission reduction. Since the cost per ton of emission reduction for this rule is substantially lower than that for the two previous rules, we would expect an even more favorable benefit-cost ratio. Thus, we believe that the value of the health and welfare benefits of this rule would substantially outweigh any cost.

[165] 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. 1-2000-01, Document No. II-A-13. This document is also available at http://www.epa.gov/otaq/diesel.htm#documents.

X. Public Participation

We request comment on all aspects of this proposal. This section describes how you can participate in this process.

A. How Do I Submit Comments?

We are opening a formal comment period by publishing this document. We will accept comments for the period indicated under “DATES” above. If you have an interest in the program described in this document, we encourage you to comment on any aspect of this rulemaking. We request comment on various topics throughout this proposal.

We attempted to incorporate all the comments received in response to the Advance Notice of Proposed Rulemaking, though not all comments are addressed directly in this document. Anyone who has submitted comments on the Advance Notice, or any previous publications related to this proposal, and feels that those comments have not been adequately addressed is encouraged to resubmit comments as appropriate.

Your comments will be most useful if you include appropriate and detailed supporting rationale, data, and analysis. If you disagree with parts of the proposed program, we encourage you to suggest and analyze alternate approaches to meeting the air quality goals described in this proposal. You should send all comments, except those containing proprietary information, to our Air Docket (see “Addresses”) before the end of the comment period.

If you submit proprietary information for our consideration, you should clearly separate it from other comments by labeling it "Confidential Business Information." You should also send it directly to the contact person listed under "FOR FURTHER INFORMATION CONTACT" instead of the public docket. This will help ensure that no one inadvertently places proprietary information in the docket. If you want us to use your confidential information as part of the basis for the final rule, you should send a nonconfidential version of the document summarizing the key data or information. We will disclose information covered by a claim of confidentiality only through the application of procedures described in 40 CFR part 2. If you don’t identify information as confidential when we receive it, we may make it available to the public without notifying you.

B. Will There Be a Public Hearing?

We will hold a public hearing in the Washington, DC area on October 24 and a second public hearing in Denver, CO on October 31. The hearings will start at 9:30 am and continue until everyone has had a chance to speak.

If you would like to present testimony at a public hearing, we ask that you notify the contact person listed above at least ten days before the hearing. You should estimate the time you will need for your presentation and identify any needed audio/visual equipment. We suggest that you bring copies of your statement or other material for the EPA panel and the audience. It would also be helpful if you send us a copy of your statement or other materials before the hearing.

We will make a tentative schedule for the order of testimony based on the notifications we receive. This schedule will be available on the morning of each hearing. In addition, we will reserve a block of time for anyone else in the audience who wants to give testimony.

We will conduct the hearing informally, and technical rules of evidence won't apply. We will arrange for a written transcript of the hearing and keep the official record of the hearing open for 30 days to allow you to submit supplementary information. You may make arrangements for copies of the transcript directly with the court reporter.

XI. Administrative requirements

A. Administrative Designation and Regulatory Analysis (Executive Order 12866)

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 Draft 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. Estimated annual costs of this rulemaking, which proposes standards for engines in four distinct categories, are estimated to be $184 million per year, thus this proposed 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. Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA), 5 USC 601 et. seq.

1. Overview

The RFA generally requires an agency to prepare a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements under the Administrative Procedure Act or any other statute unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small organizations, and small governmental jurisdictions.

For purposes of assessing the impacts of today's rule on small entities, 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. The following table provides an overview of the primary SBA small business categories potentially affected by this regulation.

Primary SBA Small Business Categories
Potentially Affected by this Proposed 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

NOTES:
a. North American Industry Classification System
b. According to SBA’s regulations (13 CFR 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.

2. Initial Regulatory Flexibility Analysis

In accordance with Section 603 of the RFA, EPA prepared an initial regulatory flexibility analysis (IRFA) that examines the impact of the proposed rule on small entities along with regulatory alternatives that could reduce that impact. The IRFA is available for review in the docket and is summarized below.

The process of establishing standards for nonroad engines began in 1991 with a study to determine whether emissions of carbon monoxide (CO), oxides of nitrogen (NOx), and volatile organic compounds (VOCs) from new and existing nonroad engines, equipment, and vehicles are significant contributors to ozone and CO concentrations in more than one area that has failed to attain the national ambient air quality standards for ozone and CO.[166] 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.[167]

Upon this finding, the Clean Air Act (CAA or the Act) requires EPA to establish standards for all classes or categories of new nonroad engines that cause or contribute to air quality nonattainment in more than one ozone or carbon monoxide (CO) nonattainment area. 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 (e.g., farm and construction equipment),
- Small land-based spark-ignition (SI) engines (e.g., lawn and garden equipment, string trimmers),
- Marine engines (outboards, personal watercraft, CI commercial, CI engines <37kW)
- Locomotive engines

On December 7, 2000, EPA issued an Advance Notice of Proposed Rulemaking (ANPRM). As discussed in the ANPRM, the proposal under development will be a continuation of the process of establishing standards for nonroad engines and vehicles, as required by CAA section 213(a)(3). If, as expected, standards for these engines and vehicles are established, essentially all new nonroad engines will be required to meet emissions control requirements. The proposal being developed covers compression-ignition recreational marine engines. It also covers several nonroad spark ignition (SI) engine applications, as follows:

- land-based recreational engines (for example, engines used in snowmobiles, off-highway motorcycles, and all-terrain vehicles (ATVs))

[166] "Nonroad Engine and Vehicle Emission Study—Report and Appendices," EPA-21A-201, November 1991 (available in Air docket A-91-24). It is also available through the National Technical Information Service, referenced as document PB 92-126960.

[167] 59 FR 31306 (July 17, 1994).

- marine sterndrive and inboard (SD/I) engines and boats powered by SI marine engines[168]
- land-based engines rated over 19 kW (Large SI) (for example, engines used in forklifts); this category includes auxiliary marine engines, which are not used for propulsion.

EPA found that the nonroad engines described above cause or contribute to air quality nonattainment in more than one ozone or carbon monoxide (CO) nonattainment area.[169] CAA section 213 (a)(3) requires EPA to establish standards that achieve the greatest degree of emissions reductions achievable taking cost and other factors into account. EPA plans to propose emissions standards and related programs consistent with the requirements of the Act.

In addition to proposing standards for the nonroad vehicles and engines noted above, EPA also intends to review EPA requirements for highway motorcycles. The emissions standards for highway motorcycles were established twenty-three years ago. These standards allow motorcycles to emit about 100 times as much per mile as new cars and light trucks. California recently adopted new emissions standards for highway motorcycles, and new standards and testing cycles are being considered internationally. There may be opportunities to reduce emissions in a cost-effective way.

The program under consideration will cover engines and vehicles that vary in design and use, and many readers may only be interested in one or two of the applications. There are various ways EPA could group the engines and present information. For purposes of the proposed rule EPA has chosen to group engines by common applications (e.g, recreational land-based engines, marine engines, large spark ignition engines used in commercial applications).

3. Summary of Regulated Small Entities

The small entities directly regulated by this proposed rule are the following:

Recreational Vehicles (ATVs, snowmobiles, and off-highway motorcycles)

The ATV sector has the broadest assortment of manufacturers. There are seven companies representing over 95 percent of total domestic ATV sales. The remaining 5 percent

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[168] As a shorthand notation in this document, we are using “recreational marine engines” to mean recreational marine diesel engines and all gasoline SD/I engines, even though some SD/I applications could be commercial. We are similarly using "recreational boats" to mean boats powered by recreational marine diesel engines as well as all boats powered by gasoline engines, even though some gasoline engine-powered boats may be commercial.

[169] see Final Finding, “Control of Emissions from New Nonroad Spark-Ignition Engines Rated above 19 Kilowatts and New Land-Based Recreational Spark-Ignition Engines” elsewhere in today’s Federal Register for EPA’s finding for Large SI engines and recreational vehicles. EPA’s findings for marine engines are contained in 61 FR 52088 (October 4, 1996) for gasoline engines and 64 FR 73299 (December 29, 1999) for diesel engines.

come from importers who tend to import inexpensive, youth-oriented ATVs from China and other Asian nations. We have identified 21 small companies that offer off-road motorcycles, ATVs, or both products. Annual unit sales for these companies can range from a few hundred to several thousand units per year.

Based on available industry information, four major manufacturers, Arctic Cat, Bombardier (also known as Ski-Doo), Polaris, and Yamaha, 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. We have identified three small manufacturers of snowmobiles and one potential small manufacturer who hopes to produce snowmobiles within the next year.

Two of these manufacturers (Crazy Mountain and Fast), plus the potential newcomer (Redline) specialize in high performance versions of standard recreational snowmobile types (i.e., travel and mountain sleds). The other manufacturer (Fast Trax) produces a unique design, which is a scooter-like snowmobile designed to be ridden standing up. Most of these manufacturers build less than 50 units per year.

Highway Motorcycles

Of the numerous manufacturers supplying the U.S. market for highway motorcycles, Honda, Harley Davidson, Yamaha, Kawasaki, Suzuki, and BMW are the largest, accounting for 95 percent or more of the total U.S. sales. All of these companies except Harley-Davidson and BMW also manufacture off-road motorcycles and ATVs for the U.S. market. Harley-Davidson is the only company manufacturing highway motorcycles exclusively in the U.S. for the U.S. market.

Since highway motorcycles have had to meet emission standards for the last twenty years, EPA has good information on the number of companies that manufacture or market highway motorcycles for the U.S. market in each model year. In addition to the big six manufacturers noted above, EPA finds as many as several dozen more companies that have operated in the U.S. market in the last couple of model years. Most of these are U.S. companies that are either manufacturing or importing motorcycles, although a few are U.S. affiliates of larger companies in Europe or Asia. Some of the U.S. manufacturers employ only a few people and produce only a handful of custom motorcycles per year, while others may employ several hundred and produce up to several thousand motorcycles per year.

Marine Vessels

Marine vessels include the boat, engine, and fuel system. The evaporative emission controls discussed above may affect the boat builders and/or the fuel tank manufacturers. Exhaust emission controls including NTE requirements, as addressed in the August 29, 1999 SBAR Panel Report, would affect the engine manufacturers and may affect boat builders.

EPA has less precise information about recreational boat builders than is available about engine manufacturers. EPA has utilized several sources, including trade associations and Internet sites when identifying entities that build and/or sell recreational boats. EPA has also worked with an independent contractor to assist in the characterization of this segment of the industry. Finally, EPA has obtained a list of nearly 1,700 boat builders known to the U.S. Coast Guard to produce boats using engines for propulsion. At least 1,200 of these companies install engines that use gasoline fueled engines and would therefore be subject to the evaporative emission control program discussed above. More than 90% of the companies identified so far would be considered small businesses as defined by SBA. EPA continues to develop a more complete picture of this segment of the industry and will provide additional information as it becomes available.

Based on information supplied by a variety of recreational boat builders, fuel tanks for boats using SI marine engines are usually purchased from fuel tank manufacturers. However, some boat builders construct their own fuel tanks. The boat builder provides the specifications to the fuel tank manufacturer who helps match the fuel tank for a particular application. It is the boat builder's responsibility to install the fuel tank and connections into their vessel design. For vessels designed to be used with small outboard engines, the boat builder may not install a fuel tank; therefore, the end user would use a portable fuel tank with a connection to the engine.

EPA has determined that total sales of tanks for gasoline marine applications is approximately 550,000 units per year. The market is broken into manufacturers that produce plastic tanks and manufacturers that produce aluminum tanks. EPA has determined that there are at least seven companies that make plastic fuel tanks with total sales of approximately 440,000 units per year. EPA has determined that there at least four companies that make aluminum fuel tanks with total sales of approximately 110,000 units per year. All but one of these plastic and aluminum fuel tank manufacturers is a small business as defined under SBA.

EPA has determined that there are at least 16 companies that manufacture CI 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.

EPA has determined that there are at least 24 companies that manufacture SD/I gasoline engines (including airboats and jet boats) for recreational vessels. Seventeen of the identified companies are considered small businesses as defined by SBA. These 17 companies represent approximately 6 percent of recreational gasoline marine engines sales for 2000. Approximately 70-80 percent of gasoline SD/I engines manufactured in 2000 can be attributed to one company. The next largest company is responsible for about 10-20 percent of 2000 sales.

Large Spark Ignition Engines

EPA is aware of one engine manufacturer of Large SI engines that qualifies as a small business. This company plans to produce engines that meet the standards adopted by CARB in

2004, with the possible exception of one engine family. If EPA adopts long-term standards, this would require manufacturers to do additional calibration and testing work. If EPA adopts new test procedures (including transient operation), there may also be a cost associated with upgrading test facilities.

4. Potential Reporting, Record Keeping, and Compliance

For any emission control program, EPA must have assurances that the regulated engines will meet the standards. Historically, EPA programs have included provisions placing manufacturers responsible for providing these assurances. The program that EPA is considering for manufacturers subject to this proposal may include testing, reporting, and record keeping requirements. Testing requirements for some manufacturers may include certification (including deterioration testing), and production line testing. Reporting requirements would likely include test data and technical data on the engines including defect reporting. Manufacturers would likely have to keep records of this information.

5. Related Federal Rules

The Panel is aware of several other current Federal rules that relate to the proposed rule under development. During the Panel's outreach meeting, SERs specifically pointed to Consumer Product Safety Commission (CPSC) regulations covering ATVs, and noted that they may be relevant to crafting an appropriate definition for a competition exclusion in this category. The Panel recommends that EPA continue to consult with the CPSC in developing a proposed and final rule in order to better understand the scope of the Commission's regulations as they may relate to the competition exclusion.

Other SERs, representing manufacturers of marine engines, noted that the U.S. Coast Guard regulates vessel tanks, most notably tank pressure and anti-siphoning requirements for carburetted engines. Tank manufacturers would have to take these requirements into account in designing evaporative control systems. The Panel recommends that EPA continue to work with the Coast Guard to evaluate the safety implications of any proposed evaporative emissions standards and to avoid interference with Coast Guard safety regulations.

The Panel is also aware of other Federal rules that relate to the categories that EPA would address with the proposed rule, but are not likely to affect policy considerations in the rule development process. For example, there are now EPA noise standards covering off-road motorcycles; however, EPA expects that most emission control devices are likely to reduce, rather than increase, noise, and that therefore the noise standards are not likely to be important in developing a proposed rule.

OTAQ is currently developing a proposal that would revise the rule assigning fees to be paid by parties required to certify engines in return for continuing Government oversight and testing. Among other options, EPA could propose to extend the fee structure to several classes of non-road engines for which requirements are being established for the first time under the Recreation Rule. The Panel understands that EPA will carefully examine the potential impacts of the Fees Rule on small businesses. The Panel also notes that EPA's Office of Air Quality, Planning, and Standards (OAQPS) is preparing a Maximum Achievable Control Technology (MACT) standard for Engine Testing Facilities, which is a related matter.

6. Significant Panel Findings

The Panel considered a wide range of options and regulatory alternatives for providing small businesses with flexibility in complying with the proposed emissions standards and related requirements. As part of the process, the Panel requested and received comment on several ideas for flexibility that were suggested by SERs and Panel members. The major options recommended by the Panel are summarized below. The complete set of recommendations can be found in Section 9 of the Panel's full Report.

Many of the flexible approaches recommended by the Panel can be applied to several of the equipment categories that would potentially be affected by the proposed rule EPA is developing. These approaches are identified in Table 1. First Tier Flexibilities: Based on consultations with SERs, the Panel believes that the first four provisions in Table 1 are likely to provide the greatest flexibility for many small entities. These provisions are likely to be most valuable because they either provide more time for compliance (e.g., additional leadtime and hardship provisions) or allow for certification of engines based on particular engine designs or certification to other EPA programs. Second Tier Flexibilities: The remaining four approaches have the potential to reduce near-term and even long-term costs once a small entity has a product it is preparing to certify. These are important in that the costs of testing multiple engine families, testing a fraction of the production line, and/or developing deterioration factors can be significant. Small businesses could also meet an emission standard on average or generate credits for producing engines which emit at levels below the standard; these credits could then be sold to other manufacturers for compliance or banked for use in future model years.

During the consultation process, it became evident that, in a few situations, it could be helpful to small entities if unique provisions were available. Five such provisions are described below.

a. Snowmobiles

The Panel recommends EPA seek comment on a provision which would allow small snowmobile manufacturers to petition EPA for a relaxed standard for one or more engine families, up to 300 engines per year, until the family is retired or modified, if such a standard is justifiable based on the criteria described in the Panel report.

b. ATVs and Off-road Motorcycles

The Panel recommends that the hardship provision for ATVs and off-road motorcycles allow hardship relief to be reviewed annually for a period that EPA anticipates will likely be no more than two years in order for importers to obtain complying products.

c. Large SI

The Panel recommends that small entities be granted the flexibility initially to reclassify a small number of their small displacement engines into EPA's small spark-ignition engine program (40 CFR 90). Small entities would be allowed to use those requirements in lieu of the requirements EPA intends to propose for large entities.

d. Marine Vessel Tanks

Most of this sector involves small fuel tank manufacturers and small boat builders. The Panel recommends that the program be structured with longer lead times and an early credit generation program to enable the fuel tank manufacturers to implement controls on tanks on a schedule consistent with their normal turnover of fuel tank molds.

e. Highway Motorcycles

The California Air Resources Board (CARB) has found that California's Tier 2 standard is potentially infeasible for small manufacturers. Therefore, the Panel recommends that EPA delay making decisions on the applicability to small businesses of Tier 2 or other such revisions to the federal regulations until California's 2006 review is complete.

7. Summary of SBREFA Process and Panel Outreach

As required by section 609(b) of the RFA, as amended by SBREFA, EPA also conducted outreach to small entities and convened a Small Business Advocacy Review Panel to obtain advice and recommendations of representatives of the small entities that potentially would be subject to the rule's requirements.

On May 3, 2001, EPA's Small Business Advocacy Chairperson convened this Panel under Section 609(b) of the Regulatory Flexibility Act(RFA) as amended by the Small Business Regulatory Enforcement Fairness Act of 1996 (SBREFA). In addition to the Chair, the Panel consisted of the Director of the Assessment and Standards Division (ASD) within EPA's Office of Transportation and Air Quality, the Chief Counsel for Advocacy of the Small Business Administration, and the Deputy Administrator of the Office of Information and Regulatory Affairs within the Office of Management and Budget. As part of the SBAR process, the Panel met with small entity representatives (SERs) to discuss the potential emission standards and, in addition to the oral comments from SERs, the Panel solicited written input. In the months preceding the Panel process, EPA conducted outreach with small entities from each of the five sectors as described above. On May 18, 2001, the Panel distributed an outreach package to the SERs. On May 30 and 31, 2001, the Panel met with SERs to hear their comments on preliminary alternatives for regulatory flexibility and related information. The Panel also received written comments from the SERs in response to the discussions at this meeting and the outreach materials. The Panel asked SERs to evaluate how they would be affected under a variety of regulatory approaches, and to provide advice and recommendations regarding early ideas for alternatives that would provide flexibility to address their compliance burden.

SERs representing companies in each of the sectors addressed by the Panel raised concerns about the potential costs of complying with the rules under development. For the most part, their concerns were focused on two issues: (1) the difficulty (and added cost) that they would face in complying with certification requirements associated with the standards EPA is developing, and (2) the cost of meeting the standards themselves. SERs observed that these costs would include the opportunity cost of deploying resources for research and development, expenditures for tooling/retooling, and the added cost of new engine designs or other parts that would need to be added to equipment in order to meet EPA emission standards. In addition, in each category, the SERs noted that small manufacturers (and in the case of one category, small importers) have fewer resources and are therefore less well equipped to undertake these new activities and expenditures. Furthermore, because their product lines tend to be smaller, any additional fixed costs must be recovered over a smaller number of units. Thus, absent any provisions to address these issues, new emission standards are likely to impose much more significant adverse effects on small entities than on their larger competitors.

The Panel discussed each of the issues raised in the outreach meetings and in written comments by the SERs. The Panel agreed that EPA should consider the issues raised by the SERs and that it would be appropriate for EPA to propose and/or request comment on various alternative approaches to address these concerns. The Panel's key discussions centered around the need for and most appropriate types of regulatory compliance alternatives for small businesses. The Panel considered a variety of provisions to reduce the burden of complying with new emission standards and related requirements. Some of these provisions would apply to all companies (e.g., averaging, banking, and trading), while others would be targeted at the unique circumstances faced by small businesses. A complete discussion of the regulatory alternatives recommended by the Panel can be found in the Final Panel Report. Copies of the Final Report can be found in the docket for this rulemaking or at www.epa.gov/sbrefa. Summaries of the Panel's recommended alternatives for each of the sectors subject to this action can be found in the respective sections of the preamble.

As required by section 609(b) of the RFA, as amended by SBREFA, EPA also conducted outreach to small entities and convened a Small Business Advocacy Review Panel to obtain advice and recommendations of representatives of the small entities that potentially would be subject to the rule's requirements. EPA's Small Business Advocacy Chairperson convened this on May 3, 2001. In addition to the Chair, the Panel consisted of the Director of the Assessment and Standards Division (ASD) within EPA's Office of Transportation and Air Quality, the Chief Counsel for Advocacy of the Small Business Administration, and the Deputy Administrator of the Office of Information and Regulatory Affairs within the Office of Management and Budget.

The proposal being developed covers diesel engines used in recreational marine applications. It also covers several nonroad spark ignition (SI) engine applications, as follows:

- land-based recreational engines (for example, engines used in snowmobiles, off-highway motorcycles, and all-terrain vehicles (ATVs))
- marine sterndrive and inboard (SD/I) engines and boats powered by SI marine engines
- land-based engines rated over 19 kW (Large SI) (for example, engines used in forklifts);

this category includes auxiliary marine engines, which are not used for propulsion.

In addition to the nonroad vehicles and engines noted above, EPA also intends to update EPA requirements for highway motorcycles. Finally, the proposal being developed included evaporative emission control requirements for gasoline fuel tanks and systems used on marine vessels.

The Panel met with Small Entity Representatives (SERs) to discuss the potential emissions standards and, in addition to the oral comments from SERs, the Panel solicited written input. In the months preceding the Panel process, EPA conducted outreach with small entities from each of the five sectors as described above. On May 18, 2001, the Panel distributed an outreach package to the SERs. On May 30 and 31, 2001, the Panel met with SERs to hear their comments on preliminary options for regulatory flexibility and related information. The Panel also received written comments from the SERs in response to the discussions at this meeting and the outreach materials. The Panel asked SERs to evaluate how they would be affected under a variety of regulatory approaches, and to provide advice and recommendations regarding early ideas to provide flexibility. See Section 8 of the Panel Report for a complete discussion of SER comments, and Appendices A and B for summaries of SER oral comments and SER written comments.

Consistent with the RFA/SBREFA requirements, the Panel evaluated the assembled materials and small-entity comments on issues related to the elements of the IRFA. A copy of the Panel report is included in the docket for this proposed rule. The following are Panel recommendations adopted by the Agency. Please note <u>all</u> Panel recommendations were adopted for this proposal.

a. Related Federal Rules

The Panel recommends that EPA continue to consult with the CPSC in developing a proposed and final rule in order to better understand the scope of the Commission's regulations as they may relate to the competition exclusion. In addtio, the Panel recommends that EPA continue to work with the Coast Guard to evaluate the safety implications of any proposed evaporative emissions standards and to avoid interference with Coast Guard safety regulations.

b. Regulatory Flexibility Alternatives

The Panel recommends that EPA consider and seek comments on a wide range of alternatives, including the flexibility options described below.

1. Large SI Engines

The Panel recommends that EPA propose several possible provisions to address concern 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.

Using Certification and Emissions Standards from Other EPA Programs

The Panel made several recommendations for this provision. First, the Panel recommends 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 recommends that EPA seek comment on the appropriateness of limiting the sales level of 300. Third, the Panel recommends 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 recommends 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.

Delay of Proposed Standards

If EPA includes a second phase of standards in its proposal, the Panel recommends that EPA propose to delay the applicability of these 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 Phase 1 emission standards that EPA is contemplating.

Production Line Testing

The Panel made several recommendations for this provision. First, the Panel recommends that EPA adopt provisions that allow more flexibility than is available under the California Large SI program or other EPA programs generally to address the concern that production-line testing is another area where small-volume manufacturers typically face a difficult testing burden. Second, the Panel recommends 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 recommends that EPA allow small-volume manufacturers to use alternative low-cost testing options to show that production-line engines meet emission standards.

Deterioration Factors

The Panel recommends that EPA allow small-volume manufacturers to develop a deterioration factor based on available emissions measurements and good engineering judgement.

Hardship Provision

The Panel recommends that EPA propose two types of hardship provisions for Large SI engines. First the Panel recommends that EPA allow small businesses to petition EPA for additional lead time (e.g., up to 3 years) to comply with the standards. Second, the Panel recommends that EPA allow small businesses to apply for hardship relief if circumstances outside their control cause the failure to comply (i.e., supply contract broken by parts supplier) and if the failure to sell the subject engines would have a major impact on the company’s solvency.

2. Off-Road Motorcycles and All-Terrain Vehicles (ATVs)

The Panel made the following recommendations for this subcategory.

a) The Panel recommends that EPA propose to apply the flexibilities described below to engines produced or imported by small entities with combined off-road motorcycle and ATV annual sales of less than 5,000 units per model year.
b) The Panel recommends that EPA request comment on the appropriateness of the 5,000 unit per model year threshold.

c) The Panel recommends 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.

d)The Panel recommends that EPA describe and seek comment on the effect of the proposed standard 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 proposed standards.

e) The Panel recommends 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.

Additional Lead-time to Meet the Proposed Standards

First, the Panel recommends 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 recommends 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 recommends that EPA request comment on the appropriate length for a delay (lead-time).

Design Certification

First, the Panel recommends that EPA propose to permit small entities to use design certification. Second, the Panel recommends that EPA work with the Small Entity Representatives and other members of the industry to develop appropriate criteria for such design based certification.

Broaden Engine Families

The Panel recommends that EPA request comment on engine family flexibility and conducting design-based certification emissions testing.

Production Line Testing Waiver

The Panel recommends that EPA propose to provide small manufacturers and small importers a waiver from manufacturer production line testing. The Panel also recommends that EPA request comment on whether limits or the scope of this waiver are appropriate.

Use of Assigned Deterioration Factors During Certification

The Panel recommends that EPA propose to provide small business with the option to use assigned deterioration factors.

Using Certification and Emissions Standards from Other EPA Programs

The Panel recommends that EPA propose to provide small business with this flexibility through the fifth year of the proposed 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.

Averaging, Banking, and Trading

The Panel recommends that EPA propose to provide small business with the same averaging, banking, and trading program flexibilities proposed for large manufacturers and request comment on how the provisions could be enhanced for small business to make them more useful.

Hardship Provisions

The Panel recommends that EPA propose two types of hardship program for off-road motorcycles and ATVs: 1)EPA should allow small manufacturers and small importers to petition EPA for limited additional lead-time to comply with the standards; and 2)allow small manufacturers and small importers to apply for hardship relief if circumstances outside their control cause the failure to comply (i.e. supply contract broken by 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 recommends that EPA propose both aspects of the hardship provisions for small off-road motorcycle and ATV manufacturers and importers and seek comment on the implementation provisions.

3. Marine Vessels

a. Burden Reduction Approaches Designed for Small Boat Builders and Fuel Tank Manufacturers

Smooth Transition to Proposed Standards

The Panel recommends that EPA propose an approach that would implement any evaporative standards five years after a regulation for marine engines takes effect. The Panel also recommends that EPA seek comment on this five year period and on whether there are small entities whose product line is dominated by tanks that turn over at a time rate slower time than five years.

Design-Based Certification

The Panel recommends that EPA propose to grant small businesses the option of certifying to the evaporative emission performance requirements based on fuel tank design characteristics that reduce emissions. The Panel also recommends that EPA seek comment on and consider proposing an approach that would allow manufacturers to use this averaging approach with designs other than those listed in the final rule.

ABT of Emission Credits with Design-Based Certification

The Panel recommends that EPA allow manufacturers using design-based certification to generate credits. The Panel also recommends that EPA opovide adequately detailed design specifications and associated emission levels for several technology options that could be used to certify.

Broadly Defined Product Certification Families

The Panel recommends that EPA take comment on the need for broadly defined emission families and how these families should be defined.

Hardship Provisions

The Panel recommends that EPA propose two types of hardship programs for marine engine manufacturers and fuel tank manufacturers: 1)allow small businesses to petition EPA for additional lead time to comply with the standards; and 2)allow small businesses to apply for hardship relief if circumstances outside their control cause the failure to comply (i.e. supply contract broken by 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 recommends that EPA work with small manufacturers to develop these criteria and how they would be used.

Burden Reduction Approaches Designed for Small Marinizers of Marine Engines with Respect to NTE Provisions

The Panel recommends that EPA propose to specifically include NTE in this design-based approach, if EPA proposes a standard that includes NTE for small marinizers.

4. Snowmobiles

Delay of Proposed Standards

The Panel recommends 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 recommends 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).

Design-Based Certification

The Panel recommends that EPA take comment on how a 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.

Broader Engine Families

The Panel recommends that EPA propose a provision for small snowmobile manufactures that would use relaxed criteria for what constitutes an engine or vehicle family.

Elimination of Production Line Testing Requirements

The Panel recommends that EPA propose that small snowmobile manufacturers not be subject to production line testing requirements.

Use of Assigned DF During Certification

The Panel recommends 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 burden rather than performing a durability demonstration for each engine family as part of the certification testing requirement.

Using Certification and Emission Standards from Other EPA Programs

If the manufacturer were to change the bore or stroke of the engine, it is likely that the engine would no longer qualify as emissions could increase, allow this option for small snowmobile manufacturers.

Averaging, Banking and Trading

The Panel recommends that EPA propose an averaging, banking and trading program for snowmobiles, and seek comment on additional ABT flexibilities it should consider for small snowmobile manufacturers.

Hardship Provisions

The Panel recommends that EPA propose two types of hardship programs for small snowmobile manufacturers: 1)allow small snowmobile manufacturers to petition EPA for additional lead time to comply with the standards; and 2)allow small snowmobile manufacturers to apply for hardship relief if circumstances outside their control cause the failure to comply (i.e. supply contract broken by parts supplier) and if failure to sell the subject engines or vehicles would have a major impact on the company's solvency.

Unique Snowmobile Engines

The Panel recommends 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 recommends 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. Finally, the Panel recommends that EPA seek comment on initial and deadline dates for the submission of such petitions.

5. Highway Motorcycles

The Panel recommends that EPA include the flexibilities described below for small entities with highway motorcycle annual sales of less than 3,000 units per model year (combined Class I, II, and III motorcycles) and fewer than 500 employees.

Delay of Proposed Standards

The Panel recommends that EPA propose to delay compliance with the Tier 1 standard of 1.4 g/km HC+NOx until the 2008 model year for small volume manufacturers. The Panel also recommends that EPA seek comment on whether additional time is needed for small businesses to comply with the Federal program. The Panel recommends that EPA participate with CARB in the 2006 progress review as these provisions are revisited, and delay making decisions on the applicability to small businesses of Tier 2 or other revisions to the federal regulations that are appropriate following the review. The Panel also recommends that any potential Tier 2 requirements for small manufacturer motorcycles consider potential test procedure changes arising from the ongoing World Motorcycle Test Cycle work described in the Panel Report.

Broader Engine Families

The Panel recommends that EPA deep the current existing regulations for small volume highway motorcycle manufacturers.

Exemption from Production Line Testing

The Panel recommends that EPA keep the current provisions for no mandatory production line testing requirement for highway motorcycles and allow the EPA to request production vehicles from any certifying manufacturer for testing.

Averaging, Banking, and Trading (ABT)

The Panel recommends that EPA propose an ABT program for highway motorcycles.

Hardship Provisions

The Panel recommends that EPA propose two types of hardship programs for highway motorcycles: 1)allow small businesses to petition EPA for additional lead time to comply with the standards; and 2) allow small businesses to apply for hardship relief if circumstances outside their control cause the failure to comply (i.e. supply contract broken by 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 recommends that EPA request comment on the California requirements, which do not include hardship provisions.

Reduced Certification Data Submittal and Testing Requirements

The Panel recommends that EPA keep current EPA regulations allow significant flexibility for certification by manufacturers who project fewer than 10,000 unit sales of combined Class I, II, and III motorcycles.

We invite comments on all aspects of the proposal and its impacts on small entities.

C. Paperwork Reduction Act

The information collection requirements (ICR) in this proposed 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. We will announce in a separate Federal Register Notice that the ICR has been submitted to OMB and will take comments on the proposed ICR at that time.

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.

D. Intergovernmental Relations

1. 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 the proposal represents the least costly, most cost-effective approach to achieve the air quality goals of the rule. The costs and benefits associated with the proposal are discussed in Section IX and in the Draft Regulatory Support Document, as required by the UMRA.

2. Consultation and Coordination with Indian Tribal Governments (Executive Order 13084)

On January 1, 2001, EO13084 was superseded by EO13175. However, the proposed rule was developed during the period when EO13084 was still in force, and so tribal considerations were addressed under EO13084. Development of the final rule will address tribal considerations under EO13175.

Under Executive Order 13084, EPA may not issue a regulation that is not required by statute, that significantly or uniquely affects the communities of Indian tribal governments, and that imposes substantial direct compliance costs on those communities, unless the Federal government provides the funds necessary to pay the direct compliance costs incurred by the tribal governments, or EPA consults with those governments. If EPA complies by consulting, Executive Order 13084 requires EPA to provide to the Office of Management and Budget, in a separately identified section of the preamble to the rule, a description of the extent of EPA's prior consultation with representatives of affected tribal governments, a summary of the nature of their concerns, and a statement supporting the need to issue the regulation. In addition, Executive Order 13084 requires EPA to develop an effective process permitting elected officials and other representatives of Indian tribal governments "to provide meaningful and timely input in the development of regulatory policies on matters that significantly or uniquely affect their communities."

This proposal does not significantly or uniquely affect the communities of Indian Tribal governments. The proposed emission standards and other related requirements for private businesses in this proposal would have national applicability, and thus would 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 proposal. Thus, EPA's conclusions regarding the impacts from the implementation of this proposed rule discussed in the other sections are equally applicable to the communities of Indian Tribal governments. Accordingly, the requirements of Section 3(b) of Executive Order 13084 do not apply to this rule.

E. 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 (e.g., 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 proposed rule involves technical standards. The following paragraphs describe how we specify testing procedures for engines subject to this proposal.

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 Draft Regulatory Support Document, transient testing is an important part of the proposed emission-control program for these engines. We are therefore not proposing to adopt the ISO procedures in this rulemaking.

Underwriters Laboratories (UL) has adopted voluntary consensus standards for forklifts that are relevant to the proposed 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 proposing a different temperature limit, because the maximum temperature specified by UL does not prevent fuel boiling. We are proposing 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, the UL standards would appropriate to reference 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.

We are proposing 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 would need 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 proposing 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 proposing the same test procedures that we have adopted for commercial marine diesel engines (with a new duty cycle appropriate for recreational applications). We are again proposing 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.

F. Protection of Children (Executive Order 13045)

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 proposed 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 proposed in this rulemaking will further reduce air toxics and the related adverse impacts on children's health.

G. Federalism (Executive Order 13132)

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” is 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 proposed 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 proposed 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 proposed 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.

In the spirit of Executive Order 13132, and consistent with EPA policy to promote communications between EPA and State and local governments, EPA specifically solicits comment on this proposed rule from State and local officials.

H. Energy Effects (Executive Order 13211)

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 proposed standards have for their aim the reduction of emission from certain nonroad engines, and have no effect on fuel formulation, distribution, or use. Generally, the proposed program leads to reduced fuel usage due to the improvements in engine control technologies.

I. 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
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)
          - (B)

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 in 40 CFR Part 90
Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Labeling, Reporting and recordkeeping requirements, Research, Warranties

List of Subjects in 40 CFR Part 91
Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Labeling, Penalties, Reporting and recordkeeping requirements, Warranties

List of Subjects in 40 CFR Part 94
Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Penalties, Reporting and recordkeeping requirements, Vessels, Warranties

List of Subjects in 40 CFR Part 1048
Environmental protection, Administrative practice and procedure, Air pollution control, Confidential business information, Imports, Labeling, Penalties, Reporting and recordkeeping requirements, Research, Warranties

List of Subjects in 40 CFR Part 1065
Environmental protection, Administrative practice and procedure, Incorporation by reference, Reporting and recordkeeping requirements, Research.

List of Subjects in 40 CFR Part 1068
Environmental protection, Administrative practice and procedure, Confidential business information, Imports, Motor vehicle pollution, Reporting and recordkeeping requirements, Warranties.

Dated_____________

ORIGINAL SIGNED BY
CHRISTINE TODD WHITMAN
ON SEPTEMBER 14, 2001

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Christine Todd Whitman
Administrator.