ENVIRONMENTAL PROTECTION AGENCY

40 CFR Parts 89, 90, 91, 94, 1048, 1051, 1065, and 1068

[AMS–FRL–7058–8]

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: *Comments:* Send written comments on this proposed rule by December 19, 2001. See Section X.B for more information about written comments.

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. See Section X.B for more information about public hearings.

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. See Section X.B for more information on comment procedures.

Docket: 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, SW., Washington, DC 20460 between 8 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 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.
Do	333111	3523	Manufacturers of farm equipment.
Do	333112	3531	Manufacturers of construction equipment, recreational marine vessels.
Do	333924	3537	Manufacturers of industrial trucks.
Do	811310	7699	Engine repair and maintenance.
Do	336991		Motorcycles and motorcycle parts manufacturers.
Do	336999		Snowmobiles and all-terrain vehicle manufacturers.
Do	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 **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.

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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 (NO_X) 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 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

[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 a broader group of compounds.

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 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 NO_X 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

[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.

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 NO_X 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.

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 Tier 3 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

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

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+NO_X 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+NO_X 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 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 NO_X 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.

TABLE I.F–2.—PROPOSED EUROPEAN EMISSION STANDARDS FOR RECREATIONAL MARINE DIESEL ENGINES

Pollutant	Emission standard (g/k W-hr)	Baseline emissions (g/k W-hr)
NO_X	9.8	8.9
PM	1.4	0.2
HC	[a] 1.5	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 NO_X and SOx emissions from marine vessels. No restrictions on PM, HC, or CO emissions were considered. The NO_X 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 NO_X 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 NO_X STANDARDS

Engine speed (n = engine speed, rpm)	NO_X (g/kW-hr)
n <130 rpm	17.0
130 rpm≤n<2000 rpm	$45*n^{(-0.2)}$

[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).

[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).

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

TABLE I.F–3.—MARPOL ANNEX VI NO_X STANDARDS—Continued

Engine speed (n = engine speed, rpm)	NO_X (g/kW-hr)
n ≥ 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 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.

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 NO_X 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

[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.*

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 NO_X 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	$HC+NO_X$, PM, CO.
Large SI	December 7, 2000, 65 FR 76790	Ozone, CO, PM	$HC+NO_X$, CO, PM.
Recreational Vehicles	December 7, 2000, 65 FR 76790	Ozone, CO, PM	$HC+NO_X$, 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 NO_X 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 NO_X 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

[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.

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 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 NO_X 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.

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. 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

[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.

[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*.

[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.

[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.

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]

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 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

[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.

[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.*

[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.

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 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 an 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 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 ambient fine particulate matter levels are at or above 16 $\mu g/m^3$ 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 $\mu g/m^3$ (29 percent of the population).[96]

To estimate future $PM_{2.5}$ levels, we refer to the modeling performed in

[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.

[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.*

[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 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.

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 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]

TABLE II.B–2.—COUNTIES WITH ANNUAL $PM_{2.5}$ LEVELS ABOVE 16 μg/m³ AND SNOWMOBILE TRAILS

State and $PM_{2.5}$ 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

[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.

[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.

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, NO_X, CO, and PM emissions, respectively, in the year 2000. The results for industrial SI engines indicate they contribute approximately 3 percent to HC, NO_X, 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 NO_X 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 categories of engines and vehicles covered by this proposal are expected to contribute 33 percent, 9 percent, 9 percent, and 2 percent of HC, NO_X, 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	NO_X		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	

[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.

TABLE II.C–2.—MODELED ANNUAL EMISSION LEVELS FOR MOBILE-SOURCE CATEGORIES IN 2020

[Thousand short tons]

Category	NO_X		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 Motorcyles	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 ug/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 NO_X 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 NO_X, 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		NO_X		SO_X		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 General	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 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

[103] No data were available at five additional parks where snowmobiles are also commonly used: Black Canyon of the Gunnison, CO, Grant Teton, WY, Northern Cascades, WA, Theodore 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.

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*	*1990*	*1991*	*1992*
		3	4	6	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 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 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 NO_X, 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.

[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.

TABLE II.D–3.—WINTER SEASON SNOWMOBILE EMISSIONS

[Tons; 1999 Winter Season]

NPS unit	HC	CO	NO_X	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.

TABLE II.D–4.—1998 ANNUAL HC EMISSIONS (TPY), YELLOWSTONE NATIONAL PARK

	HC		CO		NO_X		PM	
Source:								
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%
Snowmobiles	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		4,190.46		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.

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,

[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.

[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.

[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.

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 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.

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

[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.

[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. 11–A–45.

[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.

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 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.

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 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)

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

[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–38.

[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.

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

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.

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 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 NO_X, 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.

[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.

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 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 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 recognize 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 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. 601–612, 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 NO_X, 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

[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).

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 $HC+NO_X$ 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 $HC+NO_X$ 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-

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

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+NO_X 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 NO_X 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+NO_X and 2.5 g/kW-hr (1.9 g/hp-hr). To focus more on reducing HC+NO_X emissions, we would consider emission standards of 2.6 g/kW-hr (2.0 g/hp-hr) HC+NO_X 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+NO_X 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+NO_X 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+NO_X 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+NO_X levels. We are not proposing any restriction on manufacturers' use of the alternate standards (for example, for 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 NO_X-only field-testing standard for natural gas engines instead of a NO_X+HC standard. Since control of NO_X 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+NO_X 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+NO_X 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+ NO_X 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+NO_X 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+NO_X 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+NO_X 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 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.

[125] Stoichimetry 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.

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, 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 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

[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.

[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.

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

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 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 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.

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

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 NO_X 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 (NO_X, 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+NO_X 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+NO_X 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+ NO_X 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 NO_X 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+NO_X 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 (NO_X), 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 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 NO_X 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 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	$HC+NO_X$ 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

[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.

[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.

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 $HC+NO_X$ and PM emissions.

Consistent with our land-based nonroad and commercial marine diesel engine regulations, we are proposing to disallow simultaneous generation of $HC+NO_X$ credits and use of PM credits on the same engine family, and vice versa. This is necessary because of the inherent trade-off between NO_X 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 $HC+NO_X$ and 1.2 g/kW-hr PM; for larger engines, the maximum values are 10.5 g/kW-hr $HC+NO_X$ 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 NO_X emission reductions. Balancing this concern is the fact that recreational marine diesel engines constitute a small fraction of PM and $HC+NO_X$ 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 NO_X standard as the appropriate NO_X 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 NO_X only and these proposed standards are $HC+NO_X$. 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)	$HC+NO_X$	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 NO_X 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 NO_X 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 NO_X 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.

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,

[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.*

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 NO_X standards instead of THC plus NO_X 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 procedure 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, manufacture 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.

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

[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.

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.

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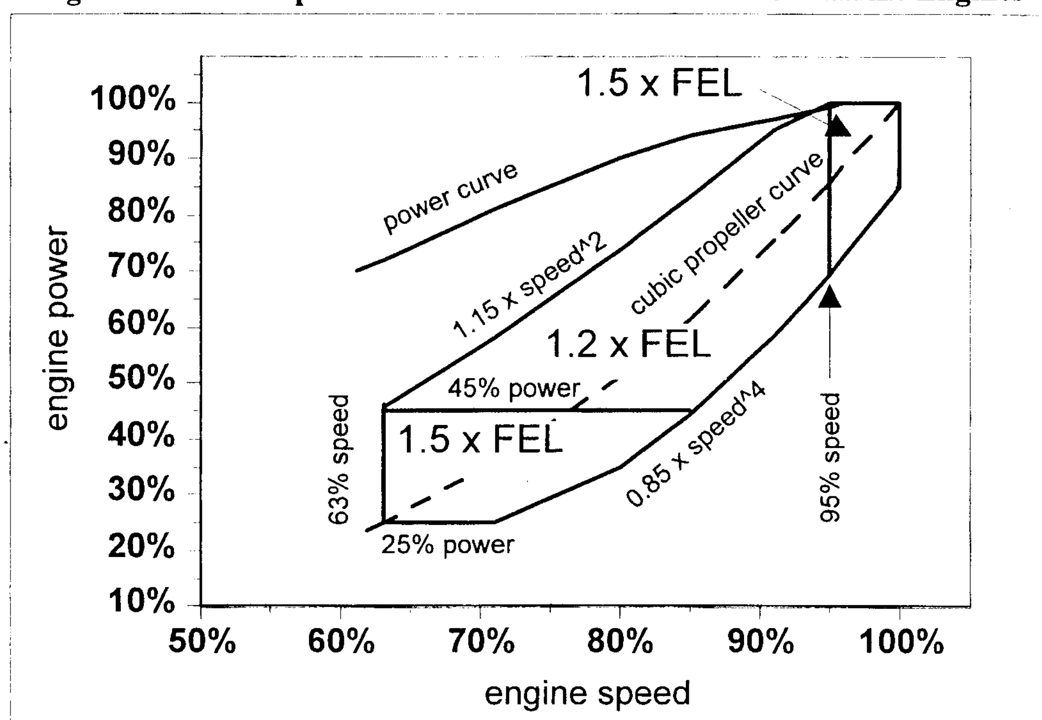
Figure V.C-1: Proposed NTE Zone for Recreational CI Marine Engines



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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 $HC+NO_X$, 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 part 86, 89, or 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 part 94.

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

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 $HC+NO_X$ 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 NO_X 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-NO_X 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 NO_X 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 NO_X 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 NO_X 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 NO_X.

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